THE FOURTEENTH ANNUAL SCIENCE AND MATH EDUCATORS CONFERENCE (SMEC 14)

Science and Mathematics Education Center (SMEC)
Faculty of Arts and Sciences
American University of Beirut, Lebanon

SMEC 14 – CONFERENCE PROCEEDINGS

(ENGLISH AND FRENCH SECTION)

PART ONE: RESEARCH SESSIONS

THE FOURTEENTH ANNUAL SCIENCE AND MATH EDUCATORS CONFERENCE (SMEC 14)

Science and Mathematics Education Center (SMEC)
Faculty of Arts and Sciences, American University of Beirut, Lebanon
March 31st, 2012

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We do apologize for any significant omissions.

SMEC 14 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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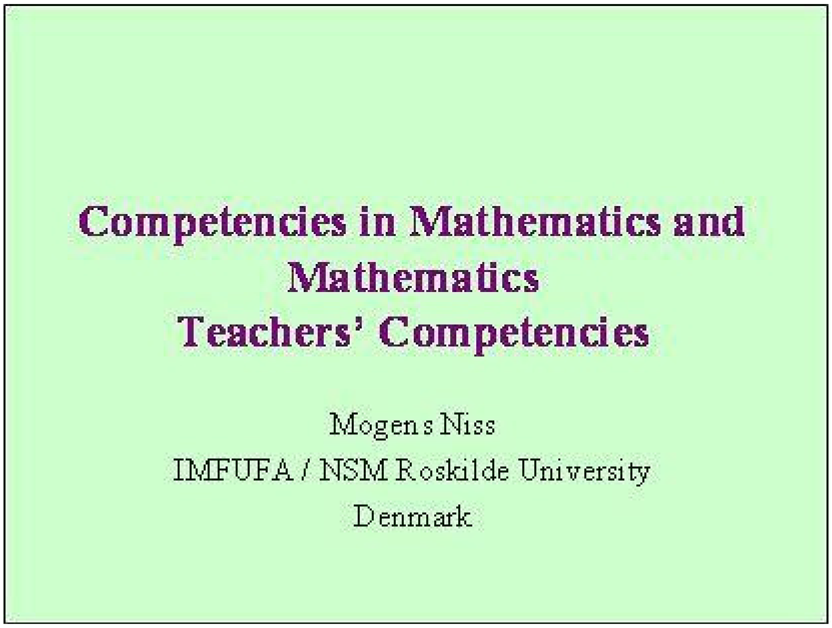
Part One
Plenary and Research Sessions

MATHEMATICS

Competencies in Mathematics and Mathematics Teachers' Competencies
Mogens Allan Niss



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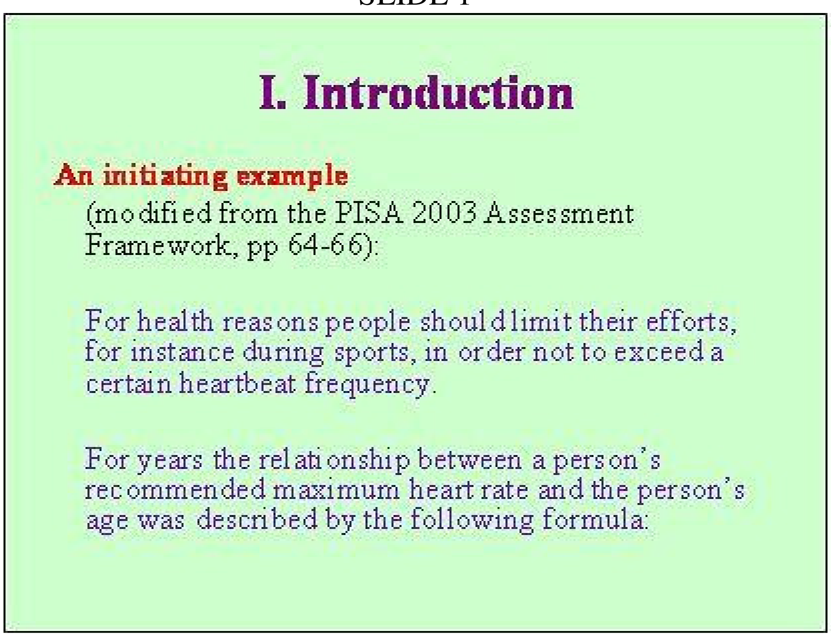

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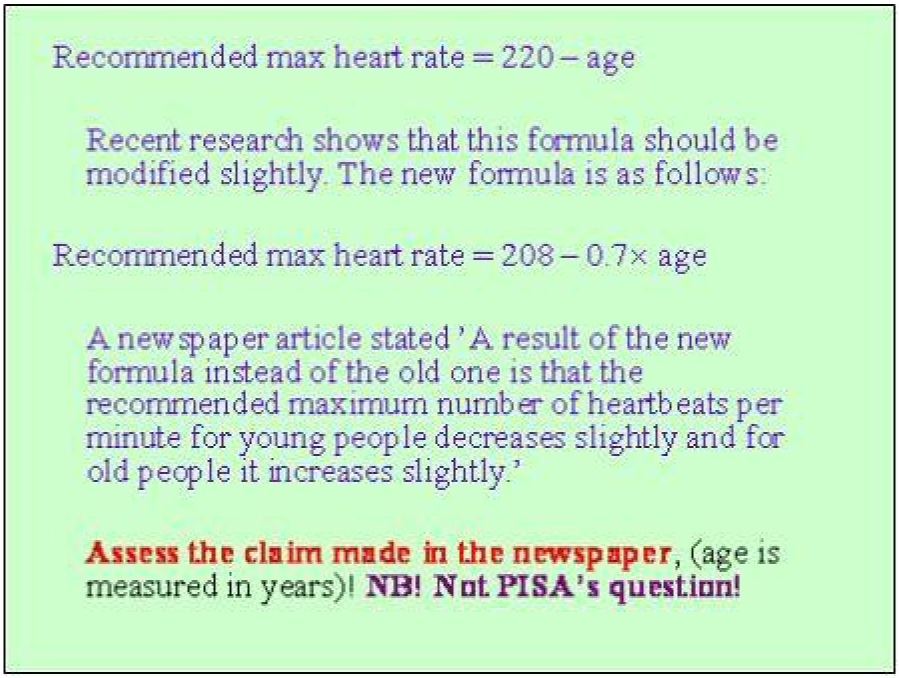

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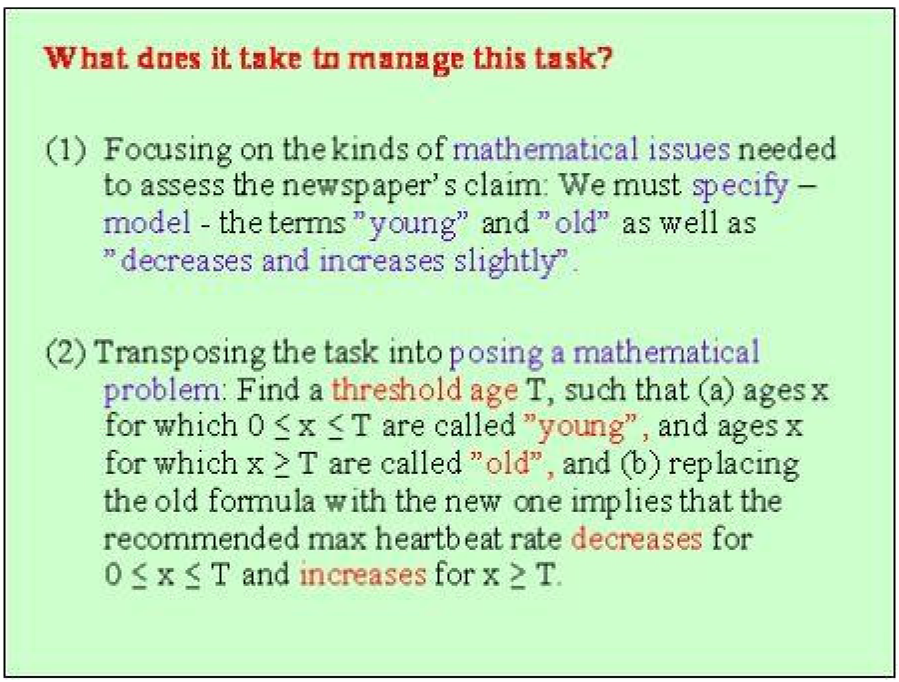

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(3) Given the two formulae, the threshold age T is defined to be the uniquely determined common value for which the two formulae yield the same recommended max heartbeat rate.

Hence, finding T requires solving the equation

$$220 - T = 208 - 0.7\ T$$

Algebraic reduction shows that the solution x satisfies

$12 = 0.3\ T$, i.e. $T = 40$ (years).

Further algebra (solving inequalities) shows that

$220 - x > 208 - 0.7\ x$ if and only if $x < 40$ and that

$220 - x < 208 - 0.7\ x$ if and only if $x > 40$.

So, by choosing the new formula the rec. max rate decreases for people younger than 40 ("young"), and increases for people over 40 ("old") (interpretation).

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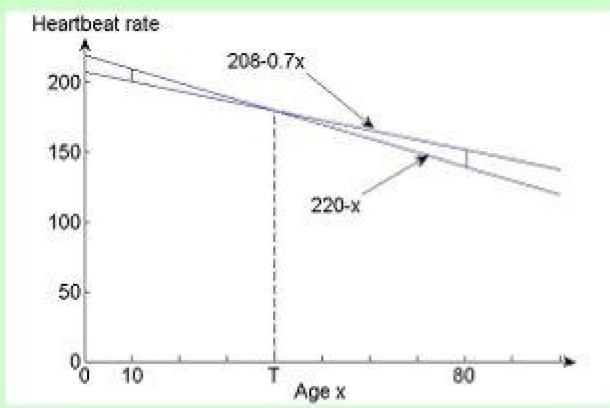
(4) The situation can be captured by a graphical representation of the functions determined by the two formulae:



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(5) The graphical representation gives a visual indication of the magnitude of the changes for "young", respectively "old" people. Are these changes "slight"?

To answer this question, let us determine the changes (more algebra):

The exact decrease for "young" people is
$220 - x - (208 - 0.7x) = 12 - 0.3\,x$ (for $x < 40$)

And the exact increase for "old" people is
$208 - 0.7x - (220 - x) = 0.3\,x - 12$ (for $x > 40$)

Assume that realistic sports ages are (further modelling): $10 \leq x \leq 80$ years

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(6) Then the maximal decrease for young people is at $x = 10$, i.e. $12 - 0.3 \times 10 = 9$, representing a maximal relative decrease of 9/(220-10), i.e. 4.3%, of the recommended maximum heartbeat rate
(requires arithmetic)

The maximal increase for old people is at $x = 80$, i.e. $0.3 \times 80 - 12 = 12$, representing a maximal relative increase of 12/(220-80), i.e. 8.6%, of the recommended maximum heartbeat rate
(requires arithmetic).

It is a physiological question whether this maximal decrease / increase can be considered "slight" or not (model interpretation)!

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(7) Satisfactory completion of the task requires oral or written communication of the solution process, at large and in detail, as well of the choices, conclusions, reasoning and deliberations undertaken.

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Important observation:

- The task just solved did indeed involve mathematical content (e.g. numbers, arithmetic, algebra, equations and inequalities, functions, coordinate systems, graphs), but the most important thing was the **decisions** made, the **actions** taken and **the processes** conducted!
- Successfully dealing with mathematical tasks and challenges requires **much more than mathematical subject matter knowledge,** the traditional way to specify a curriculum and its demands!
- **What then**? **We'll see!**

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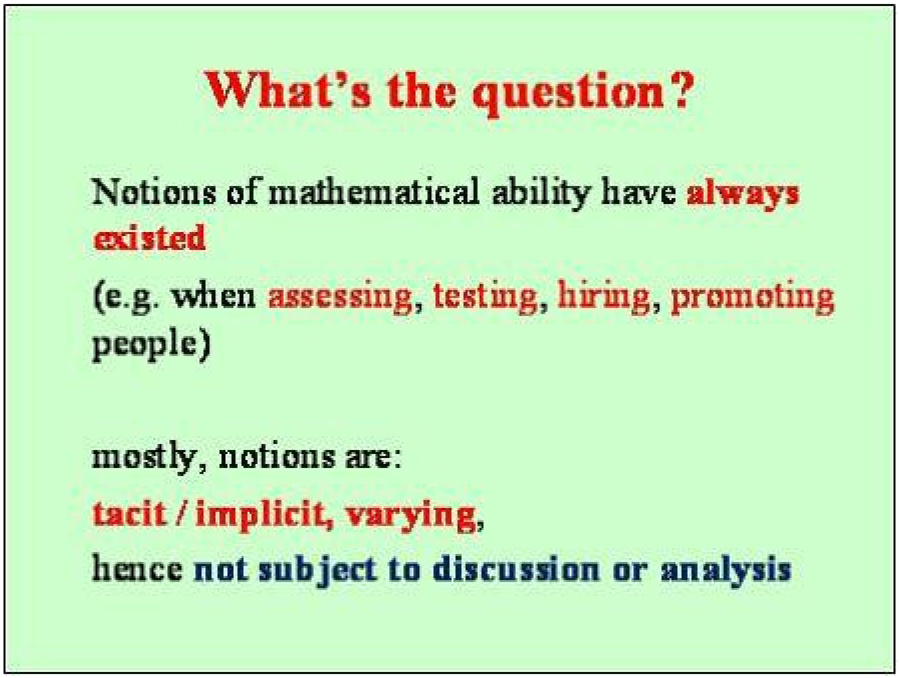

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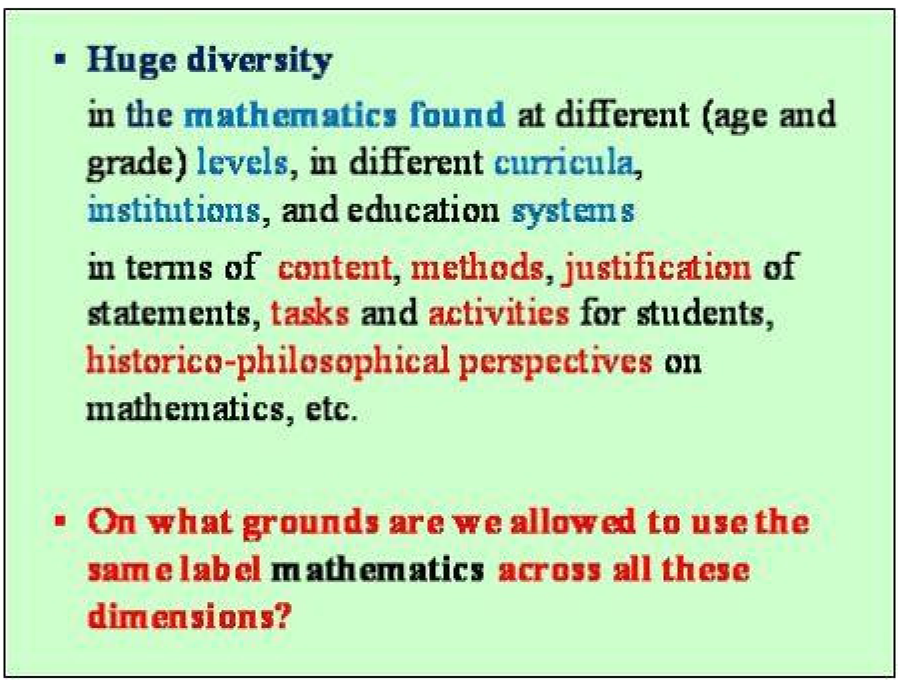

