THE SIXTEENTH ANNUAL SCIENCE AND MATHEMATICS EDUCATORS CONFERENCE (SMEC 16)

SMEC 16

CONFERENCE PROCEEDINGS

Science and Mathematics Education Center (SMEC)
Department of Education
Faculty of Arts and Sciences
American University of Beirut
Beirut, Lebanon
April 5th, 2014

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We do apologize for any significant omissions.

SMEC 16 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:

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Only Abstracts included for the following sessions:

Plenary - Science

Why Learning Scientific Concepts Is So Difficult And How Teachers Can Help?

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A large body of research has accumulated over the last four decades on concept learning in science. The more research that is done, the more we are learning about the complexities of the process of concept learning and why some concepts are so difficult to learn. This lecture will present some of the main sources of this difficulty and indicate ways that teachers can overcome them. The complexities include the following: concepts are always understood in terms of other concepts, so learning scientific concepts involves learning a network of concepts together; scientific concepts are categorized very differently from everyday concepts; science concept learning is closely connected to what students believe about science and about learning; and learning scientific concepts involves coordinating informal knowledge. Despite these complexities research has uncovered ways of helping students learn that addresses these challenges.

Plenary - Mathematics

Modeling in Mathematics Education :
A Survey on the Current Debate and Recent Trends

Professor Gabriele Kaiser,
University of Hamburg, Germany

The lecture will start with an analysis of the recent international discussion about modeling in Mathematics education, describing different perspectives on modeling around the world. Furthermore, the concept of modeling competencies is presented and different facets of this concept are elaborated. Afterwards, the lecture will discuss various attempts for establishing modeling examples in school teaching. It will be reported, amongst others, about joint modeling projects with future teachers in school, so-called modeling weeks or days. Selected modeling examples, which have been used in modeling weeks with students from upper secondary level, will be described, such as the optimal positioning of bus stops. Finally, results from research on the promotion of modeling competencies and on the usage of scaffolding or intervention measures on fostering independent modeling activities.

Mini-Plenary – Mathematics & Science

Developing Math/Science Understanding and Writing Go Hand in Hand in Early Years Inquiry

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Authentic inquiry into mathematics and science is an ideal context for furthering children's capabilities for representing their ideas and observations in writing. Authentic inquiry here refers to investigation that arises naturally from the interests and questions of the children as they experience the learning environment. Several authentic examples were presented from the work of four- to six-year-old children in the domains of mathematics and science to illustrate how these domains need to be viewed as intertwined with literacy development at the preschool level. Reflections were also offered on the role of the learning environment, the role of curriculum and the role of teachers and other adults in the learning process. With the addition of some examples from children's work in science, this plenary address built on a recently published article (2013): Making sense of experience in preschool: Children's encounters with numeracy and literacy through inquiry in the *South African Journal of Childhood Education* 3(2).

Introduction

At the outset of the plenary address the following core beliefs were offered in order to establish my point of view clearly:

- Young children are competent learners when they enter school.
- The learning environment is a crucial teacher.
- Children naturally use mathematic and scientific knowledge as the "decode" and make sense of the world.
- Uncertainty is not an enemy—it is what propels learning forward.

The audience was then invited to reflect on images of students and student work with the question in mind: Is it language or is it math (or science)? The intention was for audience members to reflect on the idea that mathematics, science and language are not simply school subjects, but they are crucial tools we use to make sense of our experience and the world around us—that is true for both children and adults.

Language occupies a special place in learning and making sense due to at least three important reasons:

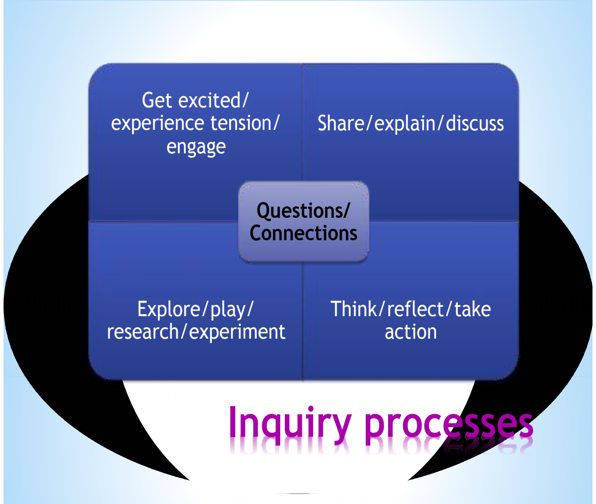
* Whether internalized or external, it is a powerful tool for organizing thought and building an identity as a learner.

* Reveals prior understanding and experience, which informs the design of the learning environment.

* Allows for listening, sharing ideas, negotiation, receiving feedback, and building on others' ideas.

Furthermore as part of meaningful learning processes, children need to engage in in-depth investigations of phenomena around them worthy of their knowledge and understanding," (Katz, 2010). Katz advocates for developing standards in early years education, not for content, but for defining the kinds of experiences children should be having in school. Inquiry-based learning is an ideal approach for engaging children in the kinds of in-depth learning journeys that Katz is talking about.

When we talk about inquiry, what are we talking about? There are many different models of inquiry teaching and learning in the ethos of the education world, but all of them—if taken seriously as authentic processes—begin with real questions, and also require a fundamental rethinking of the respective roles of teachers and students in the formal learning environment. The following diagram illustrates one way of thinking about inquiry learning. I deliberately chose not to represent it as a circular step-by-step process because in reality can be messy and the various components can happen in different orders and can be revisited over and over throughout the inquiry process.



When we look at the respective roles of students and teachers we can see that both are cast in the role of inquirers, but teachers are not only inquiring with students into their authentic questions, they are also inquiring into what is being learned by students through the inquiry process. Thus *research* actually becomes a fundamental teaching function.

Role of Students in Inquiry	**Role of Teachers in Inquiry**
* Interact with others, explore real objects	* Set up inviting, interesting environment for students to interact with
* Pursue interests and questions through self-directed exploration of environment	* Observe, ask/provoke, listen, document what students do and say
* Interpret experience, make	* Interpret, make inferences,

predictions, try things out, decide what to do next	hypotheses and predictions about what students are learning
* Use growing understandings across contexts, new interactions, and in pursuit of new explorations	* Decide what to do next, reset environment as needed to scaffold further learning

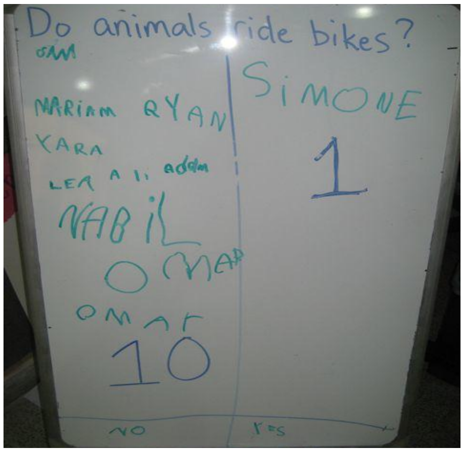
Examples of Intertwining Science, Mathematics and Literacy from classrooms of 3-5 year olds

Many examples of student-led investigations and writing produced during inquiry mainly from Lebanese preschool classrooms were shared with the audience. Some of the examples were drawn from Henningsen (2013), but there also additional examples added in order to illustrate the many opportunities for developing writing in the context of mathematics and science, even with very young children.

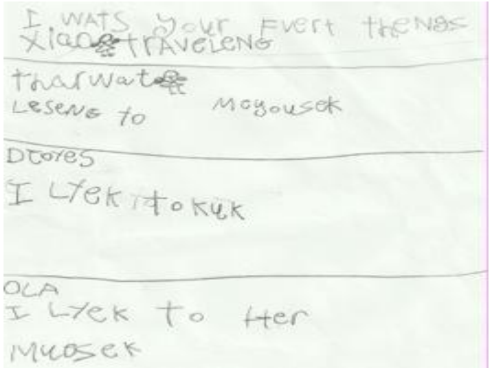
Examples shared included stories of extensive student-led inquiry investigations in which children were invited to track and record their thinking or answer questions with data, writing math stories, science notebooks, field notes and lab reports, writing letters of request, chalk talk and graffiti walls. We also looked at examples of pre-literate drawings in order to illustrate the wealth of information they often contain about children's thinking and how they are making sense of their experience and their environment. Also, we saw examples in which children were asked to "tell the story of their drawings" and it was clear that they were naturally using numbers and math concepts in their stories. Here are two such examples of stories with numbers or number concepts integrated:

I can make a telephone with numbers on it. I'm going to call teta Huda. It's 01/866536. I'm going to call her and tell her to eat because she's hungry. I'll tell her to eat carrots because she loves carrots. They're her favorite	عملت غيوم وحامض. الحامضة طلعت على الشّجرة. وفي على الشّجرة تفّاح. في كتير، في مليون، وتريليون، وinfinity. بتعرفي شو يعني gazillion؟ يعني بتعدي للميّة، وبتزيدي ميّة وبتضلك تزيدي ميّة وميّة وميّة! -ياسمينة

We also talked about writing opportunities can easily be created in many common lesson situations that might not typically require children to write. For example, in one class children were collecting data about whether or not kids in their class thought animals can ride bicycles. One way to orchestrate that might be to do a simple tally counting up the yes and no votes, but in this class the teacher turned it into a writing opportunity by simply asking children to write their names in the column of their choice as shown below, followed by counting up the results and recording a summary of the number of votes on each side:

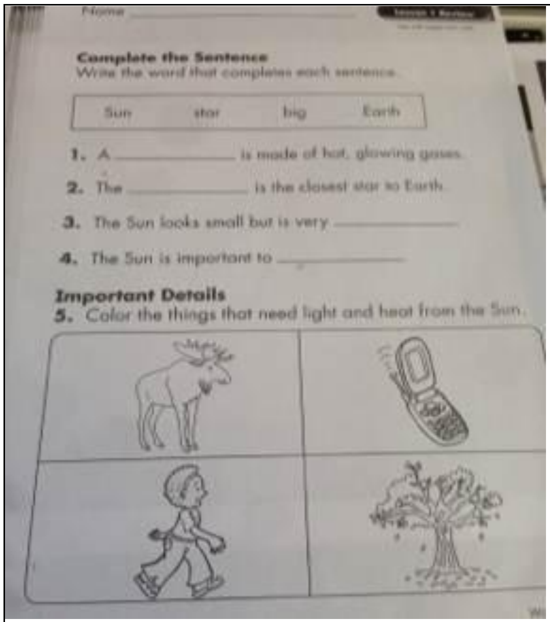
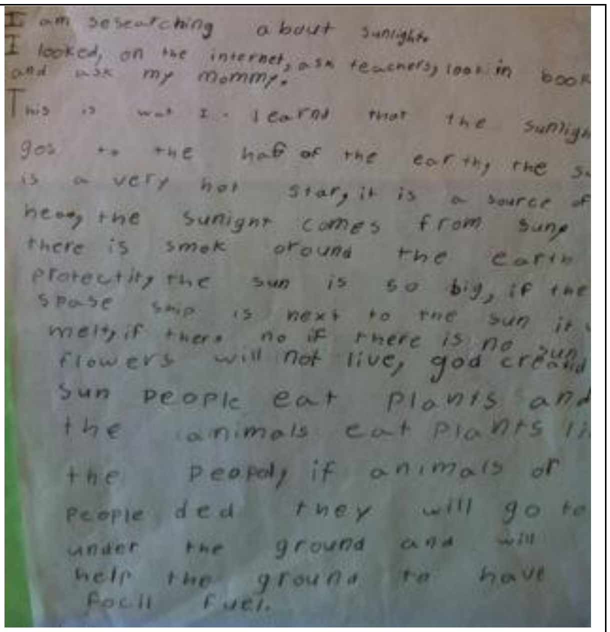


Below is another example that turned a math survey data collection activity into a writing opportunity by asking children to record their data initially in words before mathematizing it. Children were asking teachers around the school what they like to do on their free time:



I WATS your Evert theNgs
Xiao traveleng
tharwat
Lesene to Moyousek
Dtores
I Lyek to kuk
OLA
I Lyek to Her
Muosek

One extended example we looked at highlighted the difference in what children could be asked to produce if asked fill out a typical worksheet vs. asking them to do their own research and summarize their findings. This example shows on the left-hand column a worksheet taken from a well-known Grade 1 science textbook that children might complete after reading a text passage about the sun. The right-hand column shows a written summer produced by a Grade 1 child who was given the personal research task instead:

 Name **Complete the Sentence** Write the word that completes each sentence. Sun star big Earth **1.** A ______ is made of hot, glowing gases. **2.** The ______ is the closest star to Earth. **3.** The Sun looks small but is very ______ **4.** The Sun is important to ______ **Important Details** **5.** Color the things that need light and heat from the Sun.	 I am seseurching a bout sunlight. I looked, on the internet, ask teachers, look in book and ask my mommy. This is wat I learnd that the sunligh gos to the haf of the earth, the s is a very hot star, it is a source of heat, the sunignt comes from sun, there is smok around the earth protectity the sun is so big, if the spase ship is next to the sun it melt, if there no if there is no sun flowers will not live, god crea sun people eat plants and the animals eat plants li the peopoly if animals or people ded they will go to under the ground and will help the ground to have focil fuel.

In addition to engaging the child in personal inquiry and broadening the information about the sun that the child could encounter, the more open research and writing task clearly offers many more opportunities for the teacher to work with the child on writing mechanics, spelling and organization of text.

Conclusion

The talk concluded by addressing the fundamental role of the teacher in this kind of learning environment as multi-faceted:

- Data Collector
- Data Organizer
- Pattern hunter
- Documenter
- Interpreter
- Experimenter
- Designer

The importance of the documenter role cannot be underestimated because it forms the basis for interpreting children's learning and this process of trying to understand and make sense of what is being learned is an essential site for learning for the teacher. I also emphasized the importance of the teacher believing firmly in the competence of the children as learners in order for this type of learning environment to develop and reach its potential.

Selected References

Edwards, C., Gandini, L., & Forman, G. (2012). *The hundred languages of children: The Reggio Emilia experience in transformation*. Oxford, England: Praeger

Gronlund, G. (2010). *Developmentally appropriate play*. St. Paul, MN: Redleaf Press

Henningsen, M. (2013). Making sense of experience in preschool: Children's encounters with numeracy and literacy through inquiry in the *South African Journal of Childhood Education* 3(2).

Henningsen, M. (2012) TEDxBeirut: https://www.youtube.com/watch?v=CQnxfxvtALw

Katz, L. (2010). STEM in the early years. Collected papers from the SEED conference. http://ecrp.uiuc.edu/beyond/seed/katz.html

Lindfors, J.W. (1999). *Children's inquiry*. New York: Teachers College Press

Scheinfeld, D.R., Haight, K.M., & Scheinfeld, S.J. (2008). *We are all explorers: Learning teaching with Reggio principles in urban settings.* New York: Teachers College Press

The Current Status of Lebanese Biology Secondary Teachers’ Interactions with Resources, Particularly Digital Resources

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This research aimed to investigate the current status of integration of digital resources by Lebanese biology teachers in their preparation/teaching practices in general and particularly for teaching genetic concepts. For this purpose a questionnaire was elaborated and validated; 116 biology secondary teachers - from both public and private schools with varying profiles, working environments and from different Lebanese regions - filled the questionnaire. The results showed that the participants are integrating digital resources, specific websites, software and Internet resources in order to enrich and update their scientific knowledge for teaching difficult evolving concepts like genetic concepts. In the second phase of the research the documentary work of two cases were followed for two successive years during the preparation and teaching of genetic concepts in grade 11 (Scientific) in order to investigate the consequences of interactions with resources on teachers’ documentary work and conceptions related to genetic determinism of phenotype.

Introduction

Biology like any science is dynamic and evolving, its scientific knowledge is temporary and dated. Biology teachers are challenged with teaching difficult and evolving concepts. Genetics is a fundamental part of biology that is relevant to everyday life, however it is traditionally considered as a difficult subject in biology for both students and teachers (Bahar, Johnstone & Hansell, 1999; Bahar, Johnstone & Sutcliffe, 1999; Knippels, Waarlo, & Boersma, 2005; Lewis & Kattman, 2004; Lewis & Wood-Robinson, 2000). Moreover, studies have shown that students encounter difficulties when studying modern genetics in areas such as differences between genes and traits, gene expression, and the meiotic model (Duncan & Resier, 2007; Lewis & Kattmann, 2004; Lewis, Leach & Wood- Robinson, 2000 a & b; Marbach-Ad & Stavy, 2000; Tsui & Treagust, 2003).

At the end of the twentieth century scientists laid the foundation of a new paradigm in genetics, “Epigenetics”. The great debate between innate and/or acquired is outdated, both being necessarily in constant interaction (Atlan, 1999; Jacquard & Kahn 2001; Kupiec & Sonigo 2001; Lewontin 2003). The interaction between innate and acquired is now the subject of epigenetic; also the interaction between human genes and their environment is called "Epigenetics" (Morange 2005). Genetic concepts have significantly evolved over the last fifteen years, and are now less connected to innate ideas and reductionism. Unique reference to genetic determinism has been replaced by the interaction between the genes and their environment (epigenetics). Atlan (1999) claimed “the end of all genetics” (“la fin du tout - génétique”) which often reduces human traits such as intellectual or musical performance with genetic determinism. The philosopher Canguilhem (1981) defined reduction of complex phenomena to simple molecular causes and the explanation of complex social features by only the human genes as a reductionist ideology inside Life Sciences. According to him the schema one gene ➔ one trait-the belief that any human behavior or performance is mainly determined by gene- is reductionist, with a hereditarianism ideology. This implicit ideology is still very present in school textbooks as well as in teachers' conceptions.