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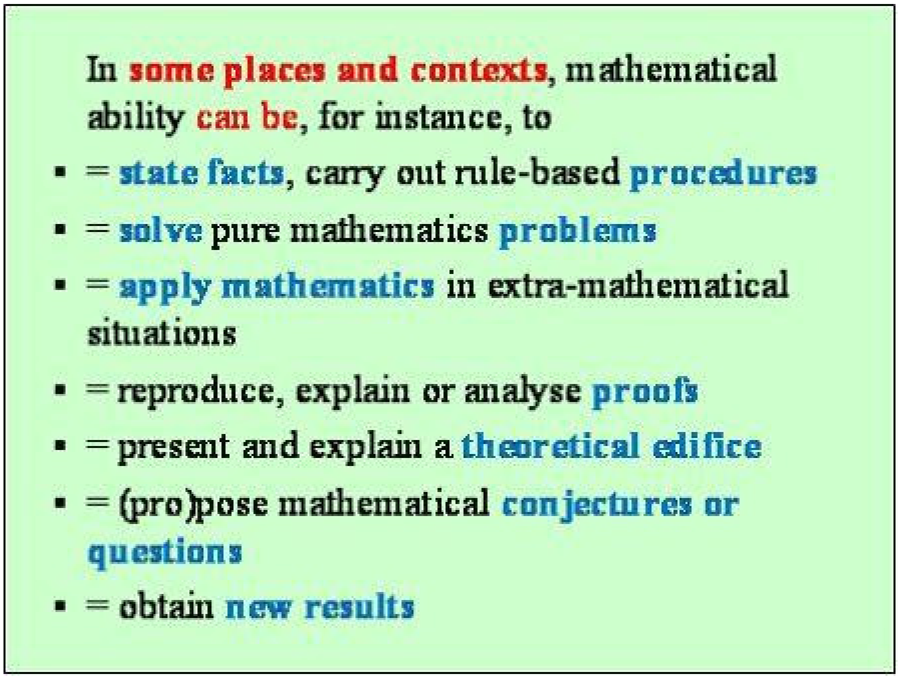

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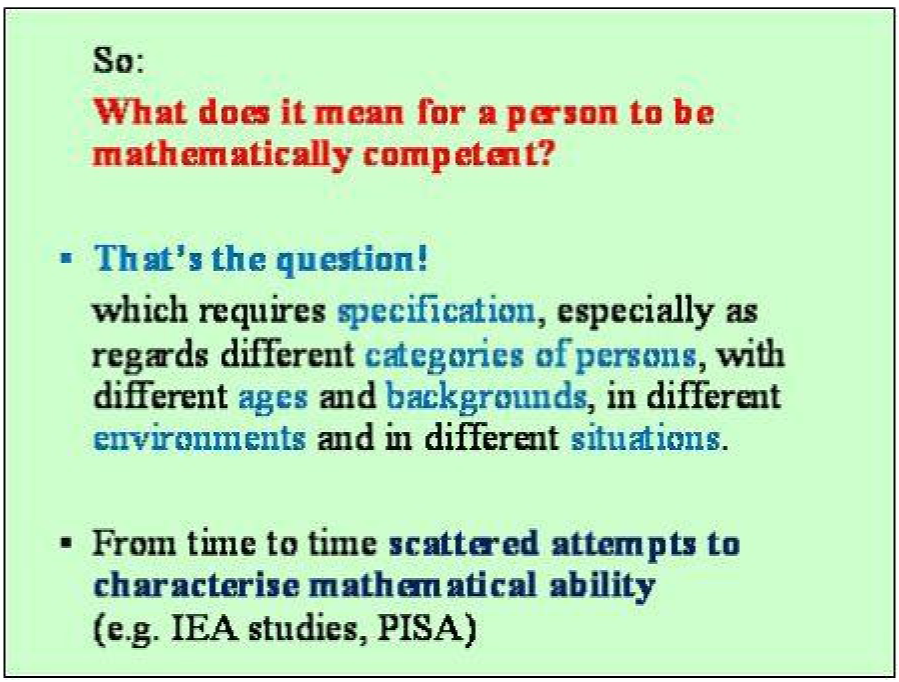

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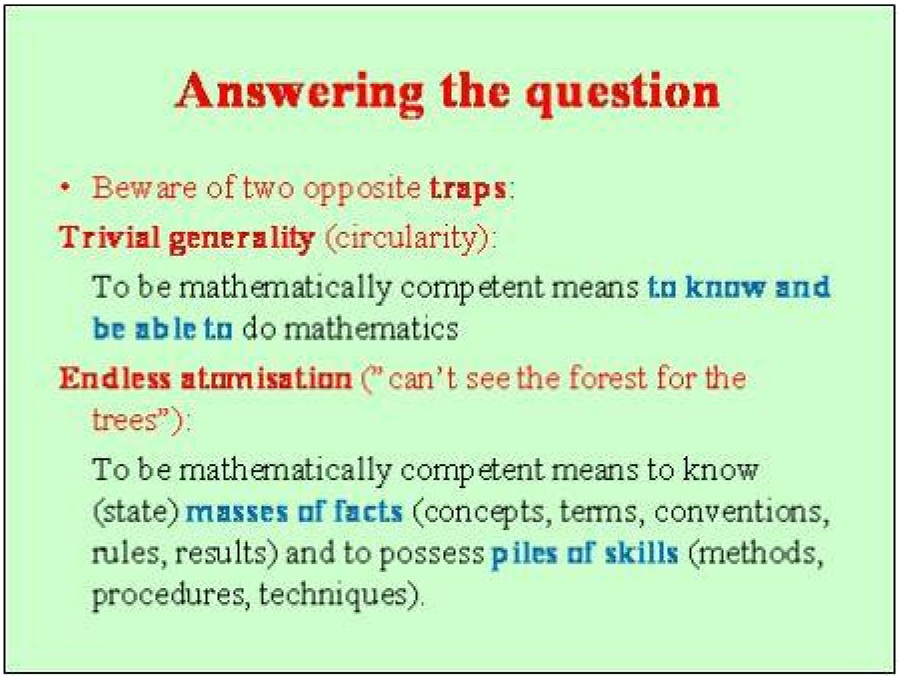

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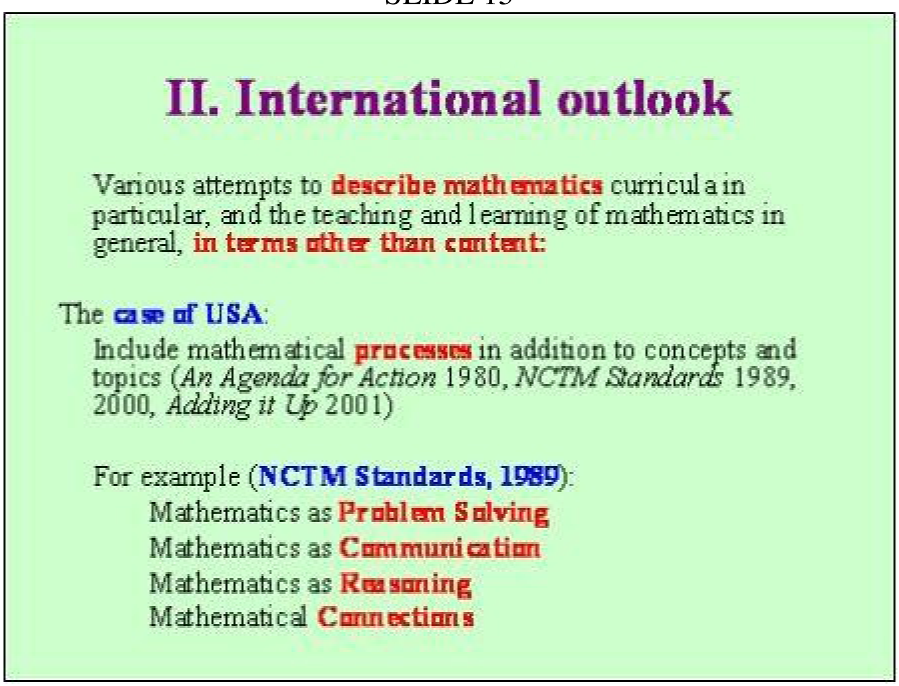

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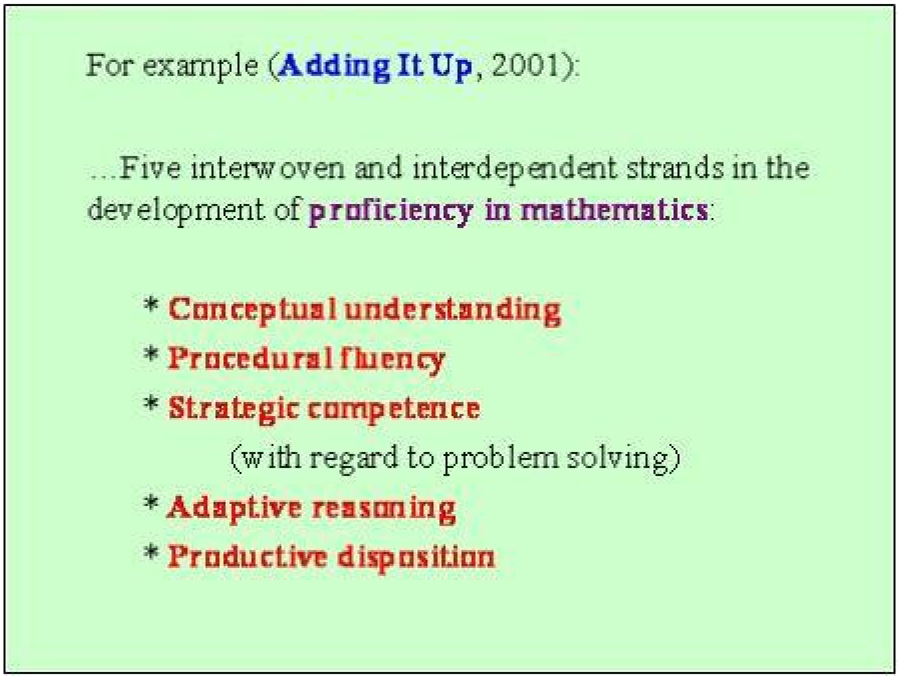

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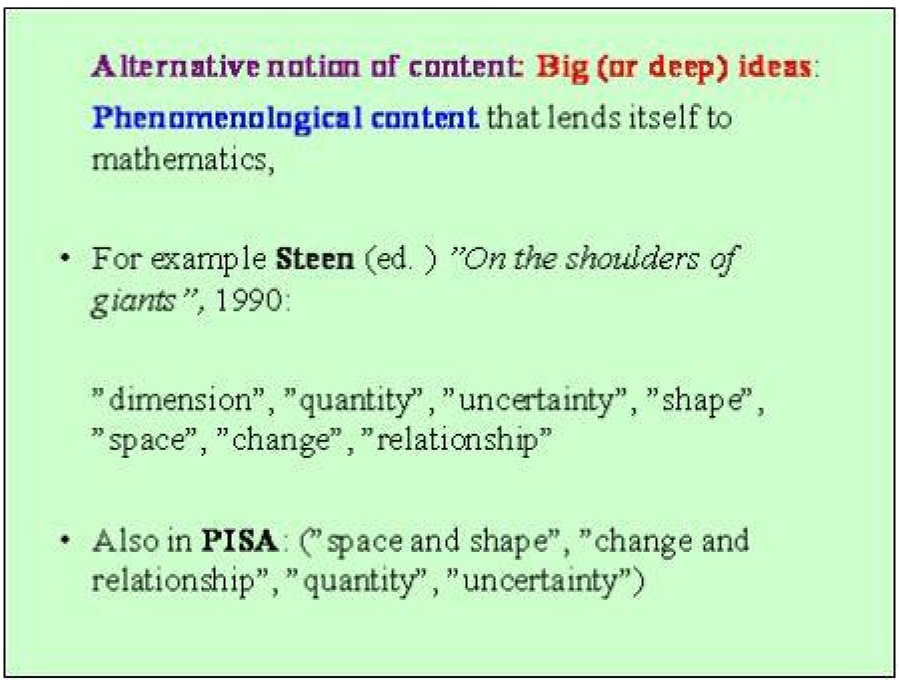

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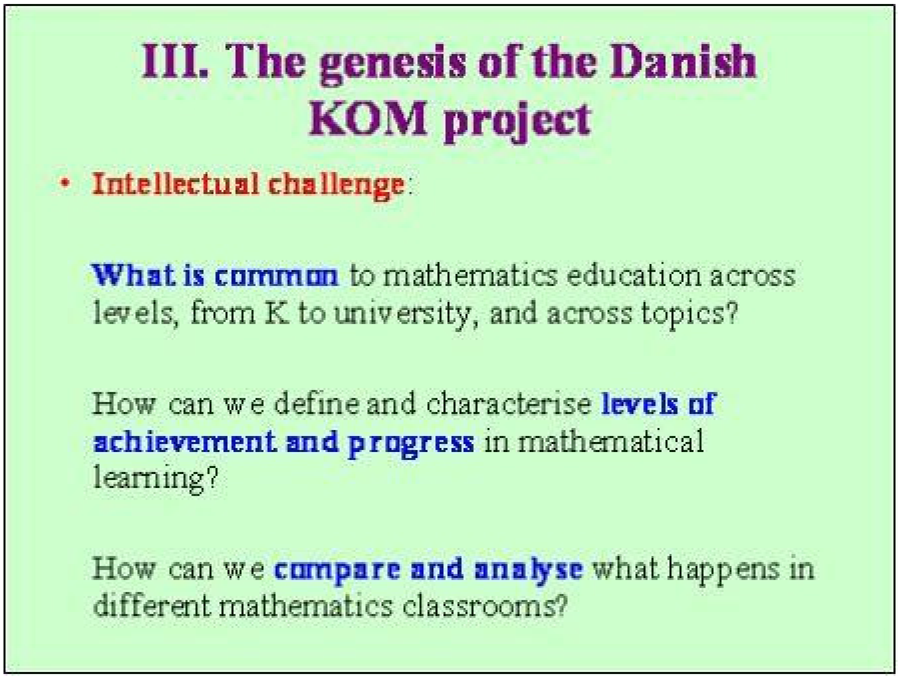

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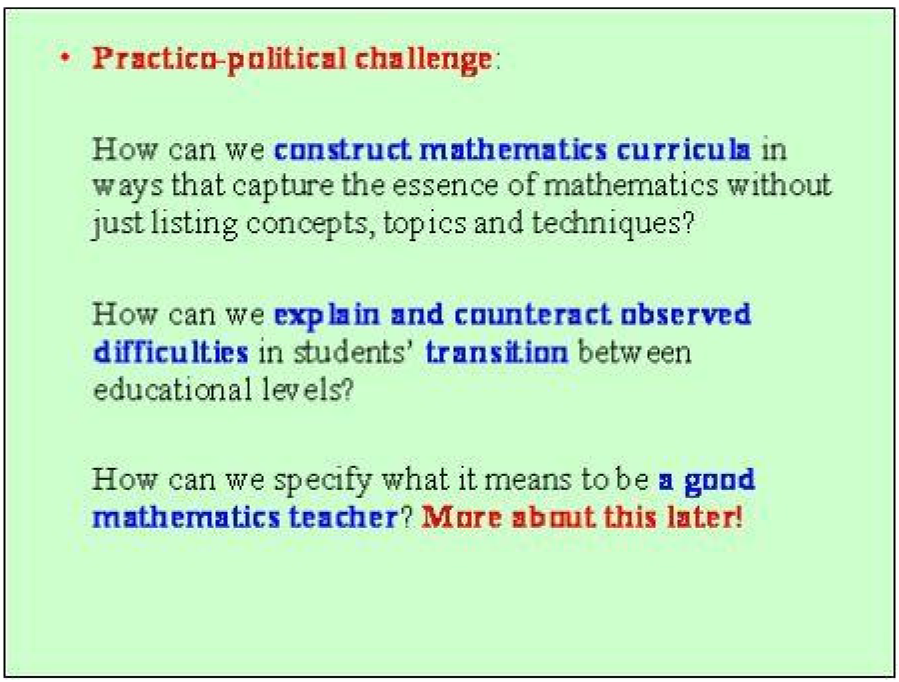

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The overall **strategy** for answering these questions is to first answer a more fundamental question:

What does it mean to master mathematics, across educational levels, and across mathematical topics?

Source of inspiration:

What does it mean to **master a language**?

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Mastering a given language – or, equivalently, possessing linguistic competence - means being able to

- (a) understand and interpret what other **people say and mean when they speak** the language, in different contexts, in different genres and styles
- (b) understand and interpret what other **people express and mean when they write** in the language, in different contexts, in different genres and styles

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- (c) **express oneself in speech,** in a comprehensible manner, to different kinds of interlocutors, in different contexts, in different genres and styles

- (d) **express oneself in writing**, in a comprehensible manner, to different kinds of readership, in different contexts, in different genres and styles

(a), (b), (c) and (d) are the constituents of linguistic competence. We may perceive (a) and (b) as its "interpretive side" and (c) and (d) as its "constructive side". **Across all ages and contexts**.

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In the KOM project – **KOM = Competencies and Learning of Mathematics** - we tried to **do something similar with mathematics**.

Definition:

Possessing **mathematical competence** – i. e. mastering mathematics – is an individual's **capability** and **readiness** to **act appropriately**, and in a knowledge-based manner, **in situations and contexts** in which mathematics actually plays or potentially could play a role.

Requires, but **cannot be reduced** to, factual knowledge and procedural skills

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A **mathematical competency** is a **distinct major constituent** in mathematical competence.

(Analogous to (a), (b), (c), and (d) as major constituents in linguistic competence.)

More specifically (**definition**):

A mathematical competency is an individual's capability and readiness to act appropriately, and in a knowledge-based manner, in situations and contexts involving **a certain type of mathematical challenge.**

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IV. Outline of eight mathematical competencies

The ability to ask and answer questions in and with mathematics:

1. **Mathematical thinking competency** – mastering mathematical modes of thought
   [roots, scopes and limitations of concepts; abstraction (concepts); generalisation (statements); characteristic questions; characteristic answers]

2. **Problem handling competency** – posing and solving mathematical problems
   [detecting, posing, and specifying problems, pure or applied, open or closed; solving problems]

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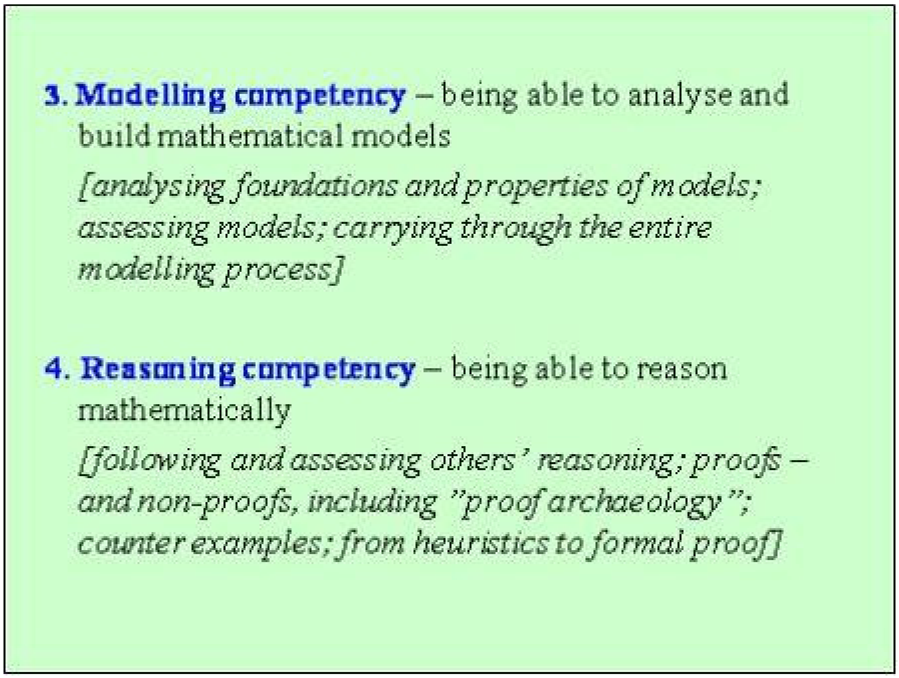

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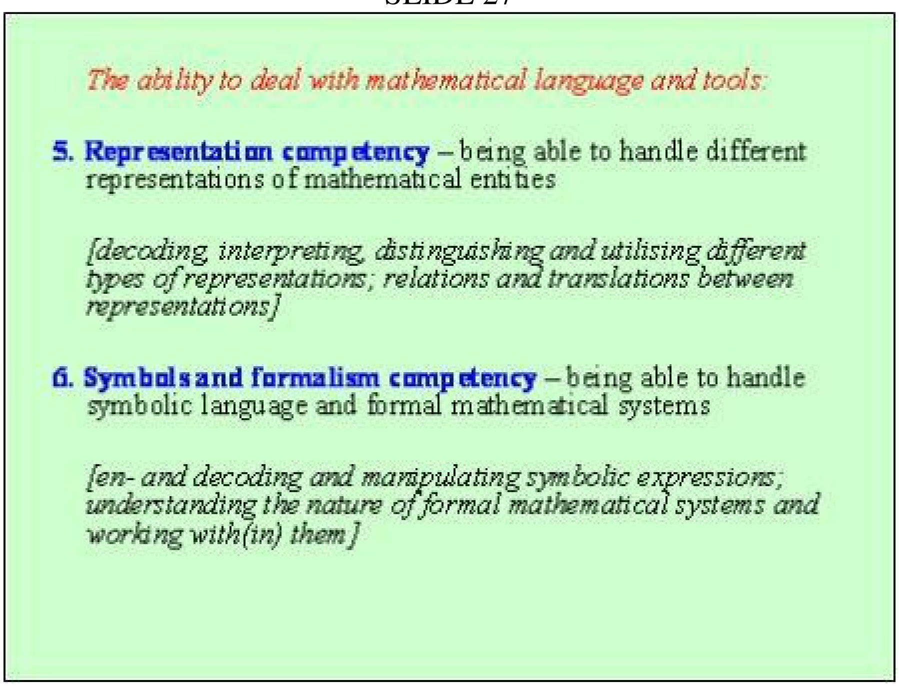

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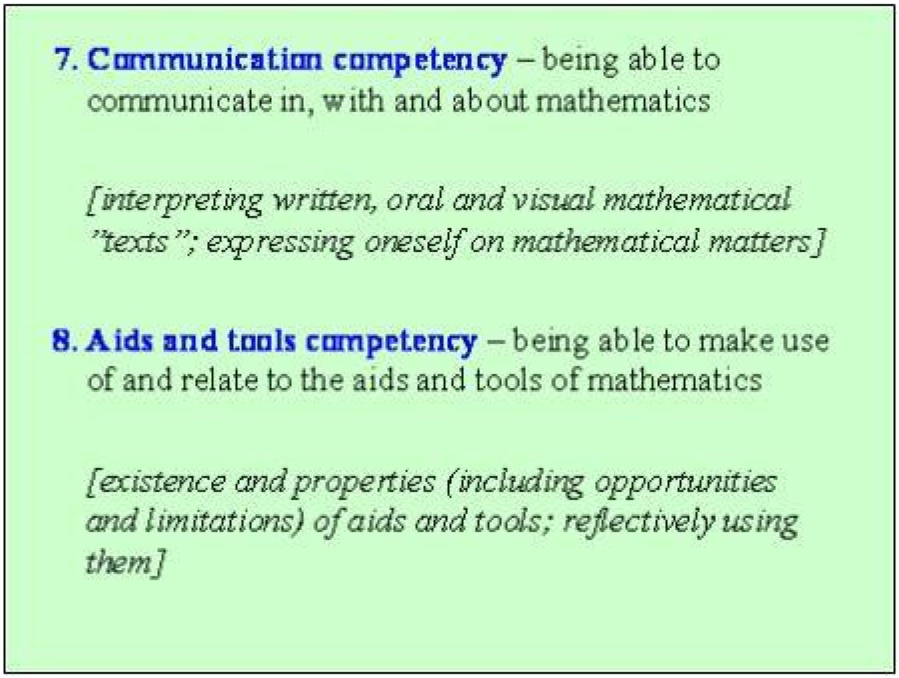

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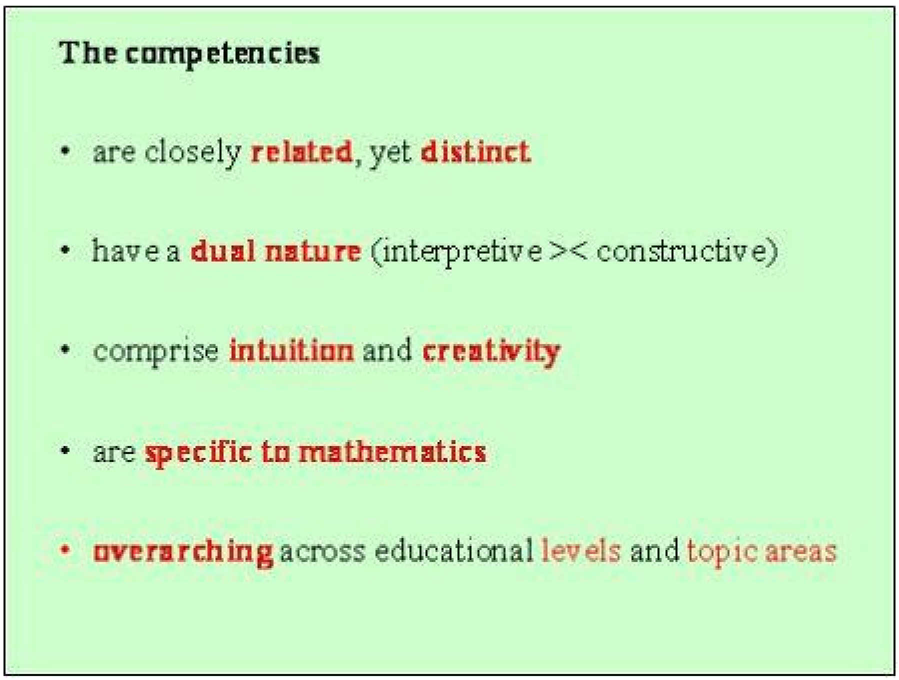

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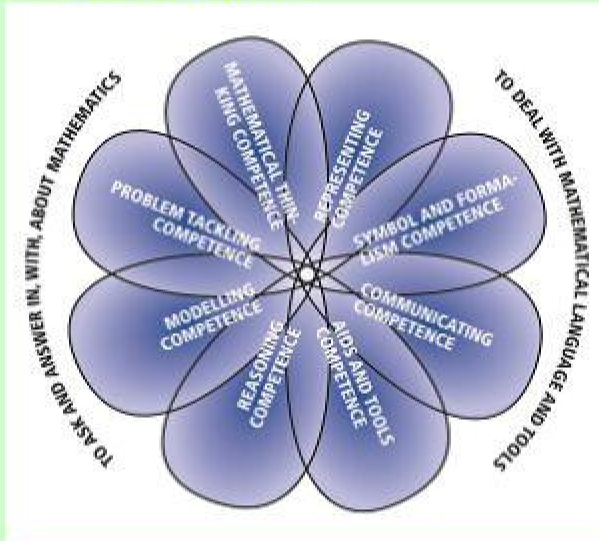
The competency flower



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In addition to the competencies:

Overview and judgement regarding mathematics as a discipline:

Focus on mathematics as a whole, not on mathematical situations

- The **actual application** of mathematics in other subjects and practice areas
- The **historical development** of mathematics, internally and externally
- The **nature** of mathematics as a discipline

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V. Relations between competencies and subject matter

A given competency can (only) be

- **developed**

and

- **exercised**

in dealing with mathematical subject matter

Competencies and mathematical topic areas are **orthogonal** to one another

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	Thinking	Problem handling	…	Tools and aids
Topic 1				
Topic 2				
…			Topic i × comp. j	
Topic n				

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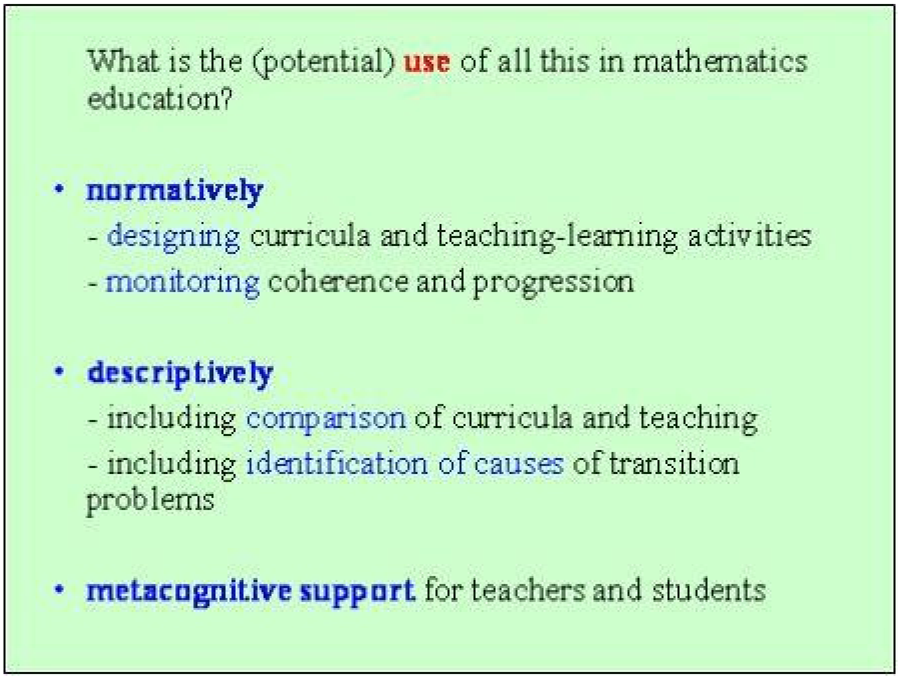

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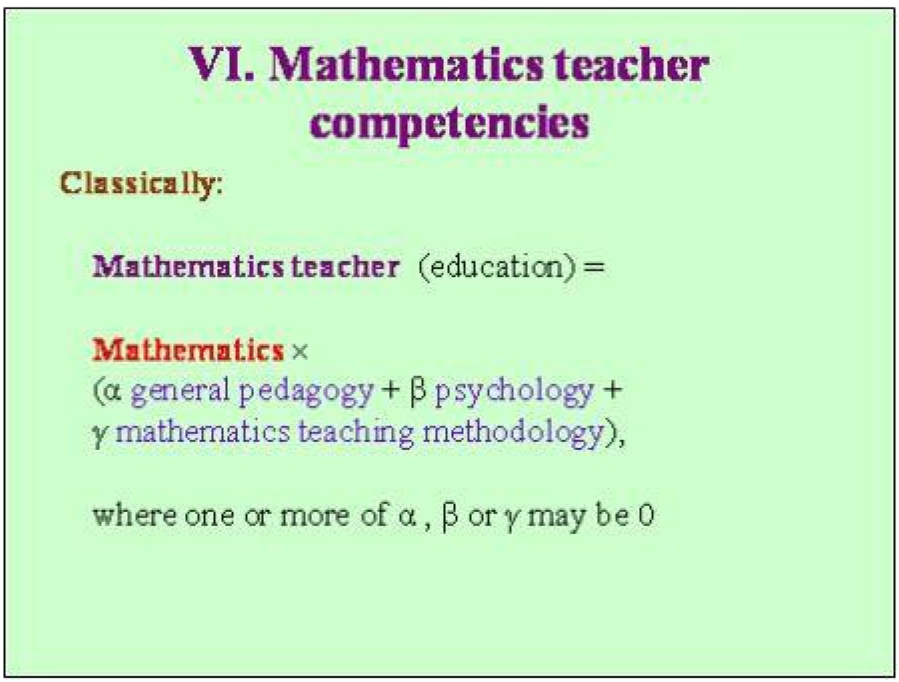

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Shulman (1986) deals with subjects in general and focuses on "the missing paradigm":

- **Content knowledge**, also known as subject matter knowledge (**SMK**)
- **Pedagogical content knowledge** (**PCK**), also deals with content
- **Curricular knowlegde** (**CK**)

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- **Ball & Bass** (2000, 2003) have pointed out that PCK cannot capture essential mathematical insights that are necessary for successfully teaching mathematics to real students. More is needed. They propose
- **Mathematical Knowledge for Teaching** (**MKT**) as answers to the questions:

  * *What* mathematical knowlegde is entailed by the work of teaching mathematics?