These scientific evolutions related to specific topics in genetics had occurred after the implementation of the new Lebanese curriculum in 1998 that is not updated till now. In the context of the European project Biohead-Citizen, Biology Health & Environmental Education FP6-CIT2 (2004-2008), the study of Castéra et al. (2008) investigated if the new trends in human genetics research (epigenetic) are present in the school textbooks, or there are still some signs of the precedent concepts (hereditarianism). The study showed that there is still implicit idea of genetic determinism in the Lebanese textbooks analyzed, this indicates that the contents of textbooks are not just scientific knowledge, but could convey implicit messages related to values (like hereditarianism). Another study done by Castéra, Munoz, and Clément (2007) related to conceptions of teachers in the context of the European project Biohead-Citizen showed that there are important differences between teachers and future teachers' conceptions on determinism of the human phenotype (older teachers with more anchored ideology of genetic determinism). So, all the modern concepts mentioned above are not tackled in the Lebanese program. In addition, there are no National training programs to update teachers' scientific knowledge and teaching practices.

According to Castéra and Clément (2009) teaching Epigenetics the interaction between the genome and environment, is a citizen challenge for the 21st century; this new paradigm in biology is a vital question with an important social challenge. It has important implications on biology teaching. So the new challenge facing Lebanese biology teachers is how to cope with these changes and to upgrade their scientific knowledge and teaching methods relying on all available resources in addition to curriculum resources.

According to Webb (2008), teachers have always developed their own resources to some extent, but now technology is enabling them to produce a wider range of types of material and to share them more easily. Due to proliferation of digital resources a large amount of learning and teaching materials are becoming available for teachers. Lebanese teachers nowadays are more and more opened to digital and online resources, there is more accessibility to Internet resources despite of the problems related to the Internet connection and speed, and most of the schools in Lebanon are increasingly equipped with technological tools: computers, LCD, software and very recently interactive whiteboard.

Digitalization is manifested by the abundance of Internet resources on one hand and the diversity of the technological tools that can be used by teachers like software, interactive white board and USB on the other hand. This evolution leads to major changes in preparation / teaching practices (Sabra & Trouche, 2011).

Moreover, the development of Internet has made diffusion, sharing and exchange of resources faster between teachers. Besides, the development of new technologies (mobile tools and USB for example) facilitated the transport of digital resources from one medium to another. But a simple use of online resources abundant on a variety of sites, or a simple exchange of digital resources is not enough of course nor solves the challenges of integrating technology in teaching. The effective integration of ICTs (Information and communication technologies) into the educational system is a complex, multifaceted process that involves not just technology but also curriculum and pedagogy, institutional readiness, teacher competencies, and long-term financing, among others (Haddad & Draxler, 2002). According to Abed-El-Khalick (2005) teachers should be trained to master technology in order to be able to use it efficiently with their students, they should develop positive attitude towards technology. In this study we are interested in teachers' interactions with digital resources and its effect on their teaching practices while teaching the difficult evolving concepts of genetics.

Theoretical background

This study is based on two theoretical frameworks: "the documentational approach of didactics" elaborated by Gueudet and Trouche (2009) and "the KVP model" elaborated by Clément (2006). These frameworks are crossed in order to investigate the nature of interactions between Lebanese biology secondary teachers and resources with special interest in digital resources, and the consequences of these interactions on their conceptions and professional development.

The *documentational approach of Didactics* is elaborated to study the teachers' development and in particular integration of ICT. ICT can be considered as a part of the available teaching resources, this fits also technological evolutions: teachers exchange digital files by e-mail, use of digital textbooks, draw on resources found on the websites (Gueudet & Trouche, 2010). It studies teachers' documentation work: collecting, selecting, transforming, recombining, sharing and revising resources; implementing them in class. The documentation refers to the documentary work and the documents generated during this work simultaneously. Resources mean anything that can be used by the teacher as a support for teaching and learning, during the preparation of sessions and teaching sessions. This approach introduces an essential distinction between a set of available resources (textbooks, official program, digital resources like software, resources accessible via the internet, students' work sheets, advice given by a colleague etc...) and a document developed by the teacher from these resources, within a *documentation genesis* process.The *documentation genesis* jointly develops a new resource (made up of a set of resources selected, modified, recombined) and a scheme of utilization of this resource. We can represent this process, in a very simplified way by the equation:

Document = Resources + Scheme of utilization

The process of genesis goes on where the document gives rise to a new resource, that combine with other resources to be involved in new geneses. In the process of *documentational genesis*: the instrumentalization process conceptualizes teacher's appropriating and reshaping resources, and the instrumentation process captures the influence of resources on teacher's activity, as illustrated in Figure 1:

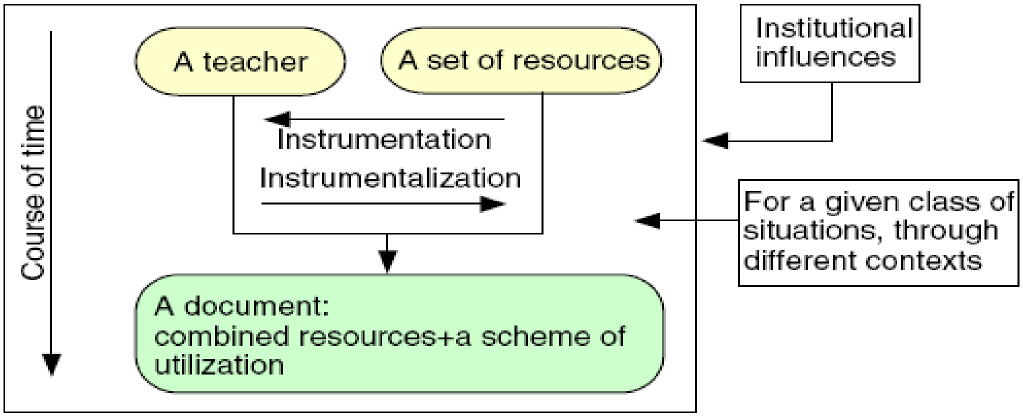

Figure 1. Schematic representation of a documentation genesis process (Gueudet & Trouche, 2009)

According to Gueudet, Pepin and Trouche (2012), the *resource system* of the teacher constitutes the 'resource' part of her *documentation system* without the scheme part of the documents; it comprises material elements, but also other elements that are more difficult to collect, like a conversation with a colleague and interaction with students. The *documentation system* consists of the *resource system* and the corresponding schemes. The documents produced by teachers are organized in a *documentation system* and the analysis of these *documentation systems* and their evolution permits the study of teachers' professional development. Thus the interactions between teachers and resources during their professional activity and the consequences of these interactions play a central role in teachers' professional development. The professional development can be measured in terms of integration of new resources that might lead to evolution in teachers' professional knowledge and teaching practices.

On the other hand, teachers' conceptions related to genetic determinism of phenotype will be studied based on the *KVP model* as interactions between knowledge (K), values (V) and Practices (P), as illustrated in figure 2.

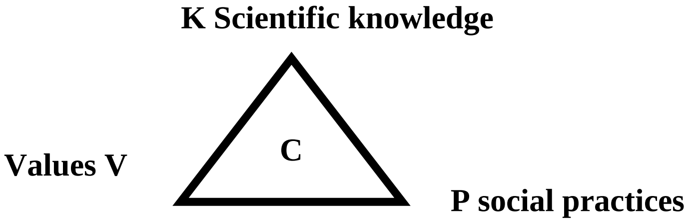

Figure 2. The KVP model where conceptions (C) are analyzed as interactions between the 3 poles K, V and P (Clément, 2006)

K stands for scientific knowledge, as it is published by the scientific community, from school textbooks, academic journal, Internet website, radio or television, scientific paper, conference or any other resource. However, in the context of biological sciences scientific knowledge is evolving at a rapid pace, this scientific knowledge might be controversial with the dated knowledge.

V stands for value systems in the widest definition, including opinions, faiths, ideologies, philosophical, and moral positions. Related to the topic of this research, human genetics, values are understood to be ideologies, as suggested by Canguilhem (1981), where an ideology is not a distortion of consciousness or science, but rather a product of history within a scientific context. As specific examples for the field of biology, Canguilhem cites "anatomism", "reductionism", and "the ideology of heredity," which is also can be called "hereditarianism," "innatism," or even the ideology of "all genetics" (Atlan, 1999).

P stands for social practices, including not only professional practices of teachers (teaching practices in school alone or with their colleagues to prepare and elaborate their courses or meeting with parents or professional associations) but also influential social practices, whether civic, religious, ethical, or other (practices of citizen outside school). Finally, it covers the personal practices of the actors of the educational system, practices more or less citizens for example, more or less related to beliefs, ideologies and moral positions that are at the heart of the V pole.

For the purpose of this study, in order to analyze the documentary work of the teachers, we articulated the two theoretical frameworks. Instead of the schemes, knowledge (K), practices (P) and values (V) of resources and institutions interacting with KVP of teachers. Thus the document developed by the teachers during their professional activity is constituted of resources enriched from the teacher's experience; the values and knowledge of these resources are reflected by their practices. The relationship between the teacher and the resources working within a set of institutions (school, society) are dialectical: teachers select, appropriate and transform resources based on their conceptions (instrumentalization) and implemented resources reshapes teachers' activities and professional knowledge which might lead to evolution in their conceptions (instrumentation process). The *documentational genesis* jointly develops a new resource (made up of a set of resources selected, modified, and recombined) interacting with KVP of teachers. Furthermore, in the context of the *documentational approach* the term "professional development" of the teacher refers to co-evolution of professional knowledge, resources and activity of the teacher. In this study we will highlight the professional development of the teacher in the context of integration of resources particularly digital resources which may lead to the evolution of scientific knowledge (K), teaching practices (P) and values (V) related to the environmental influence of phenotype (Epigenetics).

Based on the articulation between the two theoretical frameworks this paper aims to answer the following questions:

1- Are Lebanese biology secondary teachers utilizing digital resources in their preparation /teaching practices?
2- Is there a particular use of digital resources related to the teaching of the genetics' concept?

Method

This study applies a mixed design approach, sequential quantitative followed by qualitative. The quantitative part is constituted of a questionnaire administered to Lebanese biology secondary teachers in order to investigate the current status of integration of digital resource in their preparation/teaching practices. Based on the analysis of the data collected from the questionnaire the participants for the qualitative part were selected. However, only the quantitative part will be presented here.

At the beginning of the research a questionnaire was elaborated in the context of DOCENS project, a collaborative project between France (IFE-ENS Lyon) and Lebanon (Lebanese University) funded by the Franco- Lebanese program CEDRE (Coopération pour l'Évaluation et le Développement de la Recherche). Three doctorate students in didactics of biology, physics and mathematics with their French and Lebanese thesis directors participated in the project. The project targets the professional development of science teachers, and its ultimate goal is to develop a platform to design and share resources between science teachers. The questionnaire was elaborated by the researcher in collaboration with the other two doctorate students. Then the content validity of the first version of the questionnaire was determined by their directors: six expert researchers in didactics of biology (one), physics (two) and mathematics (three). For reliability purpose a pilot test (try out) for the first version of the questionnaire was done with 16 biology secondary teachers that were not part of the study. For validity purpose we applied the "think-aloud technique" with four teachers. The "think-aloud technique" is very helpful for determining whether the participants are interpreting the items as intended (Johnson & Christensen, 2008). Based on the feedback and suggestions a final version was elaborated.

The final version of the questionnaire is formed of thirty- three items, that focused mainly on the criteria of integration of digital resources and technology in the preparation/ teaching practices in general and specifically in teaching the genetic concepts. The questionnaire is divided into three parts; the first and the third part are common in the theses of the three different disciplines:

a- The first part is related to the working environment of the teacher: availability and use of computers and Internet at their schools and at home; the purposes of utilization of computers and Internet; resources and software utilized and the purpose of their utilization, technological tools available at their school and the purpose of their utilization.
b- The second part of the questionnaire is related to the preparation and teaching of the gene concept (the topic of research), it is made up of four questions three of them are open-ended. It is designed to know the resources utilized in teaching the genetic concept and the purpose of their utilization, and also to infer the role played by digital resources. This part is specific to this research.

c- The third and last part of the questionnaire is related to personal information about the teachers, their teaching experience and educational background (gender, phone number, e-mail address, type of school where they teach, name of school, its region and telephone number of school; degrees/ certificate and ICT training sessions; Grades they have been teaching and teaching language…). The questions in this part are mainly closed –ended with a checklist provided for the participants.

The questionnaire was administered to Lebanese biology secondary teachers in June, 2011 during the annual meeting for the discussion of the answer key for the National exams for Grade 12 class (Life Science, LS, section). We chose to give the questionnaire at that occasion because it is the only place where we can find a big number of Lebanese biology secondary teachers from different regions, with different profiles and different working environments. 200 questionnaire papers were distributed randomly at the doors to most of the teachers that attended this annual meeting, 116 biology secondary teachers filled the questionnaire completely. The quantitative analysis of the results of the questionnaire allowed us to study the current status of integration of digital resources based on the answers of the participating biology teachers.

Results

The first part presents some of the results related to the working environment of the teachers that filled the questionnaire: presence of computers at school and at home and their use; Internet connection at school and at home; technological tools available and accessible at school, and use of technological tools, as illustrated in figures 3 and 4 below.

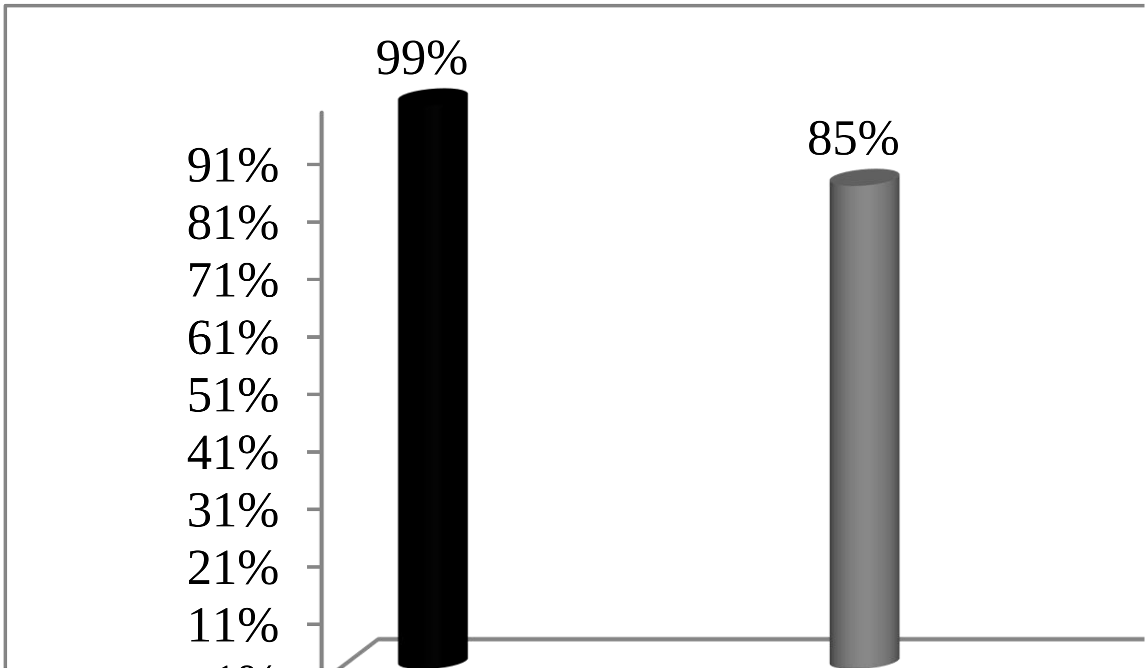

Figure3.Percentages of presence of computer and Internet connection at home and at school according to teachers' responses

The results show that according to the teachers' responses the majority of schools (> 80%) are equipped by computer labs. Around half of the teachers use the computer labs at school more often and regularly. Almost all teachers (99 %) have computers at home and 75 % of the teachers use their computers at home often or regularly. More than 70 % of schools have Internet connection and the majority of participating teachers (>80%) have Internet connection at home.

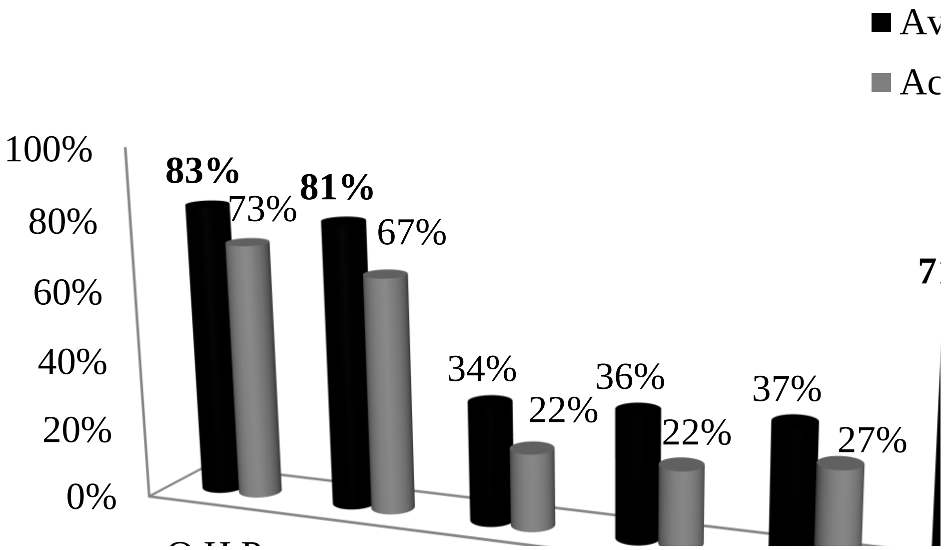

Figure 4. Percentages of technological tools available and accessible at school according to teachers' responses

The percentages of teachers' responses show that the main technological tools available in schools are Overhead projector (O.H.P), LCD, TV and videos and the least available is the IWB, laptop and DVD. Furthermore the percentages of accessibility are lower than availability for all the tools. According to the participants' responses around half of them use the technological tools sometimes, 26% use them often and 20% use them regularly.

The second part shows the types of resources used in the preparation/ teaching practices of the participant teachers, the types of software utilized and the purposes of utilizing resources in general and specifically digital resources. The results are illustrated in the figures and tables below.

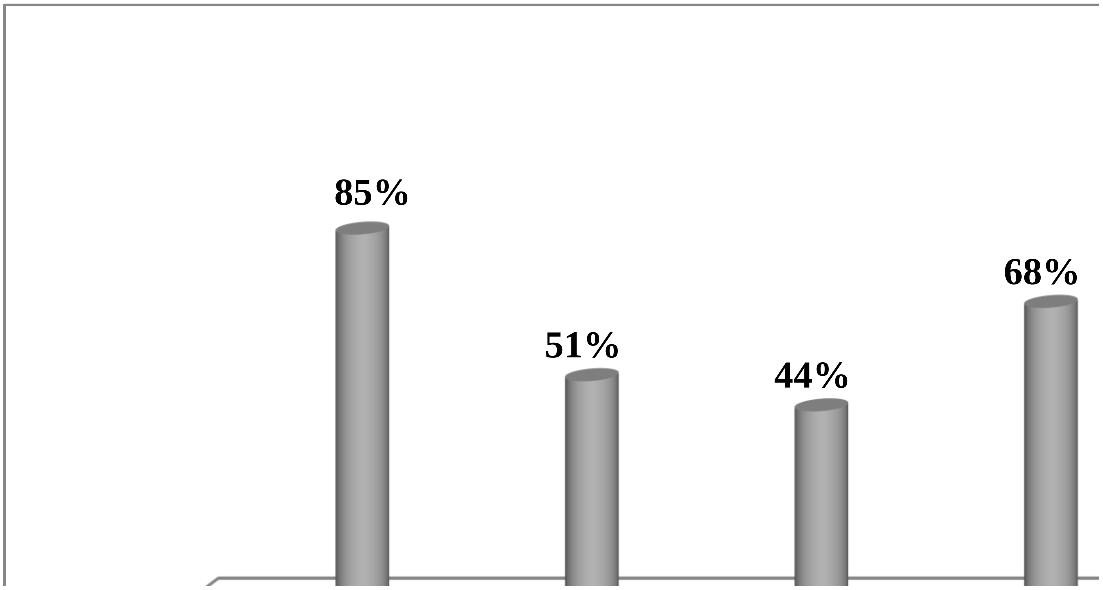

Figure 5. Resources integrated in the preparation/ teaching practices of the participants' teachers

The results show that the participants mainly utilize books in addition to specific websites, software and online resources that are used to a certain extent. The purposes of utilizing these resources are illustrated in table 1.

Table 1

Purpose of utilizing Resources

Purpose of utilizing resources	Percentages of teachers' responses
Update your scientific knowledge	**78**
Enrich your scientific knowledge	**76**
Prepare students' activities	51
Prepare application exercises	53
Prepare exams	68
Illustration	46
Effective Total	116

The results show that the majority of the participants use resources to update and enrich their scientific knowledge.

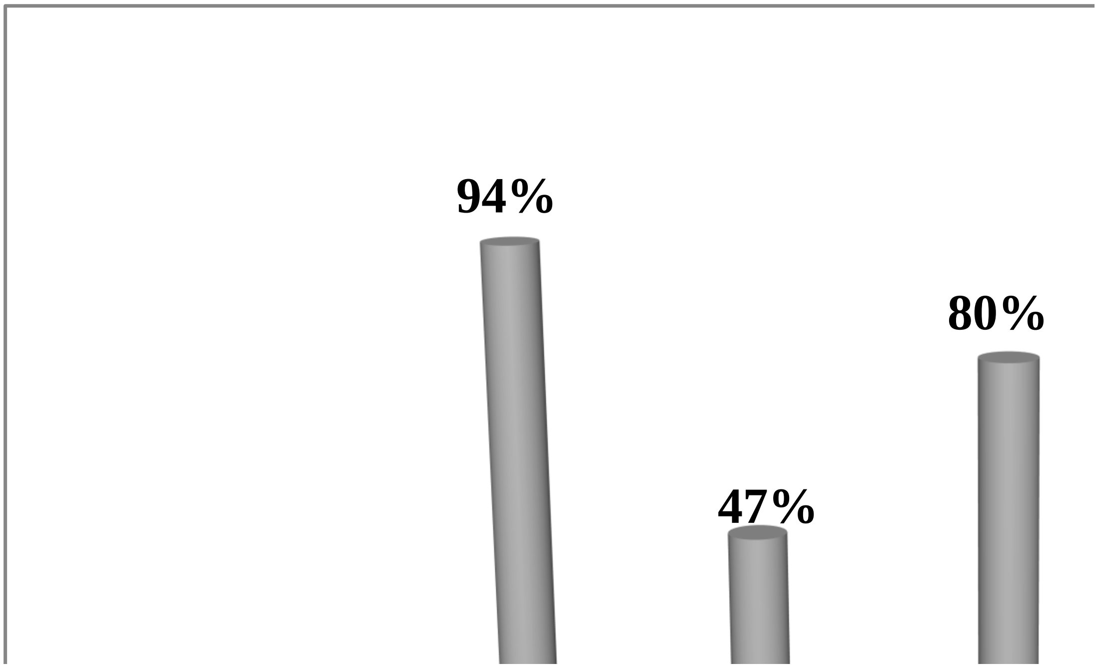

*Figure 6.*Types of software utilized in the teaching practices

The results show that the majority of the teachers are utilizing the Microsoft words, in addition to PowerPoint in their teaching practices. The purposes of utilizing these software are illustrated in the table 2 below:

Table 2

Purpose of using software

Purpose of using software	Percentages of teachers' answers
Writing your exams	**88**
Preparing students work sheets	**72**
Writing students Grades	29
Calculating averages and ranks	21
Preparing & presenting your lecture	59
Showing your students videos & animation	**69**
Effective Total	**116**

The results show that the participating teachers mainly use the software to prepare exams or students worksheets and to show students videos and animations. In addition, related to the purposes of use computers, Internet and technological tools the tables below illustrate the percentages of teachers' responses.

Table 3

Purposes of Using the Computers

Purposes of using the computer	% of teachers' responses
To use Internet	**66**
To use Internet for teaching purposes	**71**
To install and use software	35
To install and use software for teaching purpose	56
to type your exams	**89**
To search for resources on the net	**72**
To play games	9
Effective Total	116

The results show that the majority of teachers use the computers to type their exams (> 80 %), and around 70 % use them to search for resources on the net for teaching purposes.

Table 2

Purposes of Using the Internet

Purpose for using Internet	Percentages of teachers' responses
e-mail	**72**
Facebook	47
Professional purpose	59
Searching for new resources	**68**
Searching for new websites	44
Effective Total	116

The results show that teachers mainly use the Internet to check their e-mails and to search for new resources. This is consistent with the results related to use of computers, to search for resources on the net.

Therefore, in their teaching practices the sample of biology secondary teachers that filled the questionnaire are utilizing mainly books (95%), then specific websites on the Internet (68%), software (51%) and online resources (44%). They search for new resources and specific websites from the net and they utilize mainly the software Microsoft Words and PowerPoint for preparing students' exams and worksheets in addition to preparing and presenting their lectures, and they implement Real Player and animations in their teaching practices. In general they utilize resources-particularly digital resources, software and technological tools- to update and enrich scientific knowledge, for illustration, simulation, to motivate students and to arise their curiosity.

The third part presents the results related to teaching genetic concepts; this topic was chosen in this research since it is particularly sensitive to the evolution of the documentary work of the teachers in the context of availability of digital resources. Genetic concepts are difficult and constantly evolving with the advances of technology, the use of digital resources like animations and videos might enhance the teaching process, and the proliferation of Internet resources might help biology teachers to cope with genetics' evolutions and might cause evolution of their conceptions from hereditarianism towards epigenetics.

The results show that the most utilized resources for teaching the genetic concepts are still books, then specific websites and software. Related to books the common responses of the teachers were classified into six categories: the National textbook, French textbooks for secondary classes, University books, Guides, Online books, Encyclopedia and others. Moreover, the participants use mainly PowerPoint, Real Player and Flash Animation software. These results are consistent with the results obtained above emphasizing that the biology teachers use these software in their teaching practices. In addition, 4 % mentioned the use of scientific magazines and 1 % mentioned DNA model as other types of resources used in teaching genetics.

Related to the open-ended item about the use of digital resources in teaching gene concept, the results show that 64 % of the participants answered that the digital resources enhance and facilitate teaching. Some of the interesting answers include:

> *The use of animation to facilitate this concept; to facilitate comprehension of students; hard to explain this concept depending on the book only*; *facilitate communication and exchange of knowledge; fix the ideas and decrease ambiguity; can change the abstract idea into vivid, provide new teaching methods; can enhance the imagination of students…*

Results related to the factors that might hinder the integration of digital resources and the comparisons between the three disciplines are not presented in this paper.

Discussions and Future Implications

The results of the questionnaire show that a certain number of the participant Lebanese biology teachers integrate digital resources in their documentary work emphasizing their importance in teaching difficult and abstract concepts at the cellular level like the genetic concepts. Despite of the fact that our sample is not quite representative and cannot be generalized, but the quantitative results of the questionnaire shed light on the current status of integration of digital resources by biology teachers in Lebanon, and allowed us to answer the questions of research. The results showed that biology teachers use the computer and the Internet mainly to search for new resources and specific websites in order to enrich and update their scientific information related to evolving and difficult concepts. The participating Lebanese biology secondary teachers use in addition to books the software Microsoft words in their teaching practices for writing their exams and students' worksheets; they use PowerPoint to prepare and present their lectures; in addition they use the RealPlayer and Flash animation software to show their students videos and animations.

Moreover, in biology there are lots of abstract concepts that cannot be visualized or imagined by students, so maybe the implementation of these illustrative tools like videos and animation are used by teachers for simulation in order to facilitate the teaching and learning processes of such concepts. To overcome students' conceptions and difficulties in learning genetics and to understand abstract, difficult-to-grasp concepts, several researches have showed that animation–based activities, interactive computerized learning environments, and inquiry–based learning in genetics are highly successful in promoting conceptual understanding of many aspects of the genetic, meiotic and molecular models of genetics (Buckley et al., 2004; Cartier & Stewart, 2000; Gelbart & Yarden, 2006; Rotbain, Marbach-Ad & Stavy, 2006**).** Thus, one reason that can explain the implementation of digital resources in teaching genetics is the difficulty of this subject.

In alignment with these studies the results of the questionnaire showed that the majority of the participating teachers agreed that the utilization of digital resources, specifically animation and videos, can facilitate and enhance the teaching of the difficult genetic concepts. Further analysis based on the data collected from the selected cases for the qualitative part of the research emphasized our inferences and allowed us to investigate the nature of interactions between digital resources and teachers' conceptions related to genetic determinism.

Thus, the results of our research indicate the importance of interaction with resources during teachers' professional development; this could inspire the trainers of the sessions of CERD (center for educational research and development) which aims at the professional development of in- service public school teachers. In-service teachers should be supplied with resources that might cause the evolution of their conceptions; in addition, they should be trained to elaborate new resources.

Finally, in this digital era where resources are more available for teachers; they can easily communicate, share and exchange their resources. But according to Abd-EL-Khalick (2005), to integrate ICT into teaching necessitates reexamining curricular goals and pedagogical approaches; this involves also catering science teachers throughout the implementation process. So in- service professional development is necessary and aids teachers in implementing technology efficiently. In this respect the results of this study can be considered as a reference for curriculum designers and educators that should realize that ICT in itself is not a teaching approach. They have to elaborate effective strategies for the integration of digital resources and technology in the new biology curriculum and to develop programs that can aid in- service teachers to integrate technology efficiently in their teaching practices.

References

Abd-EL-Khalick, F. (2005). Instructional technology in secondary science teaching. In I. Osta (Ed.), *Education and Information Technology in the Arab Countries: Issues and Trends* (in Arabic) (pp.329-355). Beirut: Lebanese Association for Educational Studies.

Atlan, H. (1999). *La fin du" tout génétique".* Paris: INRA.

Bahar, M., Johnstone, A. H., & Hansell, M. H. (1999). Revisiting learning difficulties in biology. *Journal of Biological Education, 33,* 84–86.

Bahar, M., Johnstone, A. H., & Sutcliffe, R. G. (1999). Investigation of students' cognitive structure in elementary genetics through word association tests. *Journal of Biological Education, 33,* 134–142.

Buckley, B.C., Gobert, J.D., Kinfield, A.C.H., Horwitz, P., Tinker, R.F., Gerlits, B., Wilensky, U., Dede, C. &Willet, J. (2004). Model-based teaching and learning with BioLogica: What do they learn? How do they learn? How do we know? *Journal of Science Education and Technology*, *13*(1), 23-41.

Canguilhem, G. (1981). *Idéologie et rationalité dans l'histoire des sciences de la vie.* Paris:Vrin Librairie philosophique.

Cartier, J.L., & Stewart, J. (2000). Teaching the nature of inquiry: Further developments in a high school genetics curriculum. *Science Education, 9,* 247-267.

Castéra, J. & Clément, P. (2009). The genetic determinism of human performances. A comparison between teachers' conceptions in Finland and France. In M.F. Tasar & G. Cakmakci (Eds), *Contemporary Science Education Research: International Perspectives.* (pp. 459-466), Ankara, Turkey: Pegem Akademi.

Castéra, J., Clément, P., Abrougui, M., Sarapuu, T., Turcinaviciene, J., Agorram, B., Calado, F., Bogner, F., Nisiforou, O., Valanides, N., & Carvalho, G.S. (2008). Genetic Determinism in school textbooks. A comparative study conducted among 16 countries. *Science Education InterNational*, *19*(2), 163-184.

Castéra, J., Munoz, F. & Clément, P. (2007). Les conceptions d'enseignants du primaire et du secondaire sur le déterminisme biologique de la personnalité humaine dans 12 pays d'Europe, d'Afrique et du Moyen Orient. *Actes du Congrès interNational AREF (Actualité de la Recherche en Education et en Formation).* Strasbourg, France. Retrieved from http://aref2007.u-strasbg.fr/actes_pdf/AREF2007_Jeremy_CASTÉRA_298.pdf

Clément, P. (2006). Didactic transposition and the KVP model: conceptions as interactions between scientific knowledge, values and social practices. *Proceedings of ESERA Summer School 2006*(pp. 9-18). IEC: Braga, Portugal.

Duncan, R.G., & Reiser, B.J. (2007). Reasoning across ontologically distinct levels: Students' understandings of molecular genetics. *Journal of Research in Science Teaching*, *44*(7), 938-959.

Gelbart, H. & Yarden, A. (2006). Learning genetics through an authentic research simulation in Rotbain, Y., Marbach-Ad, G. and Stavy, R. (2006). Effects of bead and illustration models on high school students' achievement in molecular genetics. *Journal of Research in Science Teaching*, *43*(5), 500-529.

Gueudet, G., & Trouche, L. (2009). Towards new documentation systems for mathematics teachers? *Educational Studies in Mathematics, 71*, 199-218. DOI 10.1007/s10649-008-9159-8.

Gueudet, G., & Trouche, L. (2010), Des ressources aux documents, travail du professeur et genèses documentaires, In Gueudet G. et Trouche L. (dir.) *Ressources vives. Le travail documentaire des professeurs en mathématiques* (pp. 57-74). Collection Paideia, Presses : Universitaires de Rennes et INRP.

Gueudet, G., Pepin, B., & Trouche, L. (Eds.) (2012), *From Textbooks to 'Lived' Resources: Mathematics Curriculum Materials and Teacher Documentation.* New York: Springer.

Haddad, W. & Draxler, A. (2002). The dynamics of technology in education. In I. Osta (Ed), *Education and Information Technology in the Arab Countries: Issues and Trends* (in Arabic) (pp. 33-68). Beirut: Lebanese Association for Educational Studies.

Jacquard, A. & Kahn, A. (2001). *L'avenir n'est pas écrit*. Paris: Bayard.

Knippels, M.P.J, Waarlo, A. J. and Boersma, K.T. (2005). Design criteria for learning and teaching genetics. *Journal of Biological Education, 39* (3), 108-113.

Kupiec, J. J. & Sonigo, P. (2001). *Ni Dieu, ni gène*. Paris: Seuil.

Lewis, J., & Kattmann, U. (2004). Traits, genes, particle and information: Re-visiting students' understandings of genetics. *InterNational Journal of Science Education, 26*(2), 195-206.

Lewis, J., Leach, J., & Wood-Robinson, C. (2000a). All in the genes?—Young people's understanding of the nature of genes. *Journal of Biological Education 34,* 74–79.

Lewis, J., Leach, J. & Wood-Robinson, C. (2000b). What's in a cell? Young people's understanding of the genetic relationship between cells, within an individual. *Journal of Biological Education, 34*(3), 129-132.

Lewis, J., & Wood-Robinson, C. (2000). Genes, chromosomes, cell division, and; inheritance- do students see any relationship? *InterNational Journal of Science Education 22*, 177–195.

Lewontin, R. C. (2003). *La triple hélice. Les gènes, l'organisme, l'environnement*. Paris: Edition du Seuil.

Morange, M. (2005). L'épigénétique: un domaine aux multiples facettes. *Médecine/Sciences*, 21:339.

Rotbain, Y., Marbach-Ad, G., & Stavy, R. (2006). Effects of bead and illustration models on high school students' achievement in molecular genetics. *Journal of Research in Science Teaching*, *43*(5), 500-529.

Sabra, H., & Trouche, L. (2011). Collective design of an online math textbook: when individual and collective documentation works meet, in M. Pytlak, T. Rowland, & E. Swoboda (Eds.), *Proceedings of CERME 7* (pp. 2356-2366), 9th to 13th February 2011. Rzesów, Poland.