  * *Where* and *how* is mathematical knowledge used in teaching mathematics? (2003, p. 5)

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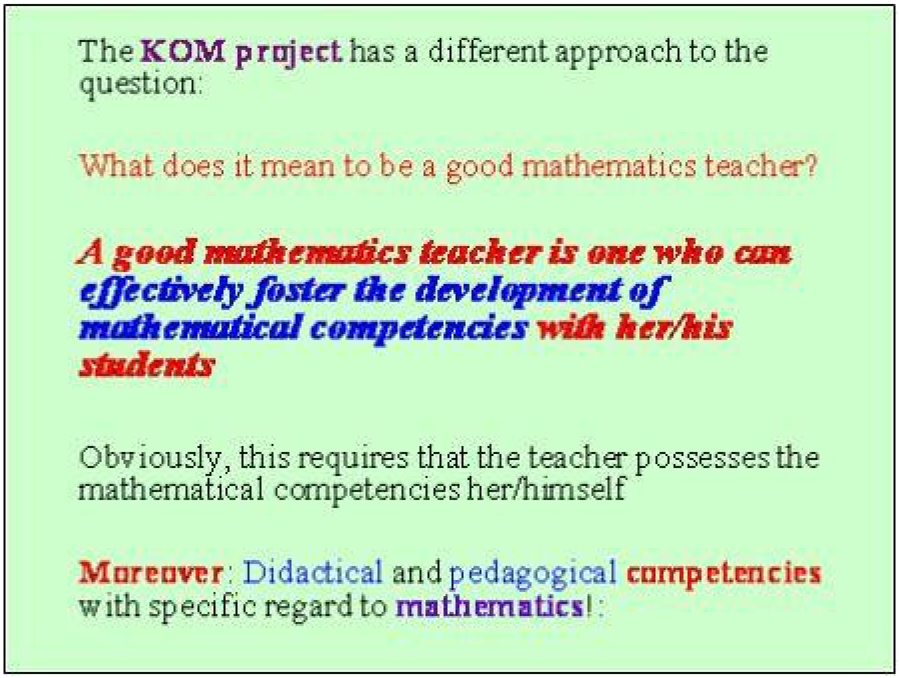

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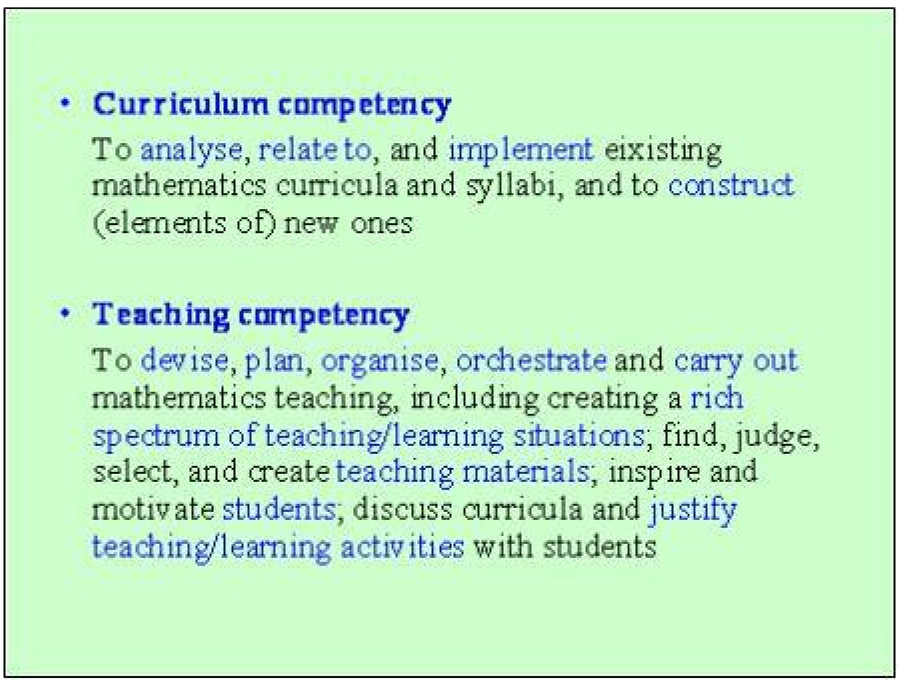

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- **Uncovering of learning competency**

  To uncover, interpret and analyse students' learning of mathematics, as well as their notions, beliefs and attitudes towards mathematics. Includes identifying development with the individual student.

- **Assessment competency**

  To identify, assess, charaterise and communicate students' learning outcomes and competencies, so as to inform and assist the individual students, and other relevant parties. Includes selecting, modifying, constructing, critically analysing, and implementing a varied set of assessment forms and instruments to serve different formative and summative purposes

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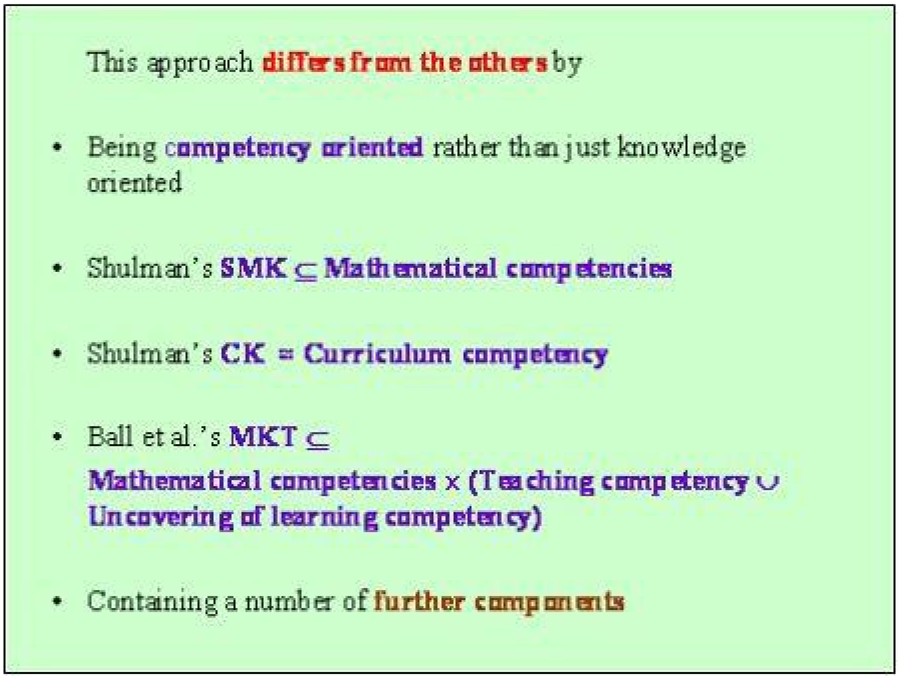
- **Collaboration competency**

  To collaborate with different sorts of colleagues in and outside mathematics, as well as others (parents, authorities) concerning mathematics teaching and its conditions.

- **Professional development competency**

  To develop one's own competency as a mathematics teacher (a meta-competency) including participate in and relate to activities of professional development, such as in-service courses, projects, conferences; reflect upon one's own teaching and needs for development; keep oneself up-dated about new developments and trends in research and practice.



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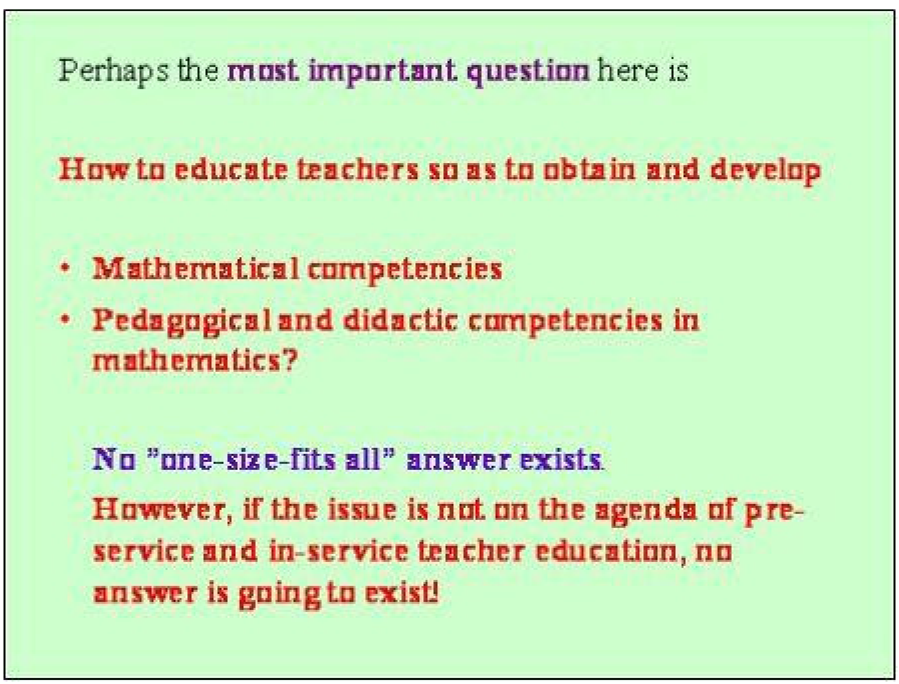

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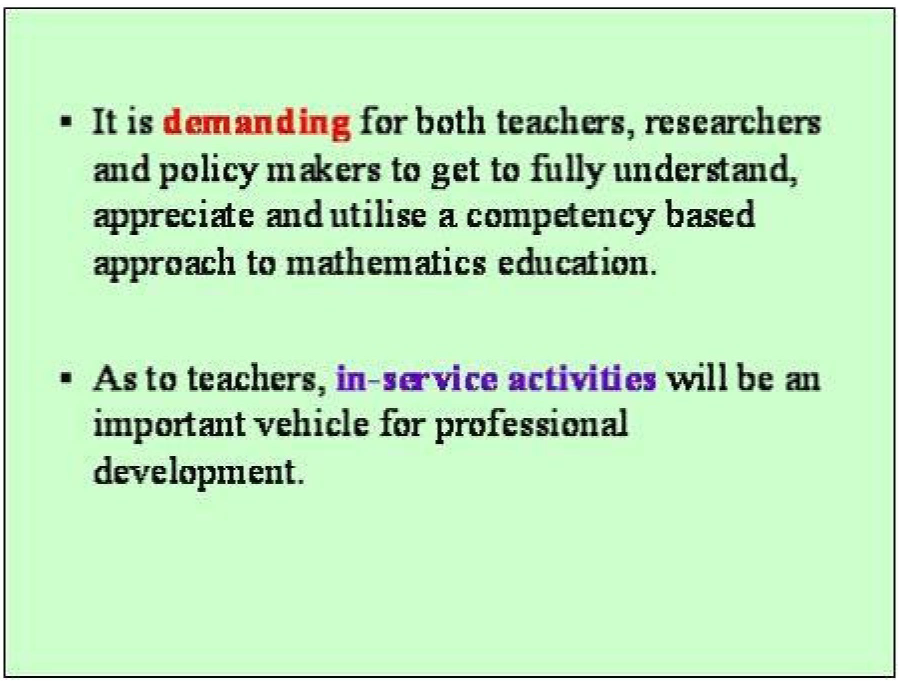

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Problem Solving at the Middle School Level: A Comparison of Different Strategies
Juhaina Musharrafieh and Naim Rouadi

Abstract

This presentation shed light and reflected on how students in grades seven and eight might think when solving a story problem. Problem solving experiences help in adding up to the child's mathematical knowledge and promote a higher level of critical thinking abilities. Students who are provided with opportunities to communicate verbally and through writing and listening will review dual benefit of communication to learn mathematics and learning to communicate mathematically. Seventh and eighth grade students were selected from two private schools, one in Mount Lebanon and the second is in the North. Both schools were of the same socio-economic status and forty students were chosen from each school. They all participated regardless of their school grades or their English proficiency. The results show that students tend to use the guess and check, or a diagram in order to facilitate the comprehension of the problem and to translate it into an equation or to find the answer. This study was a spontaneous one which needs to be modified and studied in more detail and professionalism. Problem solving has been and still is the basis for learning mathematics. This can be considered as a reflection of what our students think and do once they encounter a story problem. Thus, this can shed some light on the importance of such researches in the field of mathematics teaching.

Description of Session

The main purpose of this session was to make participants aware of the various strategies students in the seventh or eighth grade might think about when solving a story problem. Participants took on the role of the learner and tried to solve the story problem either by drawing or by writing about the problem or writing an equation. They were also allowed to verify their strategy. The session was planned as follows:

(a) Brief introduction of the importance of solving story problems at the middle school level.
(b) Participants were asked to solve two story problems then talk about the solution briefly.
(c) Some findings about the use of different strategies in two problem situations were presented.

Mathematics educators have been called to teach mathematics through problem solving (National Council of Teachers of Mathematics [NCTM], 1989, 2000). As stated in Principles and Standards for School Mathematics (NCTM, 2000): "Solving problems is not only a goal of learning mathematics but also a major means of doing so. By learning problem solving in mathematics, students should acquire ways of thinking, habits of persistence and curiosity, and confidence in unfamiliar situations…" (p. 52). Thus, problem solving experiences help in adding up to the child's mathematical knowledge and promote a higher level of critical thinking abilities. Problem solving has been viewed from varying perspectives such as means – end analyses (e.g. Newell and Simon, 1972), text processing (e.g. Kintsch, 1994a) and schema theory (e.g. 1995). Moreover, students who are provided with opportunities to communicate verbally and through writing and listening will review dual benefit of communication to learn mathematics and learning to communicate mathematically.

Background

Mathematical problem solving relies on the interaction of bottom-up and top-down knowledge structures beginning with the first reading of the problem (Pape, 2004). It is based on the knowledge of language, mathematical terminology, and the ability to visualize the problem in a drawn format which is the concrete representation of the problem. Evidence indicates that children's errors are frequently based upon the miscomprehension of the word problem (Cummins et al., 1998). This miscomprehension results from several possibilities including: language learners (Mestre, 1988), inadequate reading strategies, insufficient conceptual or procedural mathematical knowledge (Mayer, 1992) or the inability to coordinate knowledge structures necessary to solve the problem (Pape, 2004). The accurate representation and solution of mathematical word problems depend on two sets of knowledge structures, linguistic knowledge and symbolic/mathematical knowledge. To be successful, the problem solver must function between these two types of knowledge structures (Pape, 2004).

Method

Sample

Seventh and eighth grade students were selected from two private schools, one in Mount Lebanon and the second is in the North. Both schools were of the same socio-economic status and forty students were chosen from each school. They all participated regardless of their school grades or their English proficiency.

Instruments

Students were asked to solve two story problems using any strategy they found suitable. Then, they communicated their answers through text writing, drawn schema, an equation, guessing and checking, or working backwards. The two story problems are presented below:

Problem 1
The students in Mrs. Koenig's class are in three groups working in teams.

- 20% are in group A;
- 4 students are in room B; and
- the remaining students, ½ are in the front of room C and the other 10 students are at the back of the room.

How many students are in Mrs. Koenig's class?

Problem 2
Seven middle schools are in the town of Newtonville. Each school has a different number of students.
School A has 3 fewer students than school B;
School B has 3 fewer students than school C;
School C has 3 fewer students than school D;
School D has 3 fewer students than school E;
School E has 3 fewer students than school F;

School F has 3 fewer students than school G;
If 2037 students attend Newtonville middle schools, how many students are in the school with the smallest number of students?

Procedure

The two story problems were distributed to students and the allocated time was 30 minutes. Different problem solving behaviors were detected. Each solution was coded as correct if the student recorded an appropriate numerical answer. Next, the solution paths that a student followed to reach an answer were examined and analyzed in detail to determine the type of error. We coded two broad categories of errors:

1- Reading related errors and this is due to language proficiency level, and the student's inability to translate into a mathematical equation.
2- Mathematics errors which relates to misunderstanding of mathematical relationships or arithmetic operations.

We would like to note that these same findings were detected in a study done by Stephen J. Pape (2004).

Data Analysis

This presentation was considered as the preliminary step for a further study in which data will be analyzed and interpreted, and its results and implications can be used as a guide in teaching problem solving. The collected data can be summarized in a table.