Tsui, C.Y., & Treagust, D. F. (2003). Genetic reasoning with multiple representations. *Journal of Research in Science Education*, *33*, 111-135.

Webb, M. E. (2008). Impact of IT on Science Education. In J. Voogt & G. Knezek (Eds.). *InterNational Handbook of Information Technology in Primary and Secondary Education* (pp. 133–148). UK: King's College London.

--- Only Abstracts included for the following sessions ---

The Revolution of Instructional Technology: Why It Isn't Happening? Cognitive Tools in Promoting Physics Learning

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The purpose of this study was to investigate, using a design-based research approach, the effect of using interactive and student-centered technological tools, used as cognitive tools and digital resources (simulation mode) on students' conceptual understanding of and attitude toward physics. In addition, the study sought to investigate students' opinions regarding the use of computers as cognitive tools or digital resources. Thirty-nine tenth graders from two sections in a Lebanese school participated in the study. The two sections were randomly assigned to the cognitive tool group and the digital resource group during the teaching of the unit of electricity in physics. The same physics teacher/researcher taught both groups. In the digital resource group students received problems to solve, with procedures fully provided within the software, while students in the cognitive tool group were provided with the same experiment as those of the digital resource group, however, students received problems to solve and exploration space in which they designed their own plans, and tested their own hypotheses. During the implementation, the teacher provided hints, directions, coaching and feedback. Data sources for the study included an electricity knowledge test, used as a pre-test and post-test, four physics tests (each administered at the end of every chapter), and students' responses on the computer tool. Another data source was the physics attitude scale (PAS), which was used to measure changes in students' attitudes towards physics in both groups. Finally, student interviews were conducted in order to learn more about students' opinions about the computer tool. Post-test results and the results of the four physics tests indicated that students in the cognitive tool group achieved significantly higher than the digital resource group regarding conceptual understanding in physics. Analysis of the results of the physics attitude scale showed that there were no significant differences in attitudes between the two groups. Finally, students showed positive but different opinions regarding the computer tool. Implications to practice, students, administrators, policy makers, science teachers, and educational software designers as well as recommendations for further research are discussed in light of these findings.

Content Validity of Grade 9 Lebanese Chemistry National Examinations

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This session shows some preliminary findings of a study that aims to (a) examine the degree of alignment between grade 9 Chemistry National Exams (CNE) and grade 9 Chemistry National Textbook (CNT) in Lebanon over 13 years (2001-2013) and (b) improve the quality of grade 9 Lebanese CNT through determining the missing information and the unclear information in the textbook by referring to CNE. The test items of six grade 9 CNE were analyzed and matched to the parts of grade 9 CNT using a framework developed for the purpose of the study. The preliminary results show that (a) the degree of alignment between the analyzed CNE and the grade 9 CNT is acceptable to be an evidence of the content validity of those exams, and (b) the grade 9 CNT needs a serious revision due to the large amount of missing information and unclear information in the textbook.

The Effect of Using a Debate Strategy in Biology Teaching on Increasing Students' Critical Thinking

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Biology education supports students with significant knowledge that is mainly used in making cutting edge decisions regarding their health. For example learning about the effect of drugs and alcohol on the proper functioning of the nervous system. These decisions are mostly affected by peers who might lead students to fake knowledge and consequently wrong decisions. Several researchers claimed that debate strategy in biology teaching could enhance students' critical thinking skills through investigating a certain issue, searching for evidence to support their hypotheses, decision making, and presenting their knowledge in an active and amusing way(Lowenstein & Bradshow, 2004). Through this strategy, students learn how to look for evidence to support their ideas in a logical scientific way, thus, decreasing peer effect on their decision making process. In this workshop, participants will be briefed on an action research done on 8th graders and which study the effect of debate strategy on increasing students' critical thinking abilities. . A short video will be presented showing parts of debates done in class. Then, participants will be asked to reflect on this strategy and discuss its implications and possible limitations in classroom instruction.

Research Papers: Mathematics & Science

--- Only Abstracts included for the following sessions ---

The Effect of the Language of Instruction on the Math and Science Achievement of Lebanese Students

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The effect of language of instruction on the science and mathematics achievement of students is a debatable subject and the question of several research studies. Several studies revealed the relationship that exists between language and the learning of math/science. They also showed that learning math and science in the first language allows students to obtain better results than students learning in the second language. Some studies indicated that students achieved better in questions requiring higher cognitive levels of thinking when they study in their first language. This study focused on examining the effect of the language of instruction on the science and math achievement of Lebanese students. In particular, it aimed at examining whether students who learn math/science in their first language (Arabic) achieve better results on different levels cognitive questions than students learning in the second language (English). This quantitative study conducted on two groups of Lebanese students, where one group teaches math and science in the first language (Arabic) and the second teaches these subjects in the

second language (English). Science and math achievement tests were administered to 368 grade 5 students and 157 grade 11 students to test their achievement in math and science. The analysis of their achievement test results and their scores on the different cognitive levels of thinking was done using the analysis of variance statistical method which revealed that students studying in the first language achieved higher than students studying in the second language. Moreover, when exposed to questions of higher cognitive levels these students achieved better. Learning math and science in the first language might be a need for Lebanon to increase students' achievement and allow a fluent use of the second language in math and science at universities.

Demonstration in Euclidean Geometry

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Drawing out a model or a generalization in mathematic classes for cycle 3 – Grades 7, 8 and 9 – is one of the major difficulties the learners face. However, exposing the learners to excessive practice and training on strategies and demonstrations through analysis and intermediate hints can lead to appreciable improvement in the learners' abilities to solve mathematical problems which come to closure by carrying out a generalization. The aforementioned hypothesis was justified through conducting two examples on particular segments in a triangle in Grades 7, 8, and 9. Two theories support the approach of this action research. The theory of the Dutch educator - Pierre Marie Van Hiele - who divided the Geometry learning into 5 sequential or linear steps: visualization, analysis, informal deduction, deduction, and rigor. On the other hand, the theory of the French educator - Alain Kuzniak - who presented the Geometry learning as a back and forth navigation between three levels of Geometry specifying in each level the role of intuition, experience, deduction, kinds of spaces, status of drawing, and the privilege aspect.

A Tour in the Nervous System: Get set, get ready, and get on your nerves.

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Engaging students has to do with holding their attention and focusing them on their learning. One way to achieve this is to create an effective learning environment. Among the many challenges teachers face, often the most difficult is how to teach the nervous system. It's a complicated system that can be difficult to instruct. Research shows that high-school students find lots of difficulties understanding the nervous system after traditional instruction. For this, learning by doing, is common shorthand for the idea that active participation helps students to understand ideas or acquire skills, and establishes the principle of progressive education. Learning by doing expands upon the basic understanding of the nervous system through modeling, using ICT, reading and writing, etc. In this workshop, participants will be involved in a series of activities that enhances their reading abilities, manual skills, and critical thinking, in which they will acquire a better and easy understanding of the nervous system.

Making Thinking Visible

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Scientists follow a logical process to acquire and interpret data - the Scientific Method. They use hypotheses and theories to organize their data, and explanations to understand the natural world. In addition, scientists often resort to analogies and models to represent such abstract concepts. Effective science teachers also apply scientific method, analogies and models to help their students make sense of the information they are attempting to process. Effective analogies and models motivate students, clarify students' scientific thinking, help students overcome misconceptions, and enrich students with ways to visualize abstract concepts. Teachers took the role of "learner" by participating in hands-on activities and by applying scientific method, creating their own models and analogies; they moved from listeners at a conference to innovators in their classrooms, they became aware of the importance and usefulness of analogies, models, and scientific method to enhance student engagement when teaching science in elementary schools.

Improving Formative Assessment by Identifying and Addressing Students' "Misconceptions"

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Students come to science classrooms already holding their own ideas about natural phenomena that they have developed through every day experiences. Some of these ideas are at odds with accepted scientific views and persist with students if they are not addressed directly. The purpose of this workshop is to help participants identify students' science misconceptions and their sources and design lessons to address these misconceptions.

Introduction

Advances in developmental psychology and cognitive research have revolutionized the way educators think about teaching and learning science. Presently, science educators realize that students' brains are not empty vessels waiting to be filled with knowledge transmitted by the teacher. Rather, they believe that most people learn best through personal experience and by relating new information to what they already know. They also understand that learners need to construct their own scientific knowledge by actively taking control of their own learning. Specially, learners have to be able to identify and analyze problems, explore and test solutions in a variety of in-school and out-of school situations, conduct their own investigations, analyze and communicate their findings, and reflect on their learning in their attempts to rethink their explanations and retry experiments and re-evaluate problem solutions. Furthermore, students need to acquire the scientific and technological knowledge and develop the skills that will permit them to be productive and creative members of society and to develop attitudes that will help them to use their knowledge and skills responsibly when taking every day and professional decisions.

As a result of their attempts to make sense of everyday experiences and active pursuit of knowledge, students come to science classrooms already holding their own ideas about natural phenomena that they have developed through every day experiences. Some of these ideas are at odds with accepted scientific views and are referred to as "misconceptions" or "alternative conceptions". These misconceptions or alternative conceptions influence the quality of scientific knowledge students acquire as well as their ability to participate in solving science-related school and everyday problems. Consequently, it is important that teachers identify and address these "misconceptions" directly, because if not addressed they tend to persist for a very long time thus influence the quality of students science learning at all educational levels.

Strategy

The purpose of the interactive session was to provide teachers with methods that can be used to identify and address misconception in all biology, chemistry and physics with a focus on using these methods for formative assessment purposes. The strategy used in the session included involving participants in activities that introduce five methods that can be used to identify misconceptions followed by two strategies that can be used to address these misconceptions.

Identifying and Addressing Misconceptions: Main Ideas

1. *What are misconceptions*

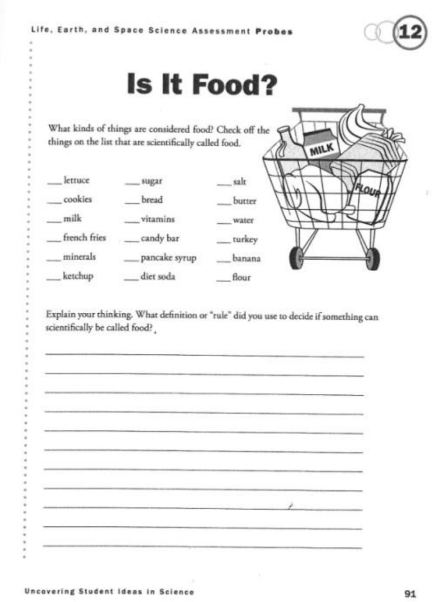
   a. Are at variance with conceptions held by experts in the field
      - Tend to be shared by many different individuals
   b. Are resistant to change by traditional teaching methods

2. ***Types of Misconceptions***
   a. Preconceived notions – popular conceptions rooted in everyday experience
   b. Nonscientific beliefs – views learned by students from sources other than scientific education
   c. Conceptual misunderstandings – faulty models constructed by students to deal with confusion about scientific concepts
   d. Vernacular misconceptions – arise from use of words that have one meaning in everyday life and another in scientific context (e.g., “work”, “burning” vs “force”)
   e. Factual misconceptions – falsities that are often learned at an early age and remain unchallenged.

3. ***General approach to dealing with misconceptions***
   a. Identify misconceptions
      i. Become familiar with common misconceptions (e.g., via websites, discussions with colleagues)
      ii. Administer a pre-test that is specifically designed to identify misconceptions
      iii. Pre-assessment instruments such as T-charts, surveys, interviews, initial concept maps
      iv. Cushioning/under-explaining – give a partial introduction to a concept and see where students take it
      v. Analyze student work (homework, tests, projects, …)
      vi. Other methods…
   b. Provide a forum for students to confront their misconception
      i. Misconceptions can be extremely difficult to eradicate and often are not changed by traditional teaching techniques. Thus there is a need to change teaching approach. For example
      ii. Involve students in activities that contradict their predictions
      iii. Have students work with physical models or computer models if available
      iv. Have students collect and analyze real data
      v. Conduct teacher-led demonstrations designed to expose misconception that address these misconceptions
      vi. Help students reconstruct and internalize new knowledge based on accurate scientific models
      vii. Use graphical models
   c. Use exams that are sensitive to students’ misconceptions
      i. Use misconceptions as options in multiple choice tests
      ii. Use misconceptions in statements of true-false questions
   d. Ask questions that require students to write their own ides (thinking type questions).

4. ***Specific strategies to identify misconceptions***
   a. Formative Assessment Probes are designed to search for commonly held ideas about fundamental science concepts that can develop early in a student’s education and persist all the

way through high school in not identified and targeted by specific teaching approaches.an



Life, Earth, and Space Science Assessment **Probes** 12

Is It Food?

What kinds of things are considered food? Check off the things on the list that are scientifically called food.

___ lettuce
___ cookies
___ milk
___ french fries
___ minerals
___ ketchup
___ sugar
___ bread
___ vitamins
___ candy bar
___ pancake syrup
___ diet soda
___ salt
___ butter
___ water
___ turkey
___ banana
___ flour

Explain your thinking. What definition or "rule" did you use to decide if something can scientifically be called food?

Uncovering Student Ideas in Science 91

example of a formative assessment probe is presented below:

b. Interviews about events and instances are conversations that a teacher or researcher has with one student focused by questions about situations represented in a diagram of series of diagrams regarding a science concept or number of concepts. An example of a diagram used in an interview about an event is presented below:

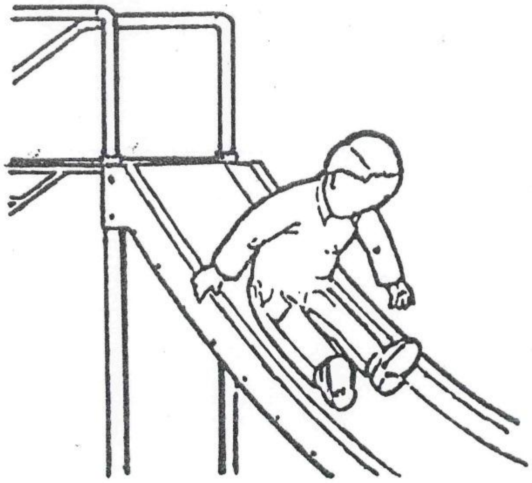


Figure 4.5: Drawing used by Stead and Osborne (1981) in interview about friction

Concept Cartoons

c. Concept Cartoons are cartoon-style drawings that put forward a range of viewpoints about an everyday event. Their features include: presentation of alternative ideas about a concept, including the scientifically acceptable stance; the use of visual images; minimal use of written language; and contexts that are familiar to children. An example of a concept cartoon is presented below:

Two-Tier questions are similar in format to traditional multiple choice questions but as the name suggests, they contain a second tier of questioning associated with the main question. The first tier of the question usually pertains to a knowledge statement with choices while the second element of the question facilitates the testing of the students learning beyond recall and into the higher levels of thinking. The distractors in the second tier are typically acquired form research on students' misconceptions. An example of a two-tier type question is presented below:

d.

Four oranges are squeezed to make six glasses of juice. How much juice can be made from six oranges? (Assume that all the oranges are the same size.)

1. 7 glasses
2. 8 glasses
3. 9 glasses
4. 10 glasses
5. none of the above.

<u>REASON</u>

1. The number of glasses compared to the number of oranges will always be in the ratio 3 to 2.
2. With more oranges, the differences will be less.
3. The difference in the number will always be two.
4. With four oranges the difference was 2. With six oranges the difference would be two more .
5. There is no way to predicting.

Strategies that can be used to address students' misconceptions

1. ***Predict observe explain***
    a. **Step 1: Predict**
        i. Ask the learners to write independently their prediction of what will happen.
        ii. Ask them what they think they will see and why they think this.
    b. **Step 2: Observe**
        i. Carry out the demonstration.
        ii. Allow time to focus on observation.
        iii. Ask learners to write down what they do observe.
    c. **Step 3: Explain**
        i. Ask learners to amend or add to their explanation to take account of the observation.
        ii. After learners have committed their explanations to paper, discuss their ideas together.
2. ***Teaching Science with Discrepant Events***
    a. A discrepant event is a science activity that can create cognitive dissonance in the mind of a learner.
    b. A discrepant event provides the learner with an opportunity to think critically in order to solve a problem
    c. There is an element of surprise in the science activity as the students are watching attentively
    d. A discrepant event motivates students to think beyond the obvious
    e. It helps children employ their prior knowledge in resolving the conflict.
    f. While actively engaged in exploring a discrepant event, students have an opportunity to utilize some or all of the science process skills.

Conclusion

Addressing students' misconceptions should be a central component of the teaching/learning process. Identifying misconceptions as part of the teaching process allows teachers to insure that students develop correct scientific knowledge rather than build this knowledge on incorrect ideas that persist throughout the students' lives. However, it is important that the identified misconceptions be considered as resources on which to base planning lessons rather than mistakes for which student are penalized.

--- Only Abstracts included for the following sessions ---

Hands-On and Minds-On Science Activities

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This workshop engaged teachers in hands-on activities that address science content at the elementary and intermediate levels. The activities discussed in relation to (a) how they target the science topics, and (b) how they engage students in hands-on, as well as minds-on experiences.

Science Command Terms in Action

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Command terms and action verbs used in science assessment have always been an issue of controversy among teachers and science coordinators and a main cause of mistakes in students' exams. This workshop sheds light on the action verbs that are most frequently used in science assessment, their meanings as well as interpretations in different science curricula (Lebanese, French Baccalaureate, GCSE etc). Session participants will be engaged in different activities that aim at clarifying the meaning of more than 50 action verbs used in exams and help them unpack science questions to find their most suitable answers. They will also practice evaluating already corrected tests and reconsider the mistakes pertaining to the misinterpretation of the action verbs used in these tests. A movie that summarizes science command terms will be projected at the end of the session.

كيفية بناء امتحان في مادة الفيزياء – كيفية تصحيح المفاهيم الخاطئة في مادة الفيزياء

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أن الهدف الأساسي من الورشة هو تزويد المشاركين بمهارات بناء الإختبار في مادة الفيزياء في الحلقة الثالثة و المرحلة الثانوية وخصوصا لصفوف الشهادات من خلال تدريبهم على خطوات بناء الإختبار, سيتم إجراء عصف ذهني لمعرفة المعلومات الأولية لدى المتدربين ومن بعدها مناقشة ، من قبل المدرب وسيتم التطرق خلال العرض الى شرح مستويات بلوم وأهميتها في وضع الإختبار بدءً من الكفايات الى الأهداف العامة والخاصة وعلاقتها بوضع أسئلة الأختبارات . تكليف المتدربين في مجموعاتهم بوضع إختبار بالمعايير التي سيتم التدريب عليها مع تطبيق لمستويات بلوم ووضع باريم مفصل باعتماد شبكة الأهداف مع عرض لرسوم بيانية تتضمن نتائج تحليلية لبعض الطلاب والطلب الى المتدربين إكتشاف الخطأ في هذا التقييم وسببه وكيفية معالجته .

How to Make Complex Science Simpler

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Conceptual science can be abstract for students of cycles III and IV. However, lecturing the knowledge and demonstrating the experiments cannot lead to real student-concept saturation. Participants in this hands-on workshop will be involved in a discussion of how to simplify complex ideas and to use some constructive strategies. These classical/innovated strategies were applied and gave great output due to our experience in Physics, chemistry and biology classes. Participants will be applying the achieved strategies using an available portable lab with a variety of equipment and apparatus. Participants will also have an opportunity to develop and share their own ideas for achieving the objectives in science classes.

Understanding Algebra through Investigation

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The development of algebraic reasoning is one of the many challenges that students encounter starting from the middle school and on. The unknown variable continues to be a mystery to students and in most cases, students tend to memorize a series of steps they should follow to answer specific models of questions. However, the main objective behind the development of algebraic thinking is not that students can follow a set of prescribed steps that answer a rote question, but rather to develop the reasoning that will allow the student to understand and analyze functions to model real life situations. For this reason, educators need to modify their approach to the teaching of algebra to include the development of pattern recognition and thinking algebraically about abstract situations. The meaning of algebraic thinking and what it entails in the classroom from activities and student experiences will be shared with participants. By the end of the workshop, participants will have a better idea on what kind of exploratory activities can enhance students' algebraic thinking that will endure throughout their learning.

The purpose of the workshop is to introduce teachers to learning activities that enhance algebraic thinking. Throughout the workshop, the participants will be playing the role of the students as they engage in different investigations that involve algebraic thinking. The participants will derive what aspects of the activity allow the development of algebraic reasoning.

The session is planned as follows:

a) **Introduction:** In the first part of the workshop, teachers will be asked the question: What are your memories of algebra? Answers will be discussed the participants will be given the technical definition upon which the proceedings of the workshop will be based.
(35 min)

b) **Description of the session:** the session will be organized as follows:

Part 1: Participants will take on the role of the students to complete the handshake activity. The participants will be asked to sit in groups and to shake hands with everyone in their group and count the number of handshakes. Using multiple representations, participants will be asked to determine the number of handshakes for n number people. This activity will be linked to the aspects of algebraic thinking introduced in the beginning. **20 min**

Part 2: Bridge activity. Participants will work in groups on the bridge activity in which they need to generalize the number of rods needed for a bridge of length l. Each group will choose a member to explain the strategy which was used and the generalization that was reached and then each generalization will be discussed and all the generalizations will be linked together. **15 min**

Part 3: participants will be given graphs that they need to match to a situation. The answers will be discussed and will be linked to the aspects of algebraic thinking introduced at the beginning. **(15 min)**

Break: Brain Teasers **(5 min)**

Using Patterns to Promote Students' Algebraic Reasoning

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Research has supported the use of pattern generalization to promote students' algebraic reasoning and enhance their understanding of core conceptual concepts including variable, change, equivalence and function. Therefore, the primary purpose of this development workshop was to equip math teachers with the knowledge and skills for using pattern generalization tasks to promote students' algebraic reasoning. For this purpose, math teachers were involved in an interactive session in which they solved different types of patterns. In addition, participating teachers discussed ways on how to effectively teach pattern generalization and how to incorporate patterns in their existing algebra lessons at various grade levels.

Introduction

The main purpose of this developmental workshop was to introduce teachers to the idea of using pattern generalization tasks (figural and numerical patterns and linear and non-linear patterns) to promote students' algebraic reasoning specifically in terms of the concepts of variable, change, equivalence and function.

Strategy

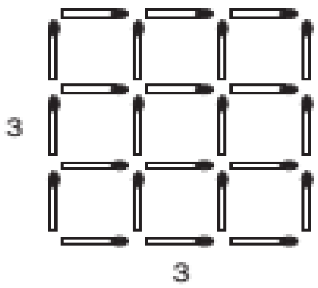
For the purpose of this workshop, participants were given different pattern tasks to solve individually and then discuss in pairs. Then, a whole class discussion ensued in which participants shared their various strategies and reflected on the relevance of patterns in algebraic reasoning.

Description of Session

1. *Introduction*: Presenters described the importance of algebraic reasoning in the Lebanese mathematics curriculum and introduced participants to the idea of using patterns to enhance students' algebraic reasoning. Participants were also shown different types and formats of patterns (i.e. figural vs numeric patterns and linear vs non-linear patterns).

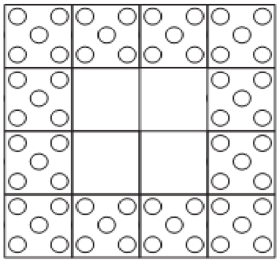
2. *Solving pattern tasks*:

   a. **Task 1: Matchstick Problem**



- Participants were given a handout with the “Matchstick Problem” and were asked to answer the following questions individually:
    - How many matchsticks are needed for an **n by n** square?
    - Describe how you obtained your answer. You may use figures and words.
    - What are the dimensions of a square that contains **180 matchsticks**?
    - Jamilah’s formula for the number of matchsticks in an n×n square is: **$4n^2-2n(n-1)$**. Is her formula correct? Why or why not?
    - As a teacher, what further questions would you ask about this pattern?
- Participants were then asked to discuss the answers to these questions in pairs.
- A whole class discussion occurred in which participants shared their solution strategies and reflected on how this particular task addresses algebraic reasoning.

b. Task 2: The Border Problem



- Participants were given a handout with the “Border Problem” and were asked to answer the following questions individually:
    - How many dotted squares are in the border of an **n by n** grid?
    - Describe how you obtained your answer. You many use figures and words.
    - What is the number of white squares for **176 dotted squares** located on the border?
    - Jamilah’s formula for the number of gray tiles is **4(n+2)-4**. Is her formula correct? Why or why not?
    - As a teacher, what further questions would you ask about this pattern?
- Participants were then asked to discuss the answers to these questions in pairs.
- A whole class discussion occurred in which participants shared their solution strategies and reflected on how this particular task addresses algebraic reasoning.

c. Task 3: Pattern Kingdom Problem

In the Pattern Kingdom, each city is connected to the other cities by a road. To make it simple for people to get around, there is a road connecting each city to any other city. For example, when the Pattern Kingdom only had four cities, there were six roads to connect them.

- Participants were given a handout with the “Border Problem” and were asked to answer the following questions individually
    - Is there a rule to find the number of roads for **n cities**? Explain your response.
    - What would be the number of cities if there were **190 roads**? Explain your response.

- Participants were then asked to discuss the answers to these questions in pairs.
- A whole class discussion occurred in which participants shared their solution strategies and reflected on how this particular task addresses algebraic reasoning.

3. *Summing up/Reflection:* Participants were asked to reflect on what they have learned in the workshop session and how they might integrate pattern tasks across different grade levels.

References

The following articles provide further reading on the topic of pattern generalization:

1. Bishop, J., Otto, A.D. & Lubinski, C.A. (2001).Promoting algebraic reasoning using students' thinking. *Mathematics Teaching in the Middle School, 6(9),* 508-514.
2. Lannin, J.K. (2003). Developing algebraic reasoning through generalization. *Mathematics Teaching in the Middle School, 8(7),* 342-348.
3. English, L.D. & Warren, A.W. (1998). Introducing the variable through pattern exploration. *The Mathematics Teacher, 91(2),* 166-170.
4. Rivera, D., Knott, L. & Evitts, T.A. (2007).Visualizing as a mathematical way of knowing: Understanding figural generalization. *The Mathematics Teacher*, *101(1),*69-75.
5. Blanton, M.L. & Kaput, J.J. (2003). Developing elementary teachers' "algebra eyes and ears". *Teaching Children Mathematics,10(2),*70-77.

The Integrative Situation: Why, What and How?

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Abstract

The Lebanese curriculum was renovated in 1997. An update of this curriculum was launched in 2008 for cycle one only. The main approach of this update depended mostly on competencies and terminal integration objectives. An integration situation is a new situation that students encounter after several learning sessions in which fragmented acquired knowledge have been attained. The aim of this integration situation is to integrate the objectives in a new form of harmonious knowledge. The integration situations are implemented as learning situations or as situations for evaluation. These problems are given to the students after 5 weeks of instruction. Each problem is usually accompanied with a checklist, an evaluation grid and a correction grid.

Introduction

Teachers usually have in mind a set of objectives to teach. These objectives are mainly knowledge centered and their approach is usually decontextualized. There is a need for a link between these objectives in order to make learning more meaningful. Roegiers, X. (2003) introduced an integrative situation that depends on competencies rather than objectives. It does not replace the ordinary teaching methods but it comes at the end of a series of instruction sessions as learning and evaluation situations.

Strategy

The strategy implemented in this workshop was a presentation about the integrative situation, its conditions and its significance in teaching followed by hands-on activities including integrative situations prepared by the presenter and solved by the participants. After each activity, an overall discussion was made, then, a correction grid for each situation was completed.

Description of the session

First Part

This part started with a presentation about the integrative situation , its implementation methods and conditions.

Definition of a competency: The development of **complex capacities** that enable students to think and act in various fields of activity.

In Short, it is

ACHIEVING **KNOWLEDGE** IN **ACTION**

Example of a competency: The student should be able **to solve problem situations** requiring knowledge of geometric objects, measurement and reproduction of figures **under certain constraints** (white paper, choice of instruments…) and certain reference (grid, dotted paper…) using an adequate vocabulary to describe and recognize figures.

Definition of an integrative situation: A set of **contextualized** information and data essential or not, **integrated** by the student, to perform a **complex task** whose product is not known in advance.

Characteristics of an integrative situation

- It is **pertinent**, it is strictly part of the family of situations of the competency.
- It is **complex**, it requires to articulate several resources. The complexity is likely to make the student reflect on the situation.
- It is **specific**, i.e. it uses specific resources .
- It is **disrupting**, the learner not knowing a priori what are the resources needed to solve the problem; this implies that it is new, in its context, in the presentation of its information and instructions.
- It is a **real life situation (if possible)**
- It is used after **4 to 5 weeks** of ordinary instruction.
- The output is concrete, i.e. that there is a production expected, clearly identifiable: a text, a solution to a problem, an art object.

Components of the integrative situation

- The **context** describes the environment in which the situation occurs.
- **Support** is the material presented to the learner related to the context: written text, illustration, photo,…
- **Set of instructions** which are explicitly given to the learner: Task, output.

Conditions of the set of instructions

- **Three independent** instructions
- **Minimal mastery** is attained when two out of three instructions are accomplished.
- **Maximal mastery** is attained when the three instructions are accomplished.

Criteria for evaluation

- **Comprehension**
- **Correct use of mathematical tools.**
- **Coherence (logical answers)**
- **Presentation of the copy** (Cleanliness, tidiness,…)

Example of an integrative situation

The Birthday Party

Nada invited 30 girls and 20 boys to her birthday party. She blew up 70 balloons from a bag containing 90 balloons.

Her mother used half of the components of this recipe to prepare the cake:

20 eggs	**14 cups of flour**	**18 cups of milk**

Instructions: Help Nada to:

- Find the number of chairs needed for the invitees.
- Find the number of eggs and cups of flour her Mom used to prepare the cake.
- Find the remaining number of balloons to be blown up.

Correction Grid

	Comprehension of the situation	**Correct use of mathematical tools**	**Coherence**	**Presentation**
Question 1	**Presence of calculation using the data given in the situation to calculate the number of needed chairs.**	**Correct use of addition of tens.**	**Presence of an answer between 40 and 60 .**	**• Readable handwriting.** **• Less than 3 scratches.**
Question2	**Presence of the number of eggs, and number of cups of flour .**	**Correct use of the half of a number.**	**Presence of answers between 5 and 12 (with a convenient unit).**	
Question3	**Presence of calculation to find the remaining number of balloons to inflate.**	**Correct use of subtraction of tens.**	**Presence of an answer (10, 20 or 30).**	
	3 pts	**3 pts**	**3 pts**	**1 pt**

Roles of the teacher and the student in the learning situation

Integrative Learning Situation		
Presentation (≈ 15 min)		
	Teacher	**Student**
	- Asks the student to observe the situation. - Reads or ask students to read the title. - Reads or asks students to read the context. - Makes sure students understand the illustrations. - Reads the instructions or ask students to read them in the aim of understanding the task at hand. - Explains few expressions of the situation without giving any clue to the answer. - Checks if students have understood the requested task by asking them to reformulate. - Writes on the board the characteristics of the expected outcome.	- **Identifies the elements in the title facilitating understanding and execution of the task.** - **Identifies the elements of the illustration.** - **Reformulates the elements of the task.** - **Reformulates the characteristics of the expected outcome.**

Task Execution (30 min)		
Second Step	Teacher	**Student**
	- Gives about 5 minutes for reflection. - Asks students to share ideas in subgroups (10 minutes) - Reminds them that the work that follows extends over 20 to 25 minutes and it is individual. - Moves among students to enhance what they produced and interfere for immediate correction. - Reminds them to pay attention to the characteristics of the product.	- **Reflects and makes a plan.** - **Shares ideas with peers.** - **Works individually.**

	Verification and remediation	
	Teacher	**Student**
Third Step	- After distributing the checklist, asks students to assess themselves. - Asks for collective correction. - Gives his or her judgment in regard to the conformity of the characteristics of the output. - Identifies the difficulties encountered by students and which require serious remediation. - Designs and prepares exercises for remediation.	- **Checks his or her work by referring to the indicators in the schedule.** - **Evaluates work of his or her peers.** - **Solves the remediation exercises if needed.**

Second Part – Hands-on Activities

Teachers were given variety of examples of integrative situations in which they played roles of students and then roles of teachers.

Third Part - Conclusion

In this part, a conclusion was made with the participants about the importance of integrative situations.

Conclusions approved by the participants.

- Teachers **reflect in-depth** on the learning difficulties of their students.
- **Evaluation criteria used are fairer** and provide better learning opportunities for the students, since they have three independent opportunities to resolve a situation and have to succeed in only two of them.
- Teachers can **produce** their own materials and will thereby become co-developers of the curriculum and not solely implementers.
- Teachers **feel at ease** using integrative learning situations in the classroom.
- **Students enjoy** working on integrative learning situations.

References

Roegiers, X. (2003). *Des situations pour intégrer les acquis scolaires*. De Boeck Supérieur.

Roegiers, X. (2007). Curricular reforms guide schools: but, where to?.*Prospects*, *37*(2), 155-186.

National Center of Educational Research and Development. (2008). *Project for Updating the General education Curricula: Mathematics Curriculum*. Lebanon: Ministry of Education and Higher Education.

Manipulatives: Bring Life to Intermediate Mathematics Classrooms

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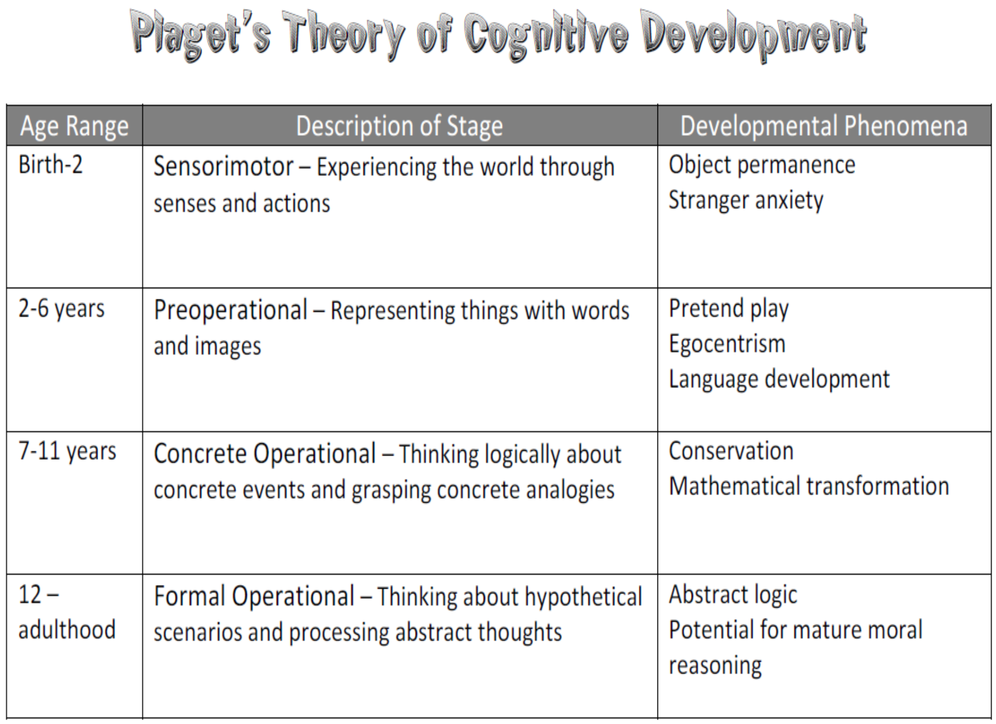
Manipulatives are concrete objects that can be used and moved by students. In mathematics classrooms, they have many applications in hands on activities that can involve students in learning, and can facilitate concrete understanding of abstract concepts. Intermediate level students sometimes feel that mathematics is difficult, boring, and irrelevant. Moreover, teachers put too much emphasis on books and examinations, and they underestimate the use of manipulatives. Participants in this workshop will discover the importance of using manipulatives in promoting better understanding of abstract in intermediate level mathematics, and in providing a lively active learning environment. Furthermore, they will be introduced to different kinds of manipulatives including commercial, low cost, or teacher constructed ones, and their possible uses in mathematics topics such as linear equations, directed numbers, area and volume, and others. Participants will be required to work in groups to try to design an activity using manipulatives in an effective way.