	Frequency of Problem Solving Strategy					
	Diagram List	*Work backward*	*Equation*	*Writing logical reasons*	*Guess check*	*Other*
Problem 1 (Percentage)	15	3	9	18	21	14
Problem 2 (Schools)	2	6	15	10	22	18
Total	17	9	24	28	43	32

	Number of Right and Wrong Answers		
	Right	*Wrong*	*No answer*
Problem 1 (Percentage)	33	35	12
Problem 2 (Schools)	15	54	11

	Percentage of Right and Wrong Answers	
	Right	*Wrong*
Problem 1 (Percentage)	41.2 %	44%
Problem 2 (Schools)	19%	68%

The results were not acceptable and this was due to a couple of factors: comprehension level and English proficiency. This theoretical description supports an understanding that success in solving word problems depends upon actively transforming the elements of the problem into a mental model (Mayer, 1992), and then representing the problem and integrating all of its elements into a conceptual whole. Comprehension of the text in any domain is a dynamic transaction that requires decoding the language, activating appropriate schemas or word knowledge to support comprehension and filtering incoming information through existing knowledge structures (Ehri, 1995; Rosenblat, 1994). Students tend to use the guess and check, or a diagram in order to facilitate the comprehension of the problem and to translate it into an equation or to find the answer.

This study was a spontaneous one that needs to be modified and studied in more detail and professionalism. However, problem solving has been and still is the basis for learning mathematics. This study can be considered as a reflection of what our students think and do once they encounter a story problem. Thus, this can shed some light on the importance of such researches in the field of mathematics teaching.

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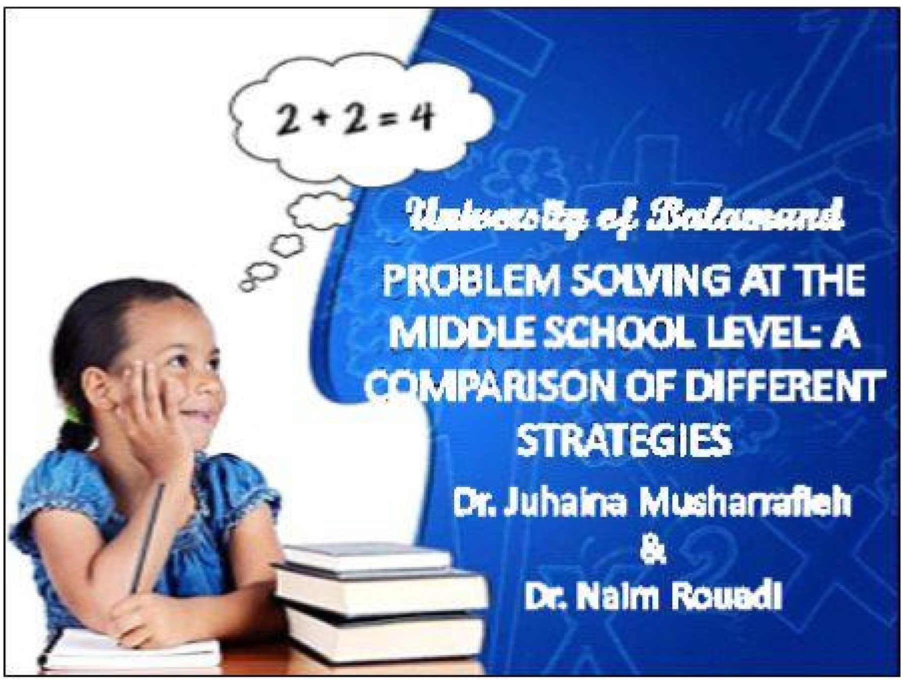

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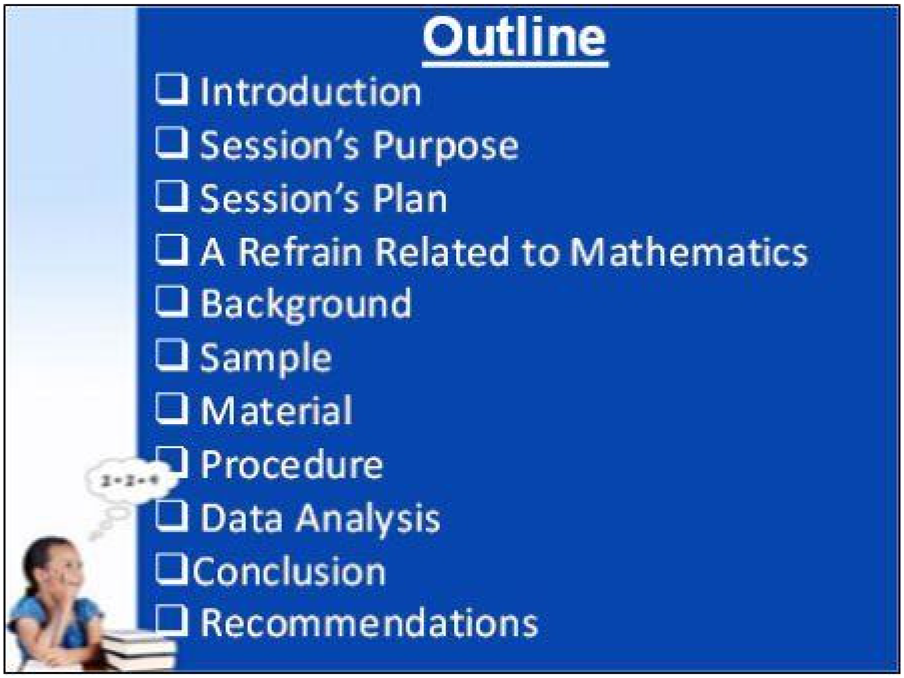

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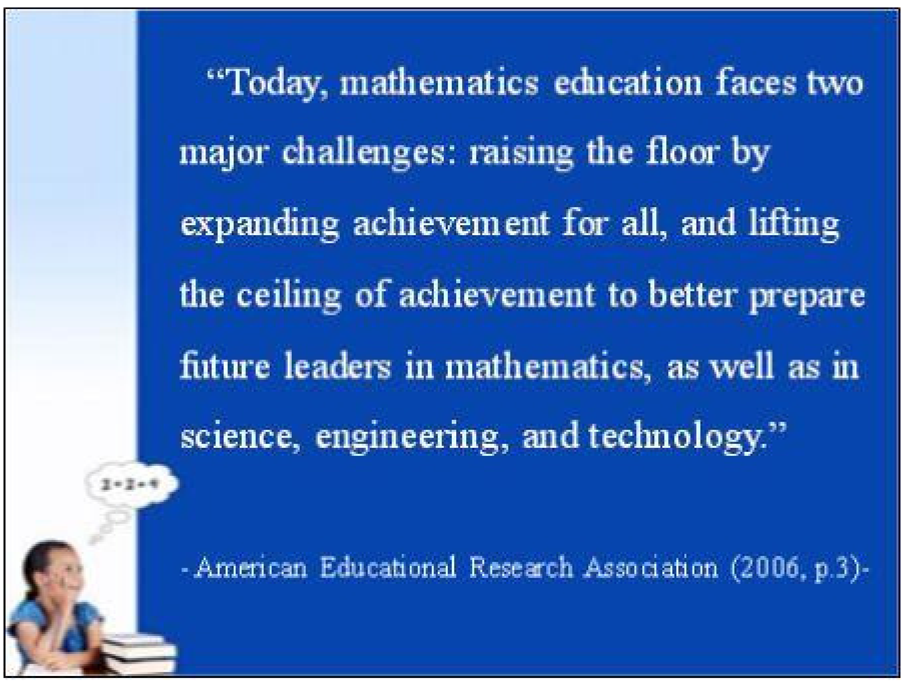

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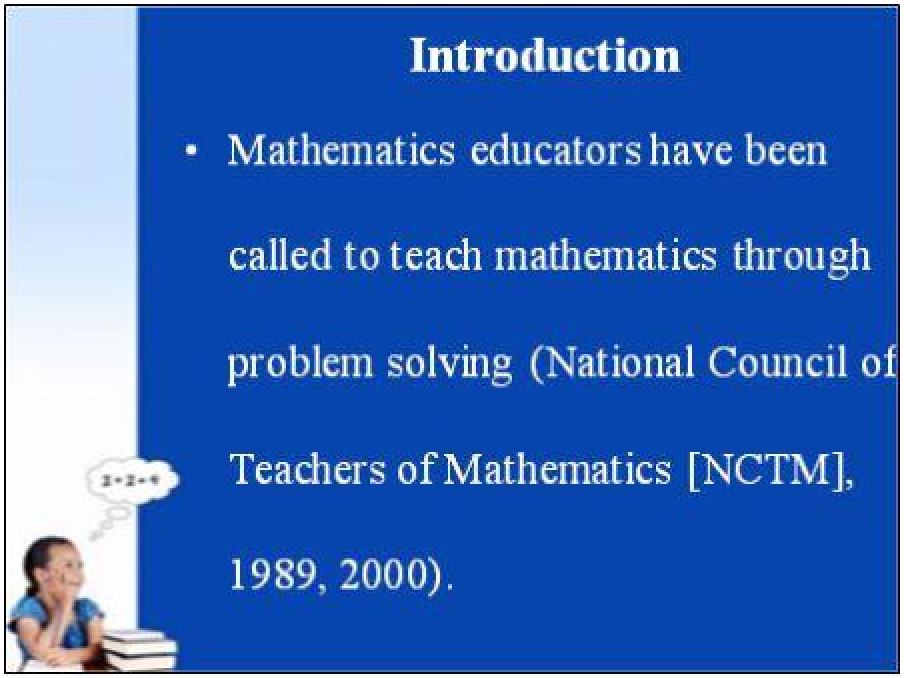

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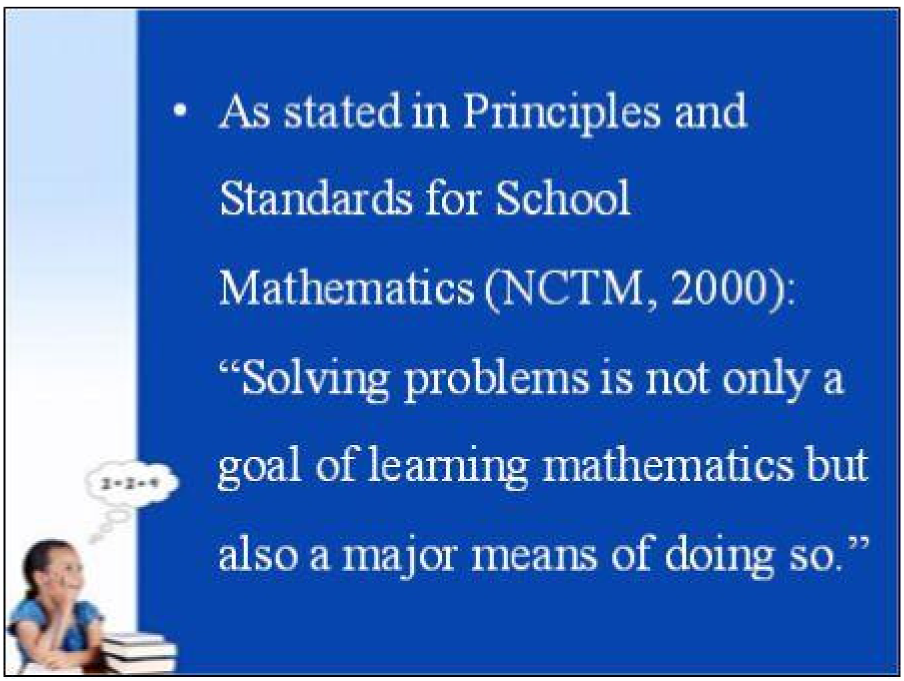

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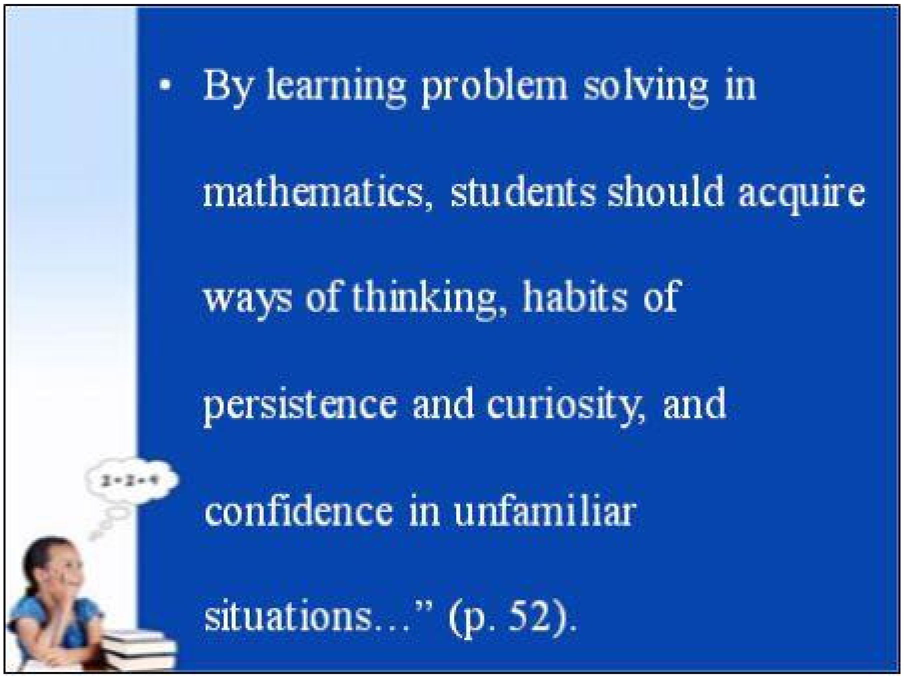

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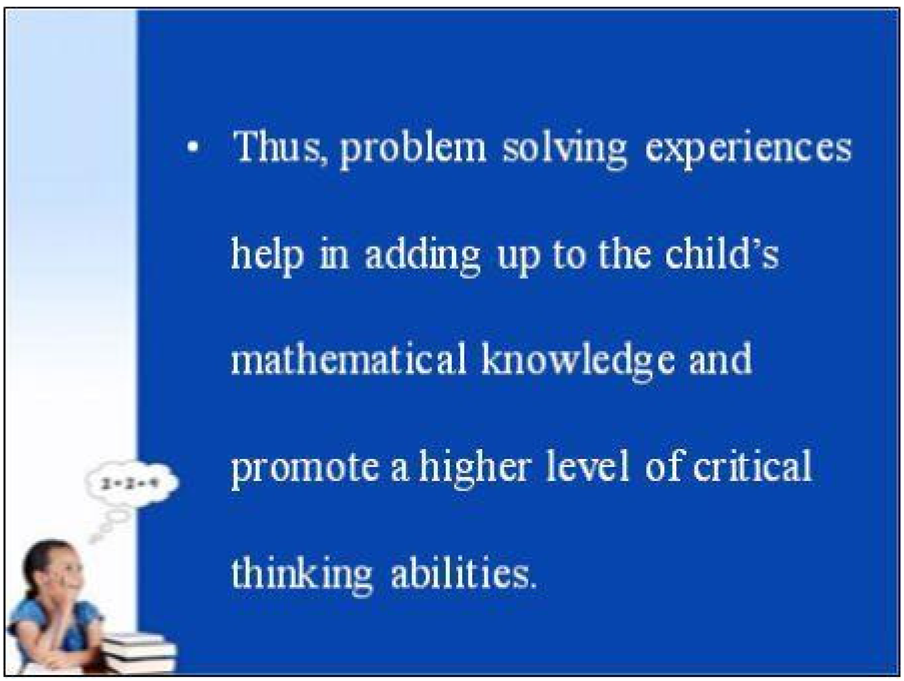