Introduction

Many students view mathematics content as abstract, and that studying mathematics is difficult. Using manipulatives can enhance learning by getting abstract ideas closer to comprehension. Manipulatives are concrete objects that students can touch, move, or rearrange (Kennedy, 1986). Their importance in the mathematics classroom lies in their ability to increase students' involvement, and facilitate their understanding of mathematical concepts. Manipulatives can promote greater conceptual understanding by providing a bridge from the concrete to the abstract (Piaget and Inhelder, 1969). Moreover, they allow students to explore ideas by acting on the material and participating in hands on activities. Although there are commercial manipulatives that can be purchased and are designed for different grade levels, but teachers can construct their own, or use accessible materials that do not cost too much money. Examples of manipulatives are: blocks, tangrams, fraction strips, dice, cards, interlocking cubes, number lines, beans, tiles, pattern blocks, and many others.

Piaget's theory of cognitive development supports the use of manipulatives. He proposed four stages for cognitive development that children go through in order to develop their cognitive abilities. The third stage emphasizes on the importance of concrete experience that can be the base for inductive reasoning and can be also a step for the fourth stage where the child can perform deductive reasoning and can reach abstractness (Bee & Boyd, 2010).

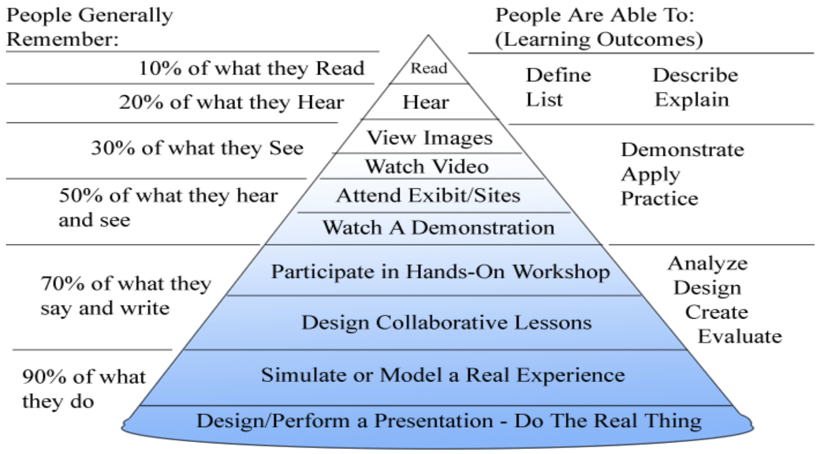


Piaget's Theory of Cognitive Development

Age Range	Description of Stage	Developmental Phenomena
Birth-2	Sensorimotor – Experiencing the world through senses and actions	Object permanence Stranger anxiety
2-6 years	Preoperational – Representing things with words and images	Pretend play Egocentrism Language development
7-11 years	Concrete Operational – Thinking logically about concrete events and grasping concrete analogies	Conservation Mathematical transformation
12 – adulthood	Formal Operational – Thinking about hypothetical scenarios and processing abstract thoughts	Abstract logic Potential for mature moral reasoning

(Retrieved from: http://discipleshipremix.com/wp-content/uploads/2011/11/2011-11-11_1410.png)

On the other hand, Edgar Dale during the 1960s theorized that students can retain more information when they 'do' and act on their own learning rather than from what they 'hear', 'read', or 'observe' (Andersen, H.). Dale's cone of experience clarifies that the more students' involvement in their own learning, the more they can remember what they have learned, and he put emphasis on the hands on activities and real experiences.



Dale's Cone of Experience

(Retrieved from: http://teacherworld.com/potdale.html)

Strategy

Bringing manipulatives to our classroom cannot do magic and does not solve all our problems, in fact, we need to know what manipulatives to use, when to use them, and how to efficiently integrate them in our teaching. "However, buying a box of manipulatives and allowing students free access is also not the answer. Promoting mathematics learning environments where students construct meaning requires major shifts in the sets, scripts, and roles of teachers and students." (Moyer & Jones, 2004). Therefore, it is important to introduce teachers to manipulatives that can be used in their classroom and help them to choose the best ones that matches their students' level, needs, and interests.

Teachers might wonder when to use manipulatives in their teaching. In fact, manipulatives can be used at different times and for different purposes, such as:

- To introduce a new math skill
- To explore new mathematics concept
- To solve problems
- To emphasize certain idea
- During free time

Although the use of manipulatives in our classrooms has many benefits, it also has some limitations. Follows we will present some of these benefits and limitations:

Benefits of Manipulatives:

- Active participation for students
- Hands on activities
- Student centered
- Emphasis on understanding and conceptualization
- Relate learning to real life
- Meets students needs
- Appeal to kinesthetic learners
- Help students verbalize their thinking
- Foster peer interaction
- Encourage cooperative work
- Decrease anxiety
- Fun and enjoyment
- Problem solving

Limitations of Manipulatives:

- Waste time (especially if it is not well planned)
- Distract some students
- Preparing manipulatives or classroom activities using them requires time and special talents
- Manipulatives are only appropriate for small children.
- Commercial manipulatives are expensive

To overcome the limitations, we have to discuss each one of them. Teachers always complain that they don't have time to use manipulatives in their classrooms. Although using manipulatives might require more time than direct teaching, this time is saved in learning. This means that the experience with manipulatives will provide students with better understanding and will help them create better mental structures. Another complain that is heard from teachers is that manipulatives distract students. This point can be true if the activity that the students will participate in while using manipulatives is not well structured. As it was mentioned earlier, manipulatives by itself cannot do the job, the important thing is how to integrate it in our teaching and how to manage our classroom. The teacher has the full control of making this activity fruitful and engaging for students. With respect to the issue that preparing manipulatives is difficult and need much talent, many manipulatives can be easily prepared and students can participate in their preparation and they can bring from their homes some simple items that can be used in class. It is a misconception that manipulatives are only appropriate for small children. It is important to be used with the development of any new concept in mathematics to help students to reach abstraction. In this paper we will present activities that can be used for intermediate level students using manipulatives to enhance their learning in different topics. The last point that we will discuss in this section is the cost of manipulatives. We do agree that commercial manipulatives can be expensive, but we encourage teachers to prepare their own that are related more to their objectives and to allow students to help them. Let us not forget that some manipulatives can be reused or shared. Moreover, we have to mention that with the advancement of technology and computer software applications these days, a bank of virtual manipulatives are available online and for free. Moyer, Bolyard, & Spikell (2002) described virtual manipulatives as: "They are visual images on the computer that are just like pictures in books, drawings on an overhead projector, sketches on a chalkboard, and so on. In addition, these dynamic visual representations can be manipulated in the same ways that a concrete manipulative can. Just as a student can slide, flip, and turn a concrete manipulative by hand, he or she can use a computer mouse to actually slide, flip, and turn the dynamic visual representation as if it were a three-dimensional object. This kind of visual representation is truly a virtual manipulative." Some of these applications were introduced to participants in this workshop.

Description of Session

During this workshop, students participated in many activities. They acted as if they were students of grade 7 or 8. Activity I was used as a warm up activity before starting the session. Participants were asked to work in groups. Each group was required to form two teams; Team A and Team B. Each group received the following: Number lines that were prepared by the presenter, Chips made of two different colors to represent the different teams, cards that have numbers that are either red or black. This activity took about 15 min, and the activity details were presented as follows:

Activity I.

Title: Addition of directed numbers

Audience: Grade 7

Prerequisites:

- Basic skills in addition and subtraction of positive numbers.

- General understanding of directed numbers.

- Ability to locate directed numbers on a number line, and to compare among them.

Material: Number line, Cards of two colors, small chips with two colors, worksheet

Kind: Introductory activity

Duration: 10- 15 minutes

Procedure:

- Divide the students into groups (preferable 4 student per group)
- Assign students into teams; Team A and Team B
- Place two chips, one for Team A and one for Team B at (0) on the number line.
- The two teams will take turns in picking cards and moving their chips a number of moves that must match the number that shows on the card, in a way that, if the card is black they move to the right, but if the card is red they move to the left.
- All movements must be recorded on the worksheet.
- ( ) + ( ) = ( ) (+ for black cards, and – for red cards)
- Students are encouraged to verbalize the moves while performing the activity using the terms plus or positive for the black cards, and minus or negative for the red cards.
- Students are encouraged to generalize and find a rule.

After this activity, an interactive discussion took place between the presenter and the participants to come out with a definition for the word manipulatives, and to analyze why teachers decide to use or not to use manipulatives in their mathematics classrooms. These discussions lead us to specify the advantages and limitation of using manipulatives in the classroom. Participants for another time took the turn of intermediate school students and worked on activity II for about 15 minutes that can enhance their understanding of the area concept.

Activity II

Title: Area of trapezoid

Audience: Grade 8

Prerequisites: Students must know from before how to

- find the area of rectangle
- define a trapezoid, and know its properties
- draw the median segment of a trapezoid and find its length with respect to the bases
- draw congruent figures

Materials: Card board- scissors- pencil- ruler

Duration: 15 minutes

Procedure:

- On the card board draw two congruent trapezoids with any dimensions.

- Cut these trapezoids
- Make sure that they are congruent
- Draw the median segment (segment joining the midpoint of the two legs)
- Measure the given segments and fill in the following (in cm):

  First Base: _______
  Second base: ________
  Median segment: _______
  Height: ________
- You can use one or two of the trapezoids to cut and paste their parts to make a rectangle. (you have to use all parts of the trapezoids)

- Find the area of the rectangle using the measures that you have.

- Make use of this value to find the area of the trapezoid.

- Make a rule. Area of trapezoid =___________________

Some other activities that require the use of available manipulatives and can enhance students understanding of different mathematical concepts were introduced afterwards. Some of these activities are:

- Cut a cardboard into triangles and squares of specific measures and use them as puzzle pieces to demonstrate Pythagoras theorem.
- Make a grid of foam using pins and rubbers to illustrate geometrical shapes, and their properties, axis of symmetry, or vectors and translation.
- Use a balance and small cubes or marbles to introduce the concept of equality and equations.

After this participants were introduced to some virtual manipulatives and the way they can be used was demonstrated in front of them. As a final work, participants were required to plan their own activity with manipulatives by specifying its objectives, the targeted audiences, the material required, prerequisite skills, and its duration. These activities were discussed and their importance was emphasized.

Conclusion

Manipulatives are material that students can use and act on to try to represent abstract mathematical ideas in concrete way. They can facilitate students' construction of mathematical concepts in an active and engaging atmosphere. Teachers must believe that their use is important in their classrooms. They can choose among available ones or prepare ones that can cost less and are directly related to their learning objectives. The option of using virtual manipulatives must also be considered since it is easily accessible.

References

Anderson, H. Dale's Cone of Experience. Retrieved from:
https://www.etsu.edu/uged/etsu1000/documents/Dales_Cone_of_Experience.pdf
Bee, H. & Boyd, D. (2010). The Developing Child, Twefth Edition. Boston, MA: Pearson Education.
Kennedy, L. (1986). A Rationale. Arithmatic Teacher, 33(6), 6-7.
Moyer, P.& Jones, M. . (2004). Controlling Choice: Teachers, Students, and Manipulatives in Mathematics Classrooms. School Science and Mathematics, 104 (1), 16-31.
Moyer, P., Bolyard, J., Spikell, M. . (2002). What are virtual manipulatives? Teaching Children Mathematics, 8 (6), ISSN1073-5836, 372.
Piaget, J. & Inhelder, B. . (1969). The Psychology of the Child. New York: Basic Books.

Related Websites

- *National Library of Virtual Manipulatives*

http://nlvm.usu.edu/en/nav/vlibrary.html
It includes many applications, for example:
- *to solve simple linear equations:*

http://nlvm.usu.edu/en/nav/frames_asid_189_g_4_t_2.html?open=activities&from=category_g_4_t_2.html
- *To multiplying binomials:*

http://nlvm.usu.edu/en/nav/frames_asid_189_g_4_t_2.html?open=activities&from=category_g_4_t_2.html
- *Virtual manipulatives Glenco*

www.glencoe.com/sites/common_assets/.../VMF-Interface.html

Teaching Probability for the Intermediate Classes

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Teaching probability has been always a headache for secondary teachers. Especially when they start with permutations and combinations and other abstract symbols from set theory; topics that are not fully mastered in intermediate levels.

Keeping in mind that probability is initiated in American schools at grade 7 where as in Lebanese schools it starts at grade 11, this workshop aims at urging the ministry of education to make the necessary changes regarding this important topic in Math and at which level it should be started.

Through our years of experience in teaching intermediate and secondary levels, we have adopted simple techniques to teach probability in the intermediate levels. Techniques that involve only simple number formats (fraction, decimal, percent) and the basic operations in mathematics (addition, subtraction, multiplication and division): no factorials, no permutations and no combinations.

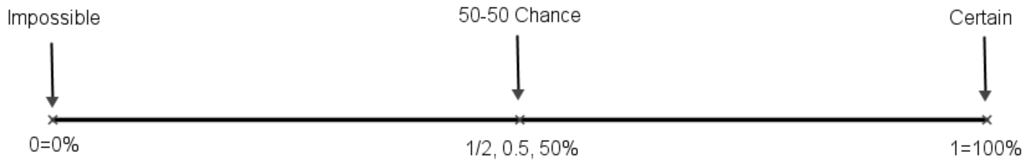
If these techniques are adopted and well taught in the intermediate levels, they will make the understanding of probability in the secondary levels as simple as any other topic in mathematics.

Synopsis:

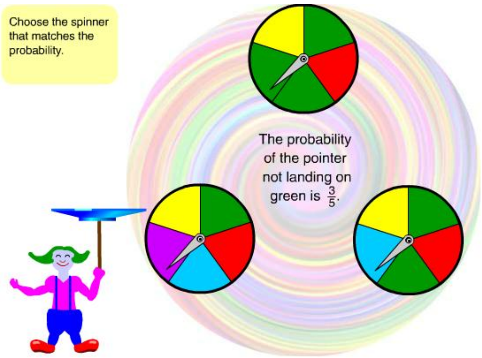
Our teaching techniques will be presented in this workshop from ground up together with several activities, games, presentations and interactive simulators to make teaching of probability a simple task for both students and teachers as well.

The session will start by discussing the concept of chance in real life. Questions like "What are the chances of getting …?" or "What are the chances of having …?" will be presented and shared with the audience then answers will be compared with the real ones. (10 min)

After that, there will be short reminder of the number formats (fraction, decimal and percent) that will be used to measure chance or probability. A probability scale will be drawn and different measurements of chance will be dropped on this scale for comparison. (10 min)

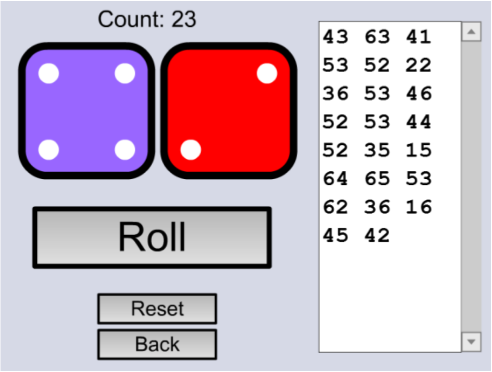


Next, there will be animations and slides showing the difference between theoretical and experimental probabilities. Several games of chance will be played using computer simulators and results will be discussed with the audience (Lottery – Cards – Dice – Coins – Spinners – Urns and balls). (20 min).



Choose the spinner that matches the probability.

The probability of the pointer not landing on green is $\frac{3}{5}$.



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43 63 41
53 52 22
36 53 46
52 53 44
52 35 15
64 65 53
62 36 16
45 42
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The remaining time of the session will be used to show the simple techniques that will be used to calculate probabilities in intermediate classes.

Sample spaces and different types of events as well as Venn diagrams will be introduced and dealt with through several examples. (10 min).

Rules for calculating probabilities of events involving the words like AND, OR, NOT will be presented with examples and demonstration slides. (10 min).

Compatible and incompatible events as well as dependent and independent events will be defined and the addition and multiplication rules of calculating probabilities will be verified with several examples. (10 min).

Constructing frequency tables and tree diagrams to calculate probabilities in a faster way will be drawn and compared to other methods of calculating probabilities. (10 min).

Conditional probabilities will be defined and different methods of calculating them will be presented with examples. (10 min).

Finally, a summary slide of all the rules discussed will be presented as a conclusion of the whole session. (10 min).

References: All animations programming and slides are prepared by Bassam Itani.

Developing Math/Science Understanding and Writing Go Hand in Hand in Early Years Inquiry

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Authentic inquiry into mathematics and science is an ideal context for furthering children's capabilities for representing their ideas and observations in writing. Authentic inquiry here refers to investigation that arises naturally from the interests and questions of the children as they experience the learning environment. Several authentic examples were presented from the work of four- to six-year-old children in the domains of mathematics and science to illustrate how these domains need to be viewed as intertwined with literacy development at the preschool level. Reflections were also offered on the role of the learning environment, the role of curriculum and the role of teachers and other adults in the learning process. With the addition of some examples from children's work in science, this plenary address built on a recently published article (2013): Making sense of experience in preschool: Children's encounters with numeracy and literacy through inquiry in the *South African Journal of Childhood Education* 3(2).

Introduction

At the outset of the plenary address the following core beliefs were offered in order to establish my point of view clearly:

- Young children are competent learners when they enter school.
- The learning environment is a crucial teacher.
- Children naturally use mathematic and scientific knowledge as the "decode" and make sense of the world.
- Uncertainty is not an enemy—it is what propels learning forward.

The audience was then invited to reflect on images of students and student work with the question in mind: Is it language or is it math (or science)? The intention was for audience members to reflect on the idea that mathematics, science and language are not simply school subjects, but they are crucial tools we use to make sense of our experience and the world around us—that is true for both children and adults.

Language occupies a special place in learning and making sense due to at least three important reasons:

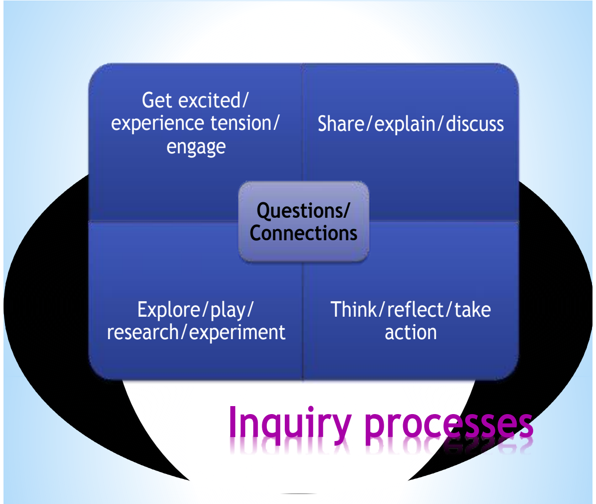
* Whether internalized or external, it is a powerful tool for organizing thought and building an identity as a learner.

* Reveals prior understanding and experience, which informs the design of the learning environment.

* Allows for listening, sharing ideas, negotiation, receiving feedback, and building on others' ideas.

Furthermore as part of meaningful learning processes, children need to engage in in-depth investigations of phenomena around them worthy of their knowledge and understanding," (Katz, 2010). Katz advocates for developing standards in early years education, not for content, but for defining the kinds of experiences children should be having in school. Inquiry-based learning is an ideal approach for engaging children in the kinds of in-depth learning journeys that Katz is talking about.

When we talk about inquiry, what are we talking about? There are many different models of inquiry teaching and learning in the ethos of the education world, but all of them—if taken seriously as authentic processes—begin with real questions, and also require a fundamental rethinking of the respective roles of teachers and students in the formal learning environment. The following diagram illustrates one way of thinking about inquiry learning. I deliberately chose not to represent it as a circular step-by-step process because in reality can be messy and the various components can happen in different orders and can be revisited over and over throughout the inquiry process.



When we look at the respective roles of students and teachers we can see that both are cast in the role of inquirers, but teachers are not only inquiring with students into their authentic questions, they are also inquiring into what is being learned by students through the inquiry process. Thus *research* actually becomes a fundamental teaching function.

Role of Students in Inquiry	**Role of Teachers in Inquiry**
* Interact with others, explore real objects	* Set up inviting, interesting environment for students to interact with
* Pursue interests and questions through self-directed exploration of environment	* Observe, ask/provoke, listen, document what students do and say
* Interpret experience, make predictions, try things out, decide what to do next	* Interpret, make inferences, hypotheses and predictions about what students are learning
* Use growing understandings across contexts, new interactions, and in pursuit of new explorations	* Decide what to do next, reset environment as needed to scaffold further learning

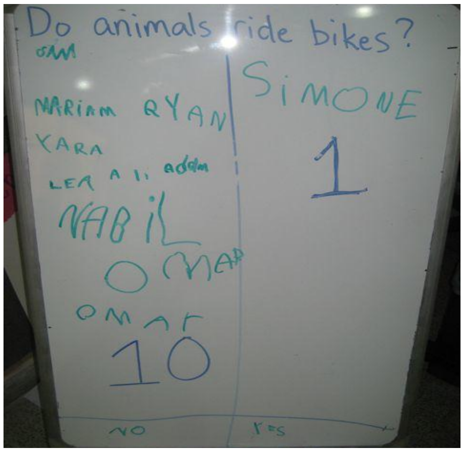
Examples of Intertwining Science, Mathematics and Literacy from classrooms of 3-5 year olds

Many examples of student-led investigations and writing produced during inquiry mainly from Lebanese preschool classrooms were shared with the audience. Some of the examples were drawn from Henningsen (2013), but there also additional examples added in order to illustrate the many opportunities for developing writing in the context of mathematics and science, even with very young children.

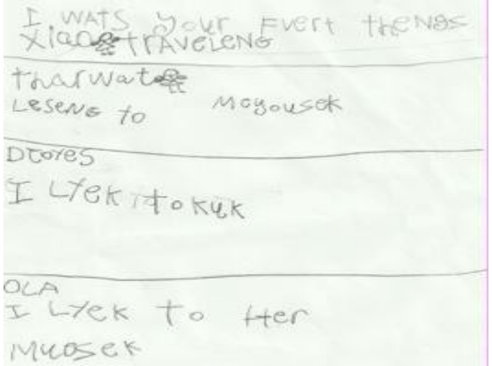
Examples shared included stories of extensive student-led inquiry investigations in which children were invited to track and record their thinking or answer questions with data, writing math stories, science notebooks, field notes and lab reports, writing letters of request, chalk talk and graffiti walls. We also looked at examples of pre-literate drawings in order to illustrate the wealth of information they often contain about children's thinking and how they are making sense of their experience and their environment. Also, we saw examples in which children were asked to "tell the story of their drawings" and it was clear that they were naturally using numbers and math concepts in their stories. Here are two such examples of stories with numbers or number concepts integrated:

I can make a telephone with numbers on it. I'm going to call teta Huda. It's 01/866536. I'm going to call her and tell her to eat because she's hungry. I'll tell her to eat carrots because she loves carrots. They're her favorite	عملت غيوم وحامض. الحامضة طلعت على الشّجرة. وفي على الشّجرة تفّاح. في كتير، في مليون، وتريليون، وinfinity. بتعرفي شو يعني gazillion؟ يعني بتعدي للميّة، وبتزيدي ميّة وبتضلك تزيدي ميّة وميّة وميّة! -ياسمينة

We also talked about writing opportunities can easily be created in many common lesson situations that might not typically require children to write. For example, in one class children were collecting data about whether or not kids in their class thought animals can ride bicycles. One way to orchestrate that might be to do a simple tally counting up the yes and no votes, but in this class the teacher turned it into a writing opportunity by simply asking children to write their names in the column of their choice as shown below, followed by counting up the results and recording a summary of the number of votes on each side:



Below is another example that turned a math survey data collection activity into a writing opportunity by asking children to record their data initially in words before mathematizing it. Children were asking teachers around the school what they like to do on their free time:



I WATS your Evert theNgs

Xiao tRAVeLeNG

tharwat

LeSeNG to Mcyousek

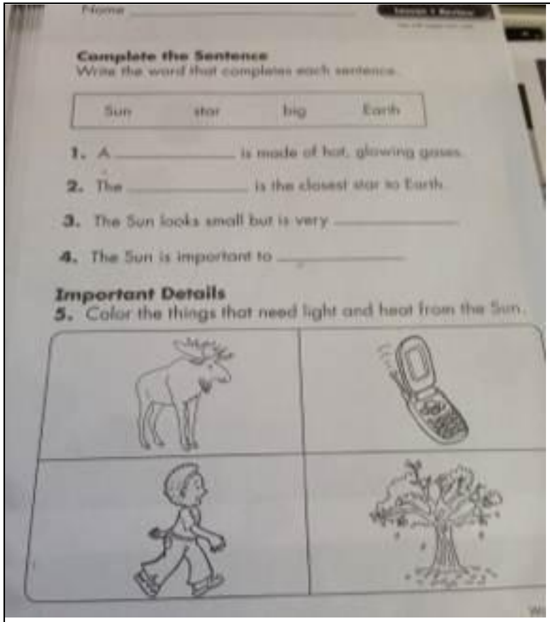
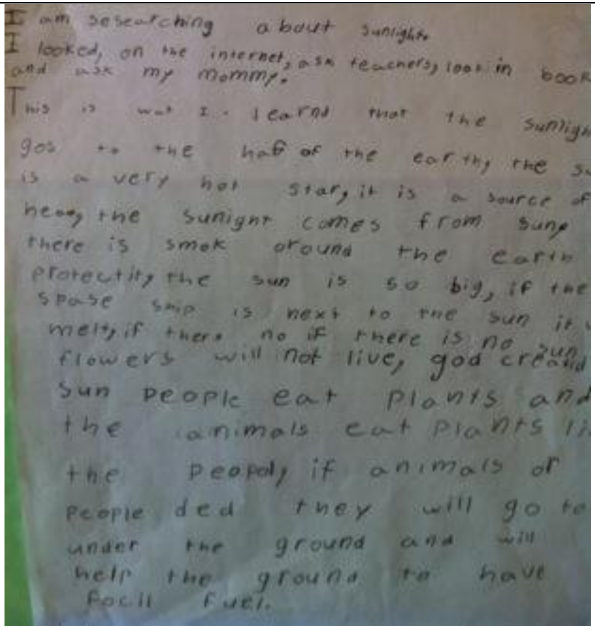
Dtores

I Lyek to kuk

OLA

I Lyek to Her Muosek

One extended example we looked at highlighted the difference in what children could be asked to produce if asked fill out a typical worksheet vs. asking them to do their own research and summarize their findings. This example shows on the left-hand column a worksheet taken from a well-known Grade 1 science textbook that children might complete after reading a text passage about the sun. The right-hand column shows a written summer produced by a Grade 1 child who was given the personal research task instead:

 Name Complete the Sentence Write the word that completes each sentence. Sun star big Earth 1. A ____ is made of hot, glowing gases. 2. The ____ is the closest star to Earth. 3. The Sun looks small but is very ____ 4. The Sun is important to ____ Important Details 5. Color the things that need light and heat from the Sun.	 I am sesearching a bout sunlight. I looked, on the internet, ask teachers, look in book and ask my mommy. This is wat I learnd that the sunligh gos to the haf of the earth, the s is a very hot star, it is a source of heat, the sunignt comes from sun, there is smok around the earth protectity the sun is so big, if the spase ship is next to the sun it melt, if there no if there is no sun flowers will not live, god creatid sun people eat plants and the animals eat plants li the peopoly if animals or people ded they will go to under the ground and will help the ground to have focil fuel.

In addition to engaging the child in personal inquiry and broadening the information about the sun that the child could encounter, the more open research and writing task clearly offers many more opportunities for the teacher to work with the child on writing mechanics, spelling and organization of text.

Conclusion

The talk concluded by addressing the fundamental role of the teacher in this kind of learning environment as multi-faceted:

- * Data Collector
- * Data Organizer
- * Pattern hunter
- * Documenter
- * Interpreter
- * Experimenter
- * Designer

The importance of the documenter role cannot be underestimated because it forms the basis for interpreting children's learning and this process of trying to understand and make sense of what is being learned is an essential site for learning for the teacher. I also emphasized the importance of the teacher believing firmly in the competence of the children as learners in order for this type of learning environment to develop and reach its potential.

Selected References

Edwards, C., Gandini, L., & Forman, G. (2012). The hundred languages of children: The Reggio Emilia experience in transformation. Oxford, England: Praeger

Gronlund, G. (2010). Developmentally appropriate play. St. Paul, MN: Redleaf Press

Henningsen, M. (2013). Making sense of experience in preschool: Children's encounters with numeracy and literacy through inquiry in the South African Journal of Childhood Education 3(2).

Henningsen, M. (2012) TEDxBeirut: https://www.youtube.com/watch?v=CQnxfxvtALw

Katz, L. (2010). STEM in the early years. Collected papers from the SEED conference. http://ecrp.uiuc.edu/beyond/seed/katz.html

Lindfors, J.W. (1999). Children's inquiry. New York: Teachers College Press

Scheinfeld, D.R., Haight, K.M., & Scheinfeld, S.J. (2008). We are all explorers: Learning teaching with Reggio principles in urban settings. New York: Teachers College Press

--- Only Abstracts included for the following sessions ---

Introducing GeoGebra 4.4

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GeoGebra is a free math software (been used for more than 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 i.e. you can write the expression of a function see its graph and get coordinates of some of its points in the spreadsheet or put some points on spreadsheet and get their graph. In this workshop, we will try to introduce most of the GeoGebra 4.4 features by actively applying some activities. Our activities will cover mainly intermediate as well as secondary levels but elementary math teachers may also attend.

Teaching & Assessing derivative using GeoGebra 4.4

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Since GeoGebra is becoming number 1 free math software all over the world and teaching derivatives is one of the corner stones in teaching calculus, we have chosen to share this workshop with secondary math teachers. We believe that to teach derivative at the procedure level a teacher does not need more than a simple board and a set of practice worksheets, but in order to teach derivative at the concept level teachers need an interactive tool that combines the algebraic to the graphical representation of the derivative number and the derivative function. In this workshop, we will use the GeoGebra software to go deep in this topic.

Scientific thinking matters in the early years and children can do it!

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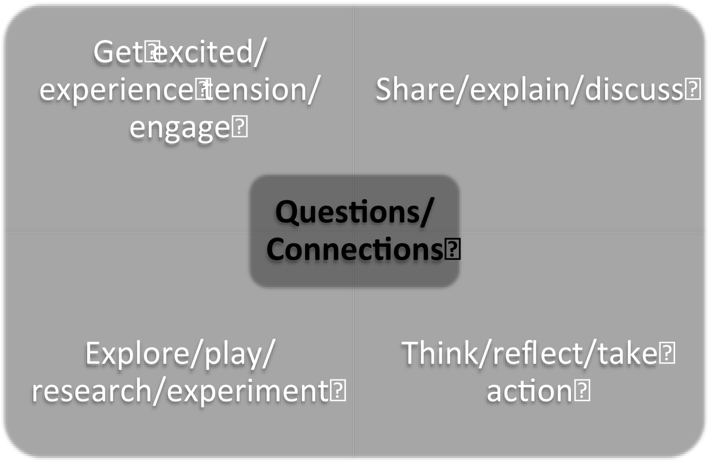
In this development workshop, participants engaged with real examples of young children (age 3-6) demonstrating complex scientific thinking. Real examples were shared through a TED talk and through student work artifacts from inquiry-based Lebanese and non-Lebanese classrooms. Participants analyzed and discuss artifacts from the real examples, and discussed and shared strategies for opening up more opportunities in the classroom for younger children to explore scientific concepts without shying away from complexity.

Introduction

The primary purpose of this session was to share and analyze vivid examples from classrooms serving children aged 3-6 years old in order to illuminate the capabilities of young children to engage with big scientific concepts using science-relevant ways of knowing, such as formulating conjectures and testing them. An additional aim was to inspire participants to open up more opportunities in the classroom for younger children to explore scientific concepts without shying away from complexity.

Strategy and Activities

We began with a discussion of the usefulness of an inquiry-based approach when engaging young children in doing science because children need “to engage with in-depth investigations of phenomena around them worthy of their knowledge and understanding,” (Katz, 2010). We emphasized that inquiry is an intellectual pursuit and also a way of taking action. So ideally the learner engages in inquiry for his/her own purposes. Katz also advocated for the importance of worrying more about “standards of experience” than content standards when designing early years education. The following diagram was presented in order clarify what is meant by meaningful inquiry processes.



Inquiry processes

We made a connection to the work of Legare (2012) that explanation is a strong vehicle for generating hypotheses while exploration serves as a mechanism for testing hypotheses. To further elaborate and make this idea more concrete, we watched and discussed the TED talk by Alison Gopnik: *What do babies think?* Participants shared what intrigued them about the work shared by Gopnik in the talk and also anything that surprised them.

Next we delved into a series of concrete examples from Lebanese classrooms. The first example was a learning story account compiled by teachers of a class of 3-year olds to document their investigations during a unit on Living Things. The learning story shared the events of a particular day when the children became very interested in snails found outside on their school campus. The second example was an excerpt from a documentation of 5 year olds' learning about "unseen forces." The specific example shared contained transcripts of children's conversations about the question of "why balloons stick to our hair." Participants were given an annotated version of the transcript that tracked and pointed out the various hypotheses children were generating, the ways they were testing them and building on one another's work, as well as significant language and ideas being used by the children in the transcript. The purpose was to highlight how such a transcript can be used to assess student understanding and capacities for scientific thinking and activity and just how much significant learning is going on in such an activity! The third example shared was another set of transcripts from a class of 4-year olds and their discussion of reflection and symmetry. In this activity participants were invited to discuss the transcripts in their groups and annotate the transcripts according to their own noticings.

Conclusion

We concluded the session by having participants share their insights from the session with one another. One of the main issues discussed was the importance of learning to read artifacts from children's work and the fact that it is a kind of literacy itself to be able to understand what the artifacts tell us about children's thinking and learning. We looked at a comparison of three children's drawings of their own shadows and discussed what we could learn about the children's scientific ideas regarding light and shadows. Finally we also looked at a photograph of a toddler obviously intrigued with her own shadow, driving home the point that children are always naturally engaging with their environment scientifically, even from infancy.

References

Gopnik, A. (2011) http://www.ted.com/talks/alison_gopnik_what_do_babies_think

Katz, L. (2010). STEM in the early years. Collected papers from the SEED conference. http://ecrp.uiuc.edu/beyond/seed/katz.html

Legare, C. (2012). Exploring explanation: Explaining inconsistent evidence informs exploratory, hypothesis-testing behavior in young children. *Child Development, 83,* 173–185.