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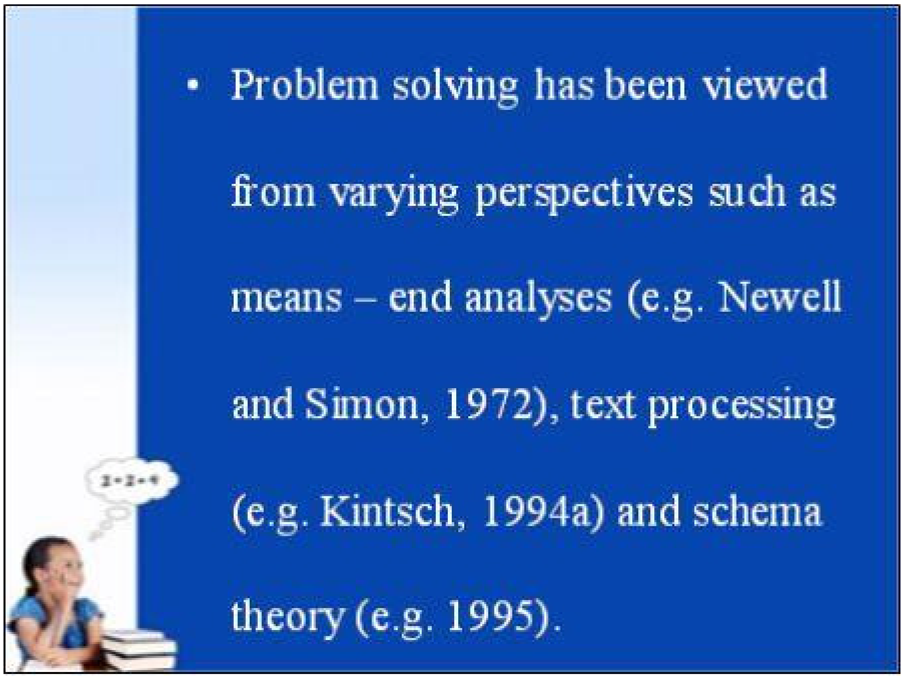

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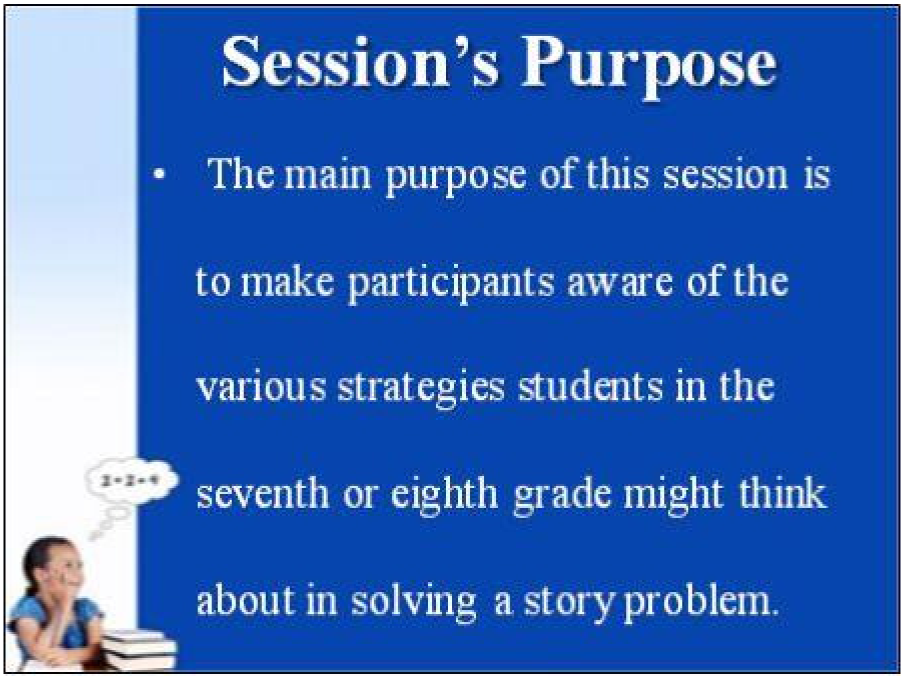

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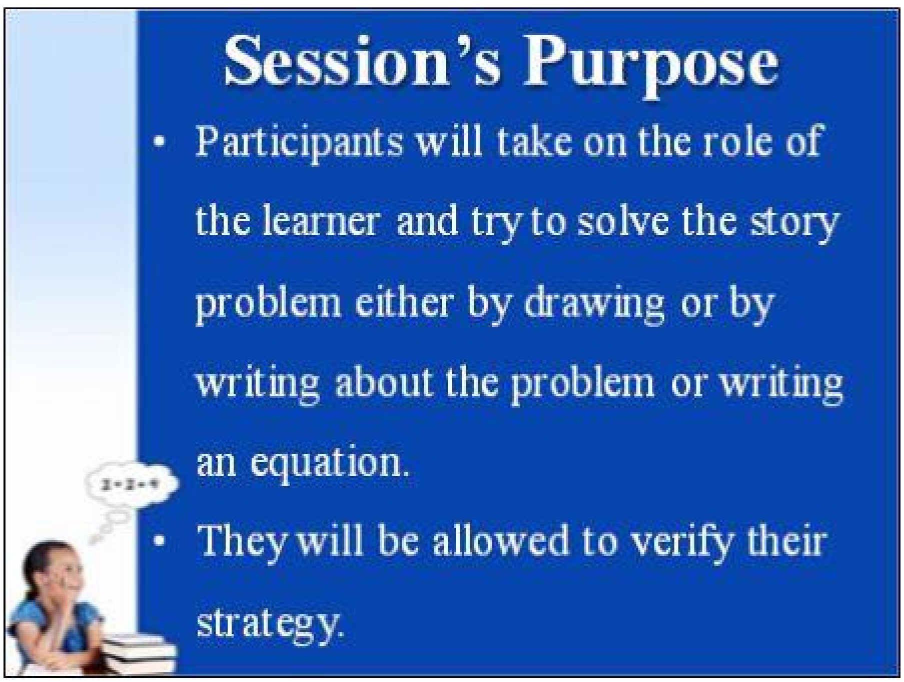

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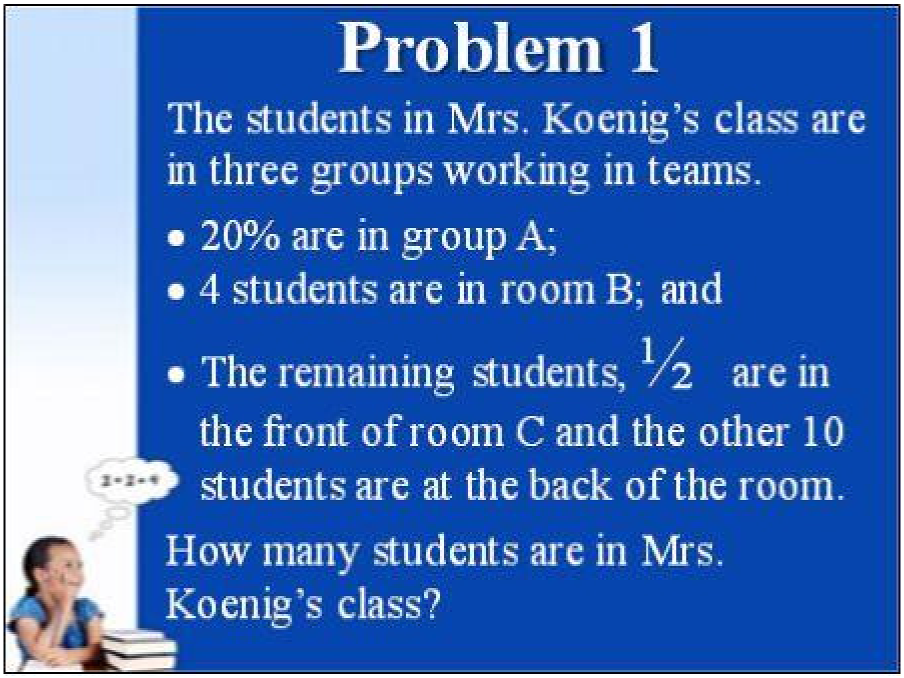

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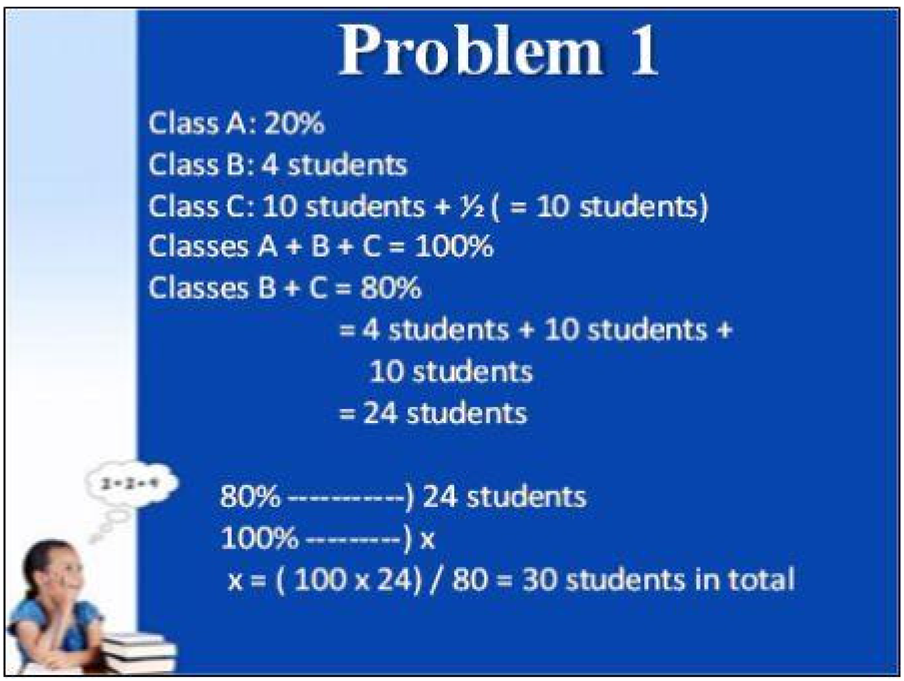

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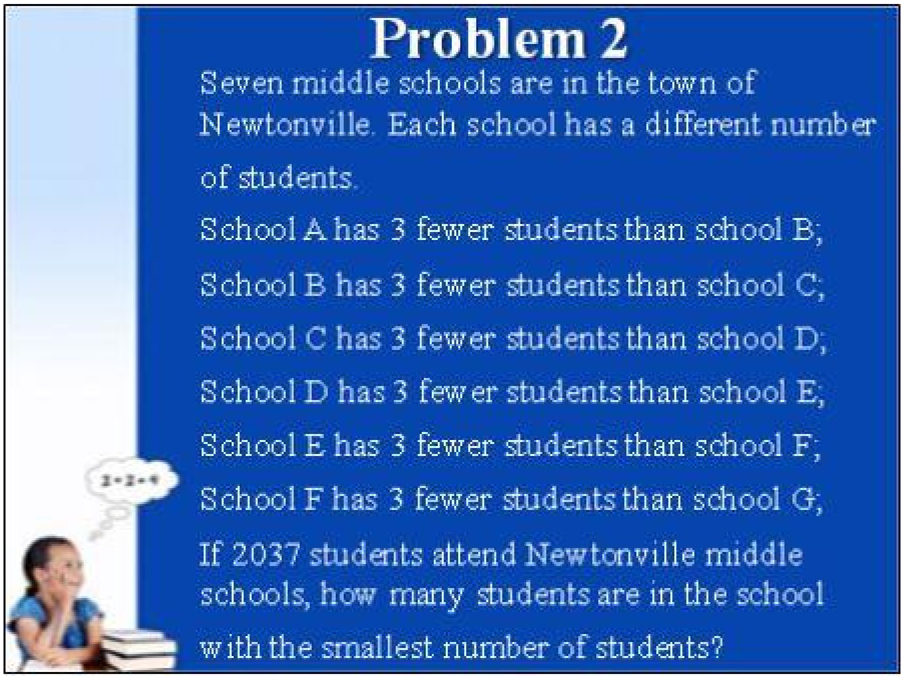

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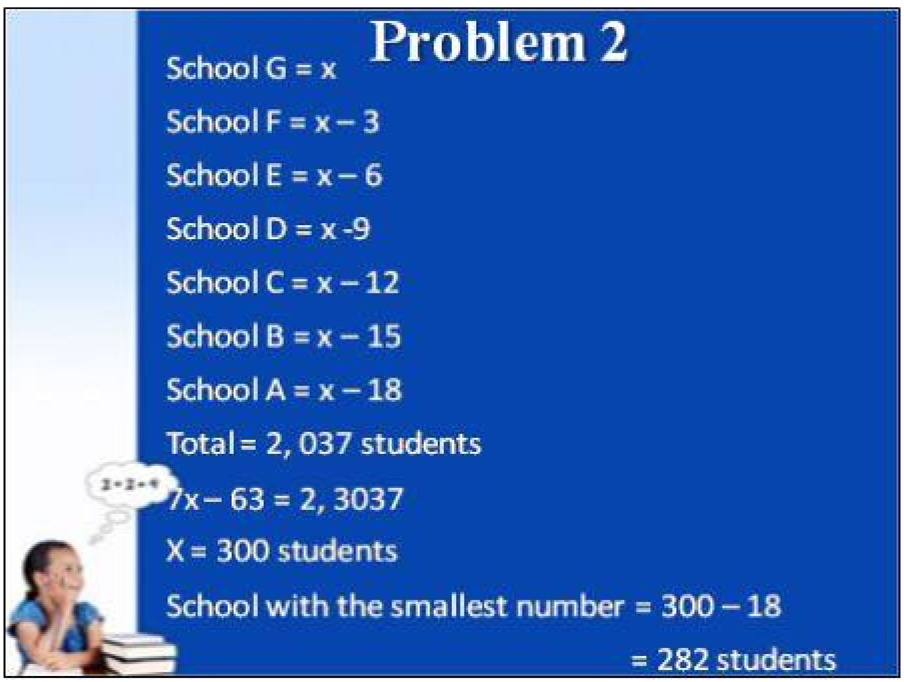

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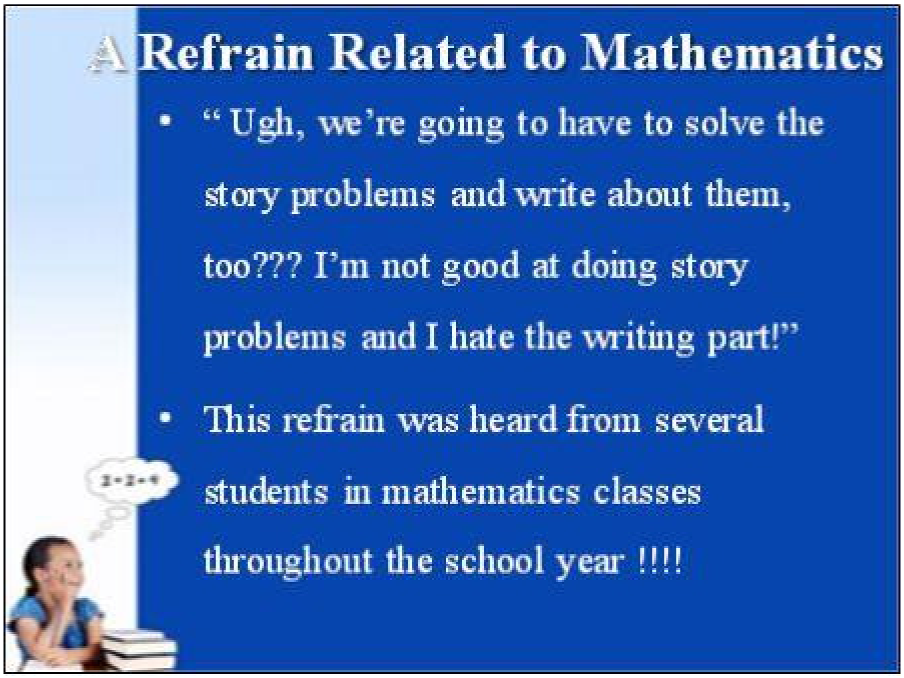