--- Only Abstracts included for the following sessions ---

Using Debate in Science Classes

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Debates are a great tool for engaging students and livening up classroom curriculum. Using debates in the classroom can build the abstract thinking, clarity, organization, media literacy, teamwork, persuasion, as well as the research, critical thinking, note-taking, public speaking and evaluation skills of students. Participants in this session shall learn, through a wide range of activities and role-playing, the format, the principles, and the rules of a successful debate. They will watch a movie that shows a real debate between students in a classroom. They will then be assigned into teams (proposition/affirmative, and opposition/ negative teams, judges) and will be asked to choose a science topic that they will debate by argumentation, refutation, note-taking, and heckling. The debate will be evaluated by the assigned judges and a winning team will be announced. Participants will realize how difficult science concepts can be made easy when debated.

Professional Development Redefined

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Making sure that professional development is both *professional* and *development* is not an easy task. The rapid pace of globalization, the shift from an industrial to a knowledge economy, the era of accountability, and the explosion of networked communications and social networking, have all created the need to work and interact in new ways and to gain fluency in new tools and paradigms. 21st century educators need to expand their skills and dispositions in order to ensure that 21st century learning takes place in the classrooms. This requires the revision of our current professional development practices and the integration of new tools that facilitates learning. Sustaining school improvement through professional development is another challenge that needs to be addressed. A technology integrated professional development model will be demonstrated with action tools and real life examples.

Creative Thinking

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A kindergarten teacher was watching a little boy drawing, she was confused by what she saw, and so she asked the boy about the drawing, he said I am drawing God. Surprised by the answer she asked:" how can you draw God? No one knows what God looks like!" The kid answered:" give me one minute and I'll show you". All children are creative, they love to explore and learn. Our job as educators is to nurture that creativity and allow it to grow throughout the years and not suppress it. Students are graduating with more knowledge but with less creativity. This session is about a whole view of creativity; creative thinking is something that can be taught. During the session we are going to explain terms of creativity, and where does intelligence stand. We will learn about creative style and give a test to participants so each can identify his own. We will explore the process of creative thinking including divergent and convergent thinking and how does creative style affects all that, and then relate it to the scientific method. During the session we will learn how all that affects the students and their way of thinking, and how the creative thinking process can be applied whether in math, science or any group work activity…

Finally we will provide two strategies on how to generate creative ideas that can be used easily in a classroom.

Innovative Idea Sessions - Mathematics

--- Only abstracts included for the following sessions:

Memorizing or Subitizing!

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The primary purpose of this session is to increase participants' understanding of subitizing, or how to develop the students' instant recognition and manipulation of numbers. This skill comes in hand in elementary mathematics classrooms as well as in their real lives. Participants will take on the role of the learner during the session by actually applying a number of subitizing activities in manipulating operations and solving problems. The activities will include concrete materials that can be easily applied in any elementary math classroom such as finger patterns, ten frames, dominoes patterns, rekenrek, math rack…

Exploring New Vision in Teaching Math via Interactive Smart Board

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Activinspire is a software that transforms traditional, lecture-based classrooms into learning environments infused with imaginative, interactive experiences that captivate students' attention. The software helps teachers bring math lessons to life with rich and powerful activities that increase students' motivation and enhance their learning. Session participants will be introduced to the main features of Activinspire through which they will learn the basic skills required to create simple, interactive math activities**.** Moreover, participants will be provided with plenty of resources and useful websites to help them learn and improve their teaching skills. Examples and creative ways for incorporating the Activinspire program in current classroom practices will be also shared with session participants.

Teaching Statistics to Secondary Students

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Statistics involves using data in the form of numbers and graphs to describe our world. However, doing statistics is, in fact, different than doing mathematics. Statistical literacy is needed by all students. For the purpose of enhancing a higher quality teaching approach in mathematics classes of secondary divisions, it is necessary to take into consideration real life data figures in the approach of teaching statistics. General principles of doing statistics and the meanings of statistical measures will be discussed collaboratively with the participants based on real life data records, from which they will be exploring the meaning of each statistical indicator. In addition, session participants will have the opportunity to share their own experiences with secondary students for the purpose of improving their teaching skills.

الأنشطة الإثرائية وألعاب التفكير في زيادة تحصيل الطلاب (أنشطة تطبيقية)

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تعتبرالأنشطة الإثرائية و ألعاب الذكاء من الوسائل الهامة في تنمية جوانب التفكير المختلفة .. فهناك أنشطة إثرائية و ألعاب تفكير لتنمية مهارة التخطيط و تنمية القدرة على التفكير في عدة مراحل مستقبلية و القدرة على دراسة البدائل المتاحة و الحلول المختلفة و اختيار أكثرها فائدة أو أقلها ضرراً و تأثيراً ... وهناك أنشطة إثرائية أخرى لتنمية روح التحدي و الصبر واعتياد الأفراد على أن التفكير في آلية الحل هو الأسلوب الأمثل للوصول إلى الحل الصحيح بدلاً من كثرة المحاولات ورغم أن بعض المعلمين يستخدمون الألعاب كجزء من وسائلهم واستراتيجياتهم في التدريس، إلا أن معظم الألعاب التي يستخدمونها لا تحقق أقصى فوائدها في زيادة التحصيل الدراسي للطالب من هنا كانت الفكرة في تنشيط تفكير الدماغ للأولاد من خلال استهداف تفكيرهم بشكل مباشر عبر ألعاب الذكاء و الأنشطة الإثرائية التي أظهرت الدراسات بأنها تزيد 20% على تحصيل التلاميذ .إن الهدف من هذه الورشة تعريف المعلمين بالألعاب التي تمرن عقل الطالب و تدريبه عليها لإكتساب مهارات التفكير وسيتم عرض بعض نماذج ألعاب التفكير والأنشطة الإثرائية والتدرب عليها خلال الورشة وأهم أهدافها وكيفية تطبيقها ضمن الحصص التعليمية

Math Is Language Too: Talking and Writing in the Mathematics Classroom

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Engaging learners in the excitement of language and teaching them to be more risk-takers in the integration is the workshop’s aim. There are wonderful teaching strategies that excite learners and foster understanding. In addition, session participants will realize that children's literature plays an important role in confirming the notion that math is more than computation on paper and provides opportunities for learners to develop the language of math. Thus, attendees will be looking towards math with new perspective. During the workshop, participants will enjoy various innovative activities taking on the role of the learner in some situation.

Acting-out Mathematics

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One of the most important challenges for teachers in teaching mathematics today is to reach all of students in their classrooms. This can be done if the teacher takes into consideration the different students’ backgrounds and abilities when introducing a new lesson. Differentiation leads to the instructions that meet every student’s needs. Nothing is better than theater to be used as a tool that proves how different people are and how unique their needs are. Through a variety of funny activities participants will get introduced to differentiated instruction, will discuss the importance of its usage in classrooms, and will realize that it provides a deep understanding of math skills

Innovative Idea Sessions - Science

Science Snacks

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No matter how often our students have contact with the world around them, a lot of things stay mysterious. This makes their curiosity limitless, and the need to know is imperative. “Why?” is a common question that you always hear from students. Everything must be experienced to be learned – being told does not suffice. Based on the above conception, the teacher has to be a story-teller, a designer, an artist, and possibly a cook. The key to success is to expose children to as wide a variety of tools and experiences as possible; consequently, the lighter, simpler and closer to the children these experiences are, the more successful their tasks become. Make your period look, smell and taste attractive; all you need is visual aid, hands-on experiments and some music to lighten things up. To our fortune, science, art and music are in complete harmony, allowing us to create small “snacks” that trigger our students’ appetite to discovery and refresh their power and talents. Thus, how can you cook a successful class? This workshop will lead you to use pictures, mind games, music, experiments, and much more to keep your students captivated and fully involved in the center of learning.

Using ice to remove bubble gum from a T-shirt

Introduction :

The best thing that we had for our workshop session that it came right after lunch, what made it seem like a real snack. We started off saying that we wanted to share all the little additives that we use in our science sessions, we are all teachers with lots of experiences on how to add up snacks when needed. We added that were there to have fun and enjoy a sunny day before anything.

Elephant toothpaste

1- **The strategies that we used :**

The session was very interactive, focusing on the swift alternation between different teaching techniques widely used in science classes, including visual aid, music and experiments.We kept pushing the audience to talk, and luckily, that was easily attained, they were driving a lot of the talk both in their small groups and with the entire number present.

2- **Description of the session :**

The participants were motivated when we started with the ice breaking activity. We divided our workshop into 4 parts. We tried to use a variety of activities that serve the objective.

A. Visual discovery

-The participants discover mind games and their role in asessing students in class: audience play the games and discover their objectives.
-Determine how mind games, pictures and videos can be related to science
-Introduction to useful links: Microsoft Apps, Wordle, Memory, Photo Games

B. Hands-On Activities

-Divide the participants into groups and give each a simple experiment (using a variety of materials: e.g. balloons, crayons, marshmallows, cranberry syrup, eggs, etc)
-Allow the groups to discover the objective of their experiments, why we should do an experiment and when?

-Asking an open-ended question: Can experiments stand alone in class?

Varying the concentration of a grenade solution

C. Science and Communication Arts

-Ask participants to listen to a piece of music and allow them to discover the concepts in it.
-Suggest more songs that relate to science and think of ways to use them in class.

D. Group Work:

1. After the end of this workshop, would you still choose your color for the same reason?

2. Use the different strategies to help your students remember a certain concept (assign to each group one of the above techniques).

Playing with a helium balloon

3- Conclusion:

These techniques that we used fixed the concepts in the mind of our participants and pushed us equally to feel proud of our work. The motivation of our participants was gradually increasing with the time of the workshop

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Flame light relight

4- References:

1. Colour changing milk: https://child.unl.edu/c/document_library/get_file?uuid=4c050aa6-f073-4475-8235-feb704ffc1c8&groupId=313877&.pdf
   https://www.youtube.com/watch?v=6T3C-0-Djas&html5=1
2. Elephant toothpaste: http://www.sciencebob.com/experiments/toothpaste.php
   https://www.youtube.com/watch?v=AR71yet0DbQ
3. Flame light relight: http://www.stevespanglerscience.com/lab/experiments/flame-light-relight
   https://www.youtube.com/watch?v=r0hACYXuaDk&html5=1
4. Foam meltdown: http://lifestyle.howstuffworks.com/crafts/other-arts-crafts/science-projects-for-kids-chemical-reactions1.htm
   https://www.youtube.com/watch?v=h9Jx8NRkWTo&html5=1
5. Melting crayons art: http://www.wikihow.com/Make-Melted-Crayon-Art
   https://www.youtube.com/watch?v=1NXcZWxBGSA
6. Chewing gum removal: http://www.videojug.com/film/how-to-remove-chewing-gum-from-clothes
7. Radioactive – Imagine Dragons:
   https://www.youtube.com/watch?v=ktvTqknDobU&html5=1
8. Wordle: http://www.wordle.net/
9. Selective attention test (the gorilla):
   https://www.youtube.com/watch?v=vJG698U2Mvo&html5=1
10. Useful games: http://mrnussbaum.com/gamescode/

--- Only abstracts included for the following session:

Rendre l’enseignement des sciences attrayant et concret

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Les défis que rencontre l’enseignant dans le domaine de la science sont nombreux : comment stimuler le questionnement et l’observation chez l’élève? comment l’initier à l’expérience et à la cueillette des données? comment le guider dans l’exploration de phénomènes qui relèvent de la chimie, la physique et la biologie? comment lui donner le goût de la science et rendre l’enseignement attrayant? Nous apportons, par la suite des réponses à toutes ces questions.Il faut retrouver des situations d’apprentissages ludiques pour donner le goût des sciences et de la découverte aux élèves. C’est tout petit, que les enfants prennent le goût des expériences soit en chimie, en physique ou en biologie. Par exemple, un enfant qui a compris qu’une chose comme la cuisine est de la chimie aura moins de difficultés à aimer cette discipline à l’école.D’une manière générale l’enseignement doit informer la science d’une manière ludique, émouvante et concrète.On présente les choses dans un langage de tous les jours pour viser la masse d’élèves et non l’élite.Pour conclure, on peut dire que l’enseignement scientifique doit être attrayant concret et intéressant la masse d’élèves.

Light Ball Strategy

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Relating and linking scientific ideas and concepts together, or to real – life examples, can facilitate to a great extent the process of teaching, and eventually the perception of these concepts by the students. The “Light – Ball strategy” workshop has set its purpose to clarify this method, and provide some supportive examples in three scientific subjects: physics, chemistry and biology. These samples of ideas and examples will help show how starting with a simple real – life example, application, picture or document provided to the students, can unite and correlate different objectives or concepts in a unit or chapter together. Participants will have the opportunity to develop and apply this strategy with their own examples in any of the three subjects mentioned, and then communicate their ideas with others.

Teaching Science in Life and for Life

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A high-quality education goes beyond the classroom walls, the school building, and the playground boundary; it requires more than the newest technology, the latest text book, and the best materials and equipment. A high-quality education is a process that sets students up for and starts them on the right path to success, with open minds and desires to continue to learn for the rest of their lives. It requires administration, teachers, parents, and students all working together with the common goal in mind of getting the students to be successful both in and out of the classroom. As future educators, we want to do our part in assuring that each student receives a high-quality education by providing the necessary tools for each of them to reach his or her full potential and achieve a positive mindset towards being a life-long learner, by helping them develop self motivation to learn, connections with the curriculum to the real-world, and essential life skills so that they can be successful both in and out of the classroom.

Science Online Classroom

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The initial purpose of this session is to increase participant's understanding on how to make good use of the available online material and how to combine them to form online classrooms that help in better understanding science concepts. Participants will get to know the Online Classroom on Wikispaces, the purpose for its use and development, how teachers are able to upload different material on it, and how students interact. Another important aim of this session is to attract the attention of the students we teach especially that they are being exposed to online material and are becoming more and more dependent on the Internet; so why not make use of it in our teaching as educators. Participants will check a prepared classroom, what is posted, and how the interaction between teacher and students and students and students is occurring. The session is planned as follows: (a) Brief introduction of session and purpose (5 min); (b) Checking the different online classrooms (Kidblog, wikispaces…) (10min); (c) Participants will check a prepared online class, they will try to post on the pages, develop new pages, and check the interactions between teacher and students and students and students which is occurring (50 min); (d) Questions and Answers (10 min).

تغيّري له هدف

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إيماناً بأهمية انخراط الطلبة في الفعاليات الصفية واندماجهم فيها وتواصلهم الايجابي ببعضهم البعض وبمعلمهم، تنحى الاتجاهات الحديثة في التدريس إلى التقدم بالطلبة نحو مركز العملية التعلمية التعليمية. وتُعدّ الخبرات التي يمر بها الطلبة خلال انجازهم للمشاريع التي يتطلبها المنحى متداخل التخصصات فرصة للطلبة لتبوء موقع المسؤولية عن تعلمهم.

وفي هذا المنحى، يصبح المعلم أكثر مرونة في تناول المادة الدراسية ويتحول دوره نحو التوجيه والدعم والتشجيع، هذا بالاضافة إلى تحفيز الطلبة لتنفيذ مهام واقعية هادفة للمشروع يسعى الطلبة من خلالها إلى البناء والانتاج وصنع الأشياء.

تتكون الجلسة ثلاثة أقسام، هي: مقدمة نظرية حول مفهوم تطبيق وحدة مصممة وفق المنحى متداخل التخصصات داخل الغرفة الصفية، وعرض نشاط ينمذج المنحى موضوع الجلسة ومحكاة لتلك الوحدة من قبل المشاركين يتناولون فيها أهداف جديدة حول تكيف الكائنات الحية في بيئاتها.

Innovative Idea Sessions – Mathematics & Science

--- Only abstracts included for the following session ---

How to Make Your School as Environmental School?
كيف تجعل مدرستك مدرسة بيئية؟

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الإنسان ابن بيئته ،.حيث يواجه هذا العالم اليوم تحديات بيئية هائلة في مقدمتها زيادة معدلات استهلاك الموارد الطبيعية وتفاقم مشكلات التلوث والتصحر وتغيير المناخ وفقدان التنوع الحيوي وتآكل طبقة الأوزون وغيرها من التحديات الناجمة عن الآثار السلبية للتطور التكنولوجي والتنمية الصناعية والزراعية والتوسع العمراني وزيادة أعداد السكان ، وغيرها من العوامل التي تؤدي إلى إختلال التوازن البيئي والإضرار بالإنسان والكائنات الحية الأخرى والأعتداء على حق الأجيال القادمة في البيئة الصحية والمزدهرة .

ولإن أنجح انواع العمل البيئي هو "التوعية بالقدوة" وهي التي يجب ان تنطلق من المدرسة لما لها من دور ريادي في المجتمعات ، فيجب علينا ان نحول مدرستنا إلى مدرسة بيئية تعزز القيم والسلوكيات البيئية من أجل تحمل المسؤولية الفردية وإعداد جيل يحترم بيئته ويكون نواة لبلد بيئي وبالتالي لعالم بيئي تهدف هذ الورشة لعرض بعض الأنشطة البئية و كيفية تنفيذها في المدرسة حيث نبتعد عن الأنشطة النظرية وننطلق بإنشطة ملموسة تواكب التلاميذ خلال تواجدهم في المدرسة بداء من ملعب المدرسة مرورا بالصف وصولا إلى الدكان المدرسي وتنفيذها يعتمد على التلاميذ والمعلم والإدارة ، بحيث يمكننا ان نستفيد من وسائل وادوات بسيطة قد تكون عبيء سواءِ الورق والهدر في الطاقة والمياه والعذاء والتنوع البيولوجي والأنشطة والهواء والتسوق والسياحة البيئيةولا تكلف المدرسة مادياً بل على العكس تكون مصدر لكسب المال وتساعد على تعزيز التربية البيئية بمفهومها الشامل لدى التلاميذ والمعلمين والموظفين في المدرسة ليصبح سلوك بيئي مستدام ينطلق من المدرسة إلى المنزل فالمجتمع برمته .