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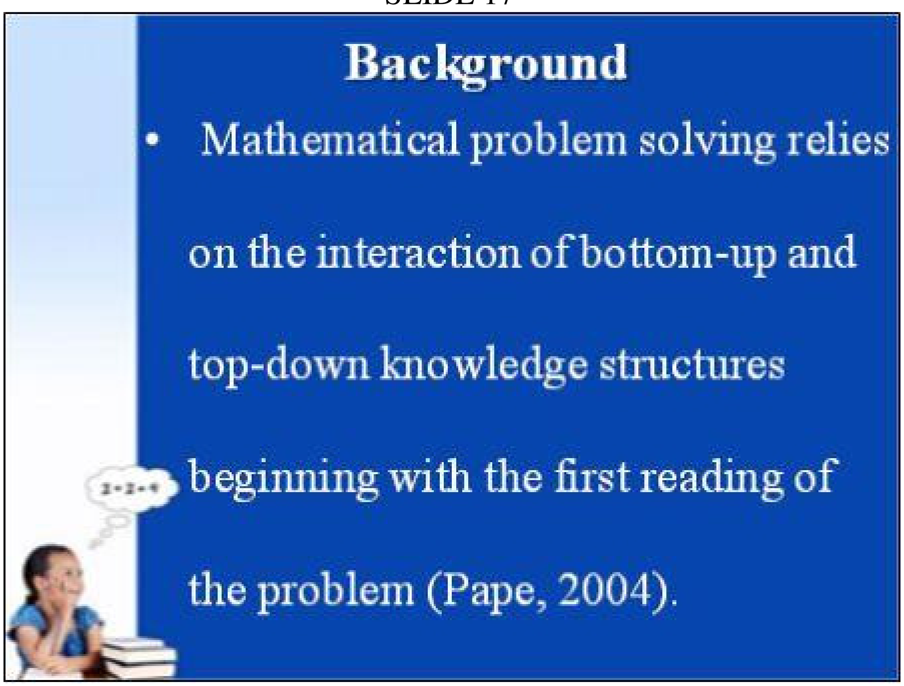

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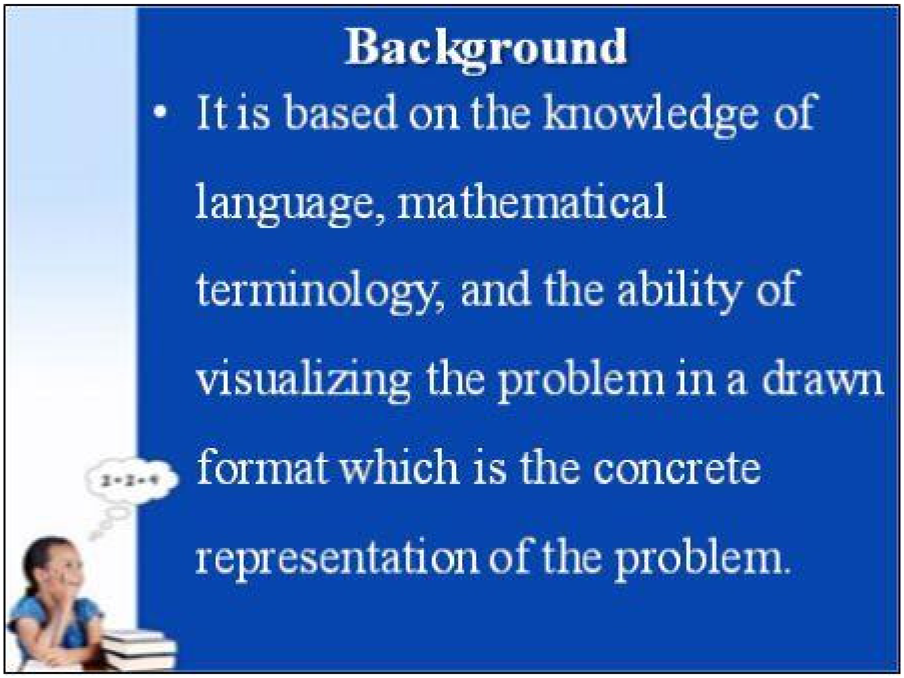

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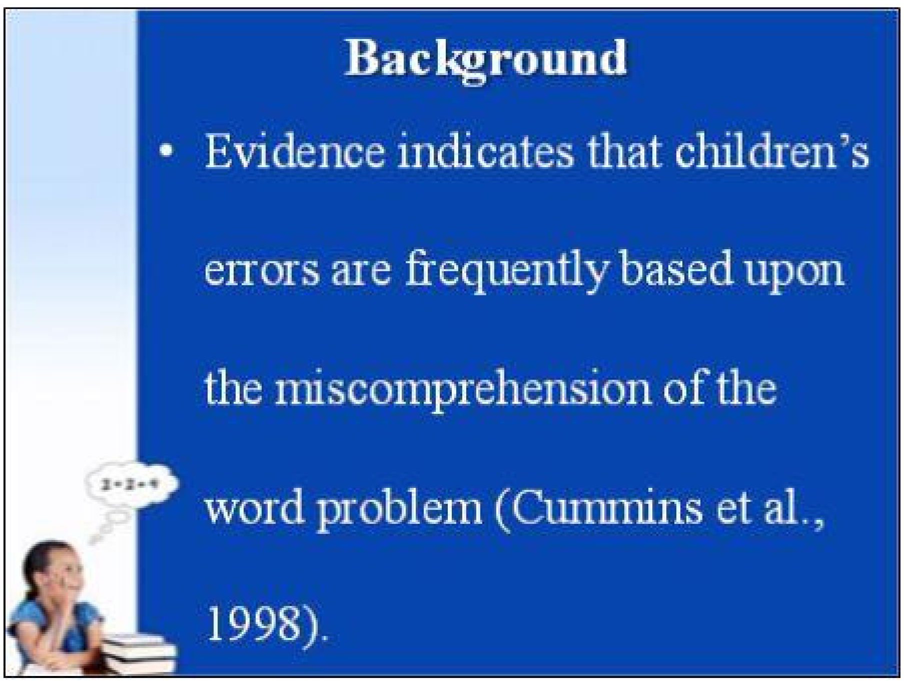

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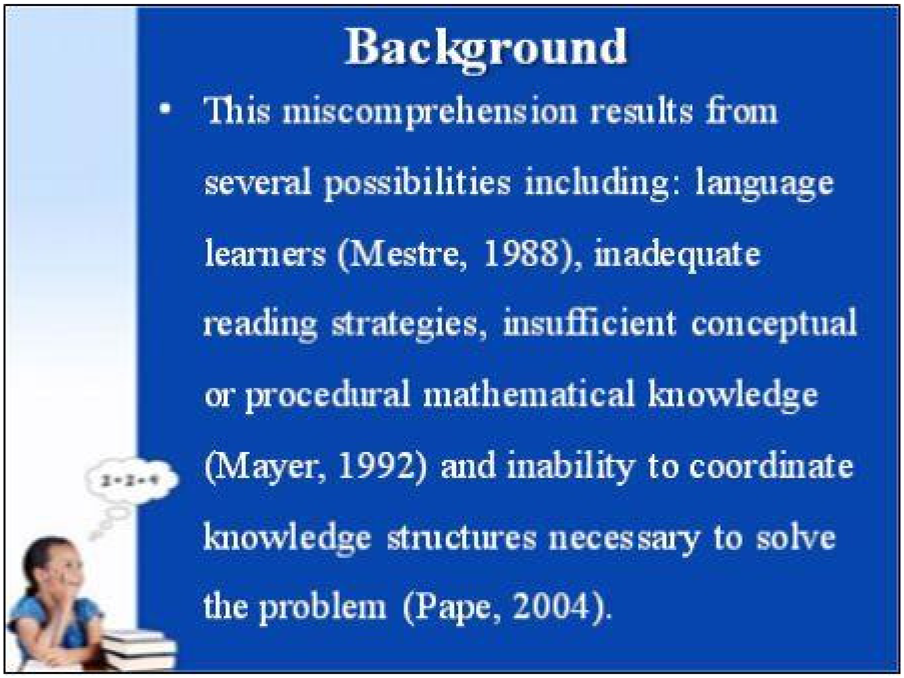

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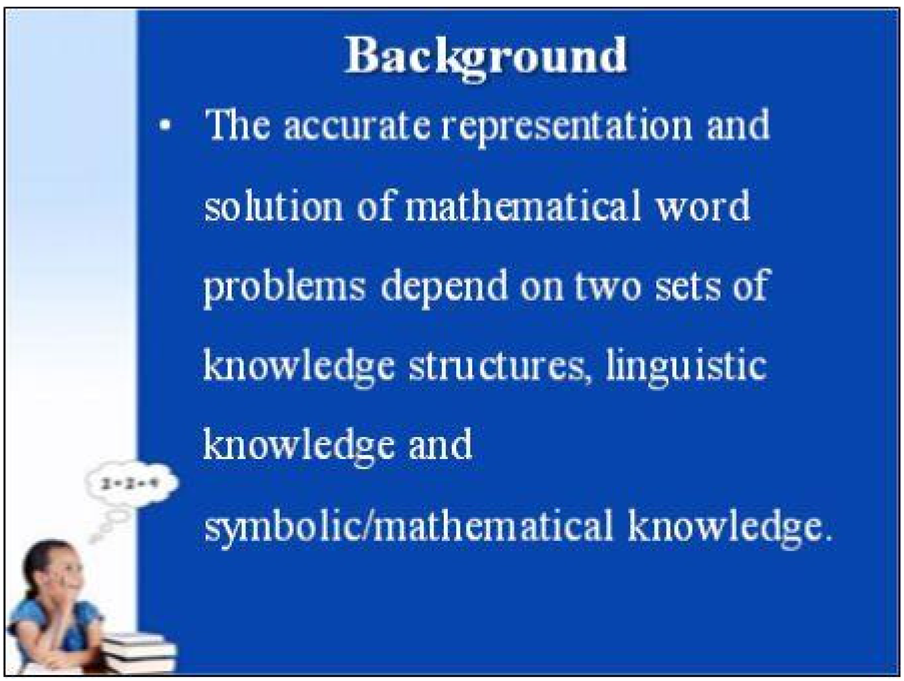

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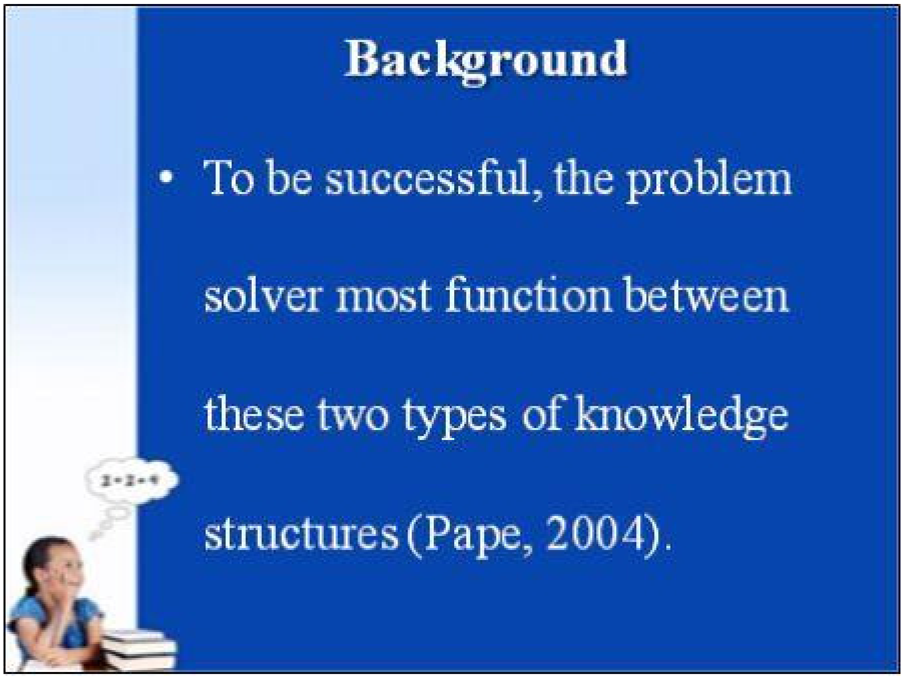

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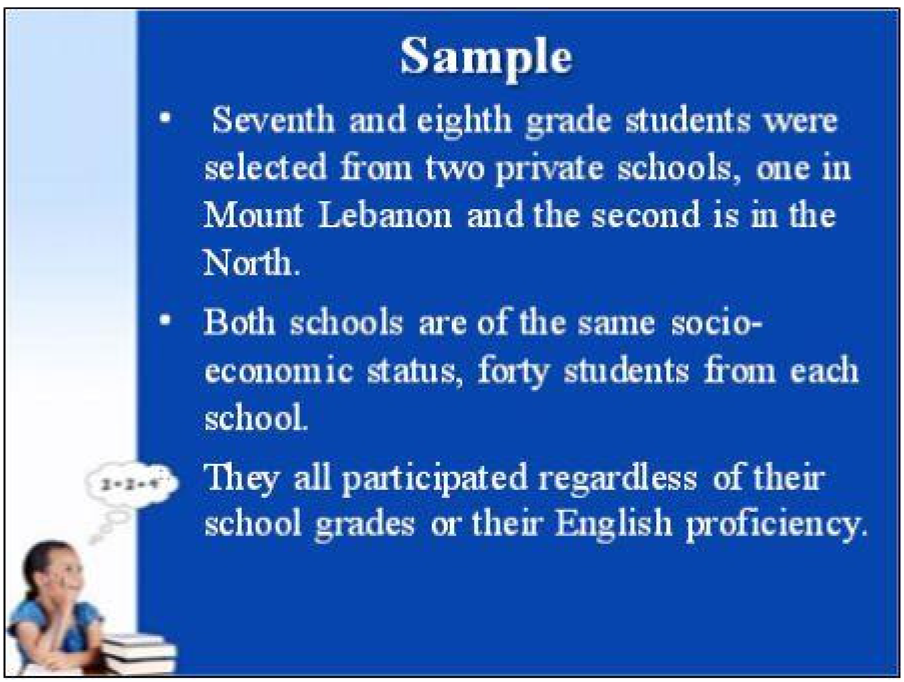

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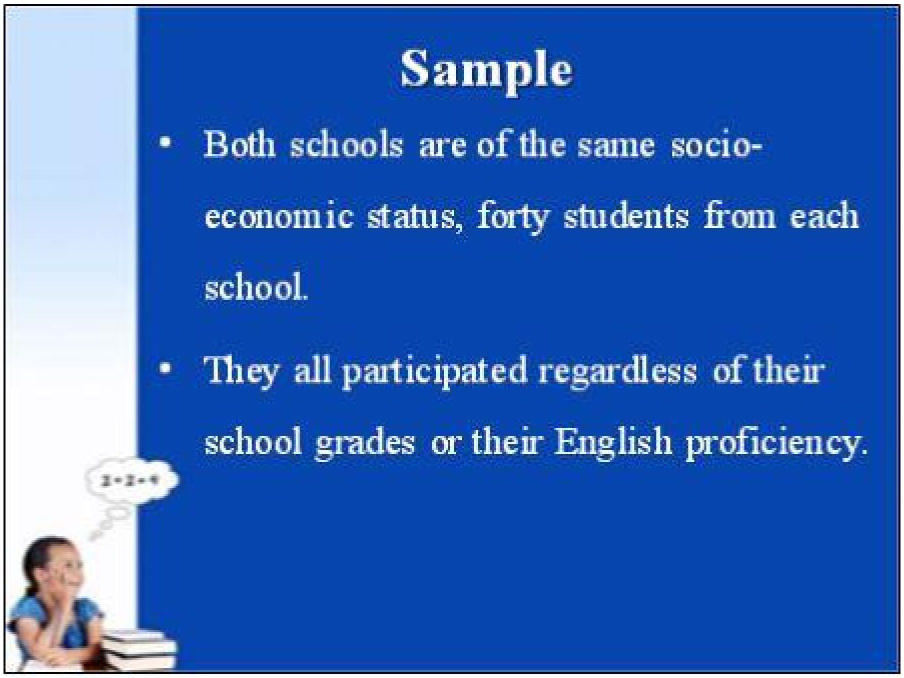

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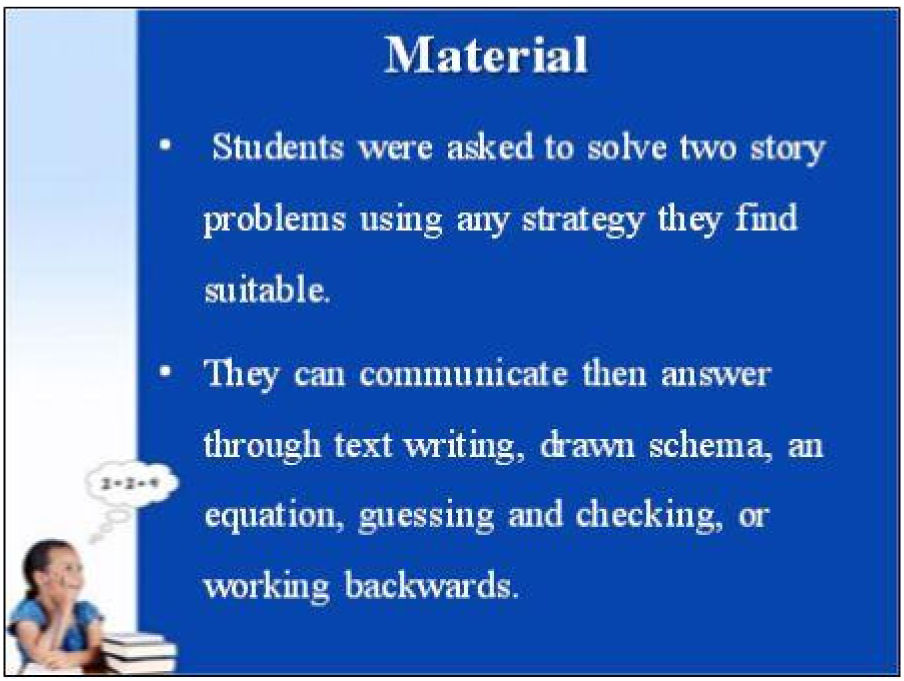

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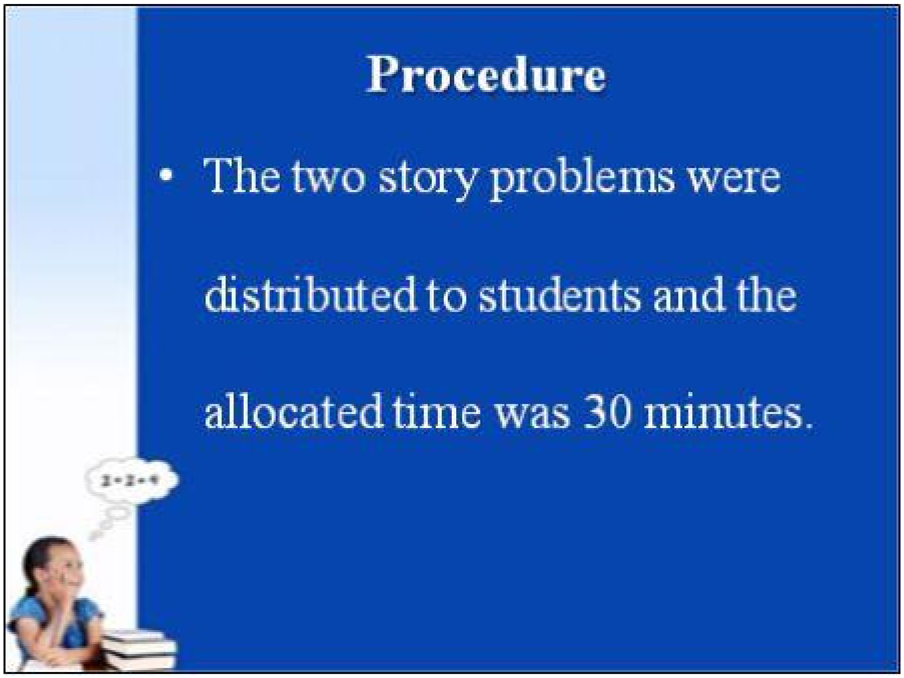

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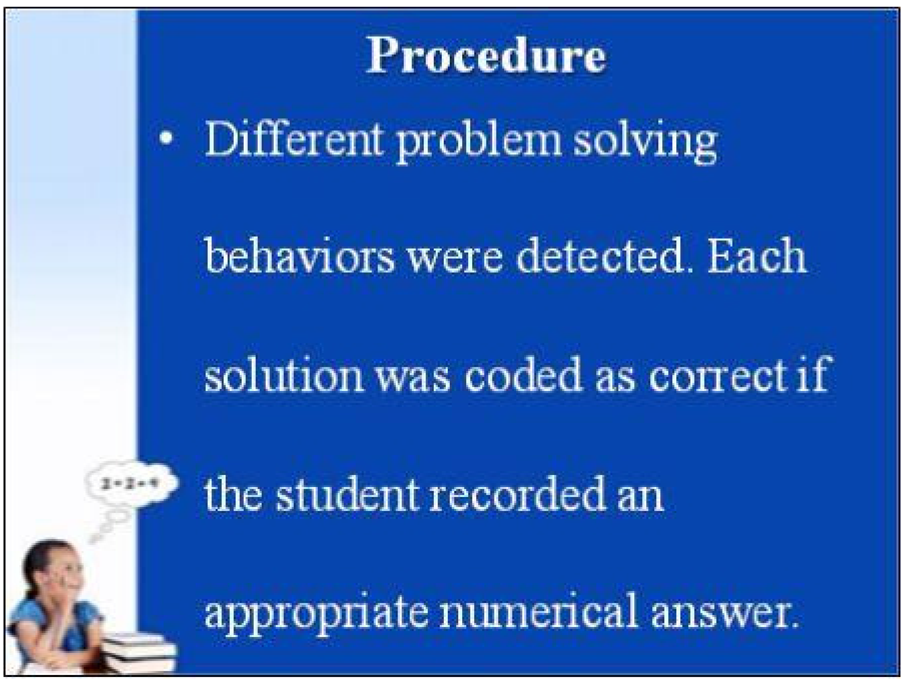

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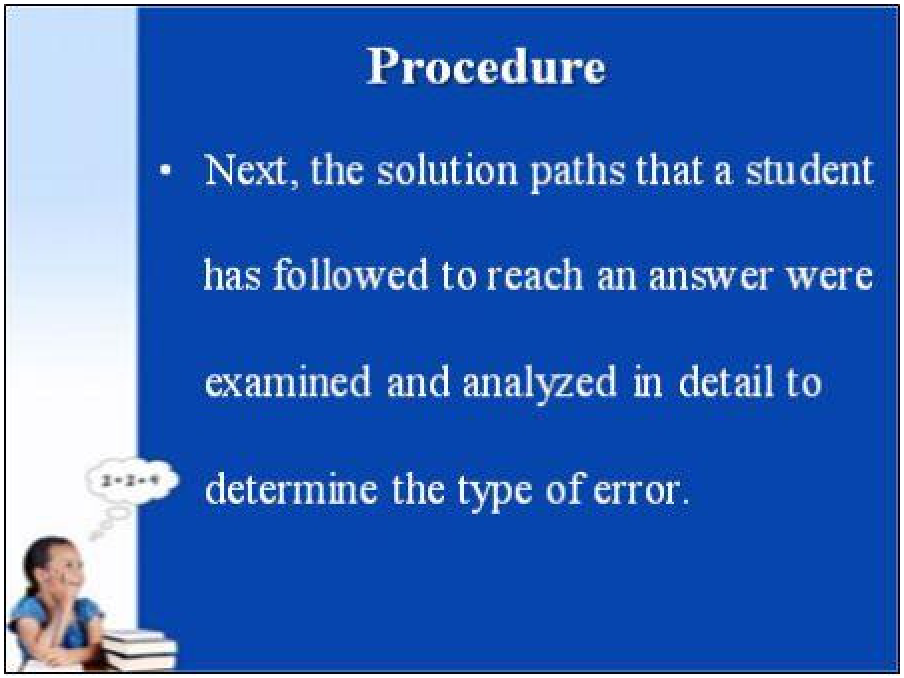

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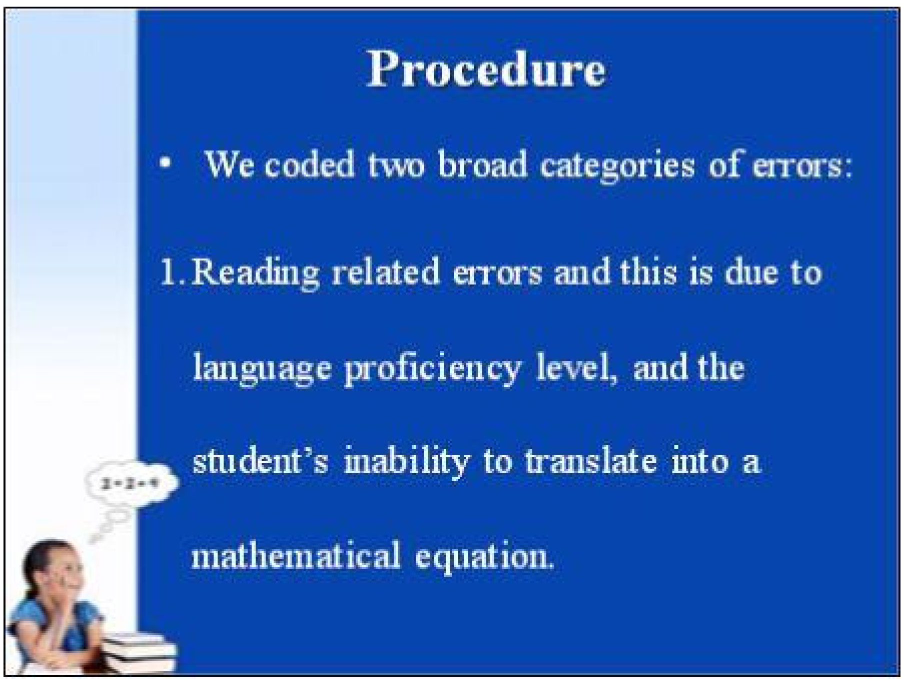

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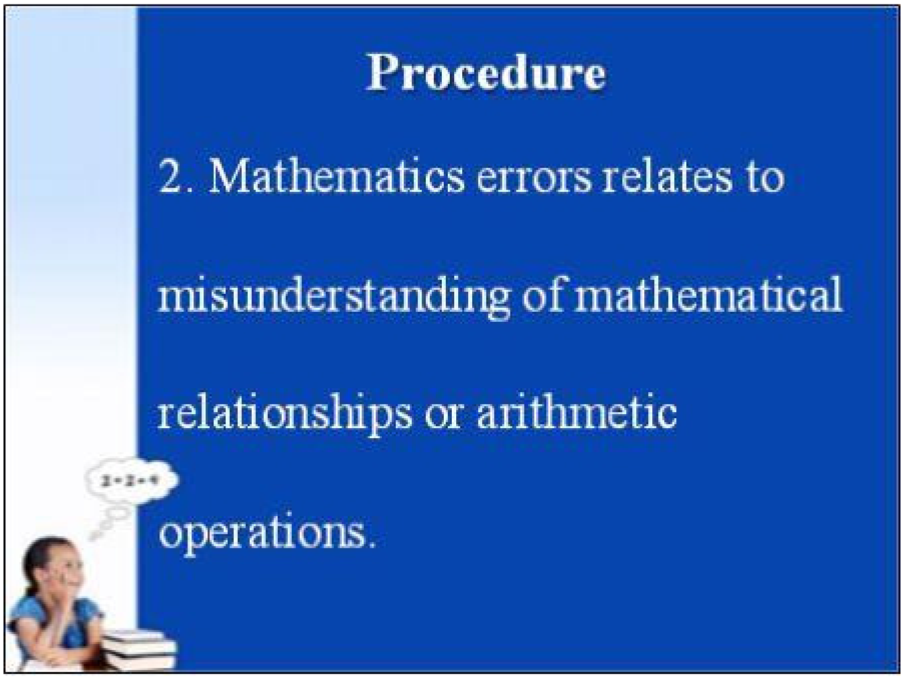

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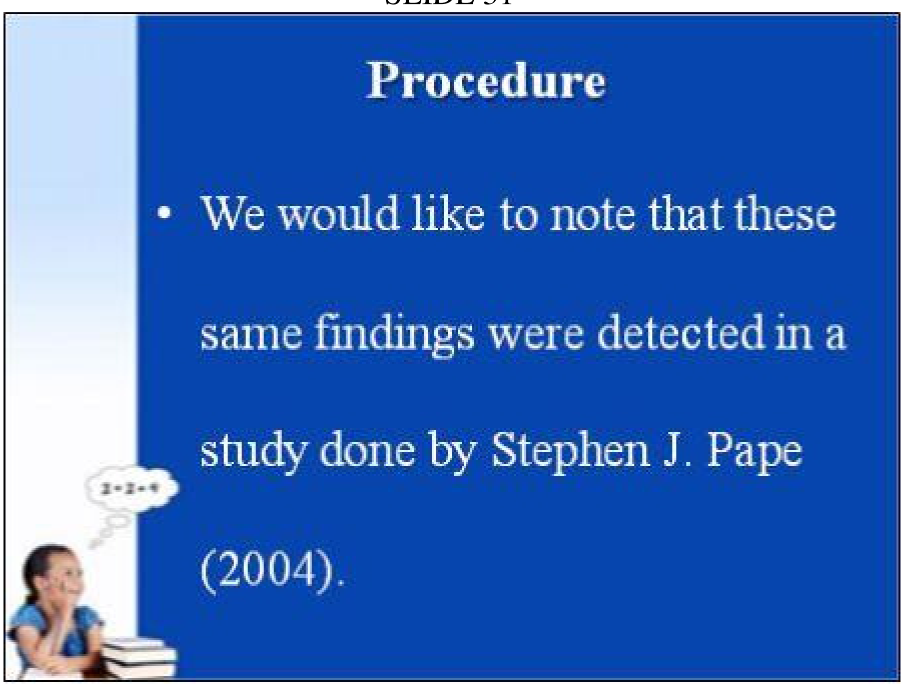

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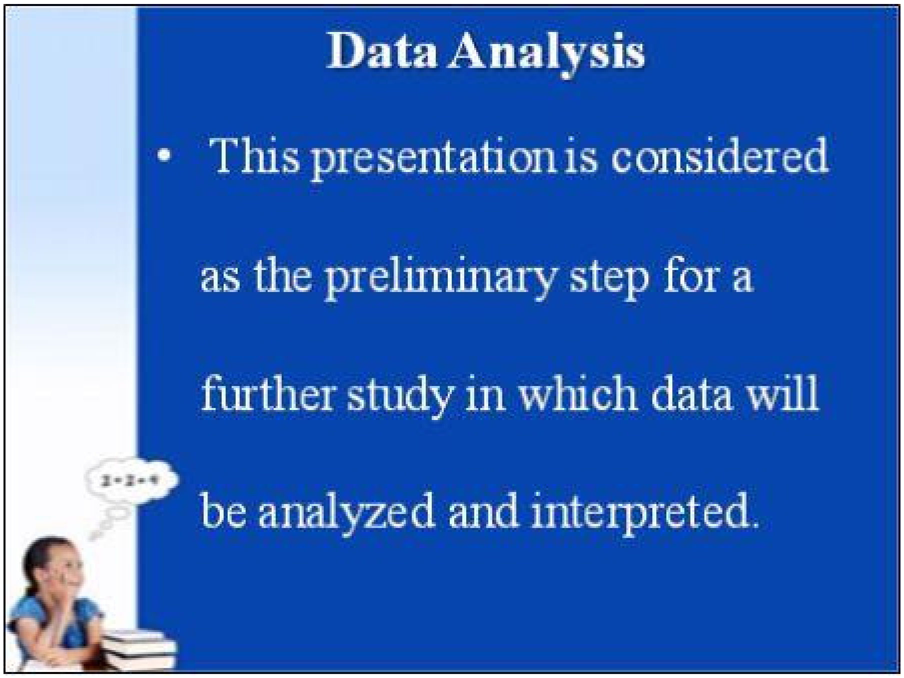

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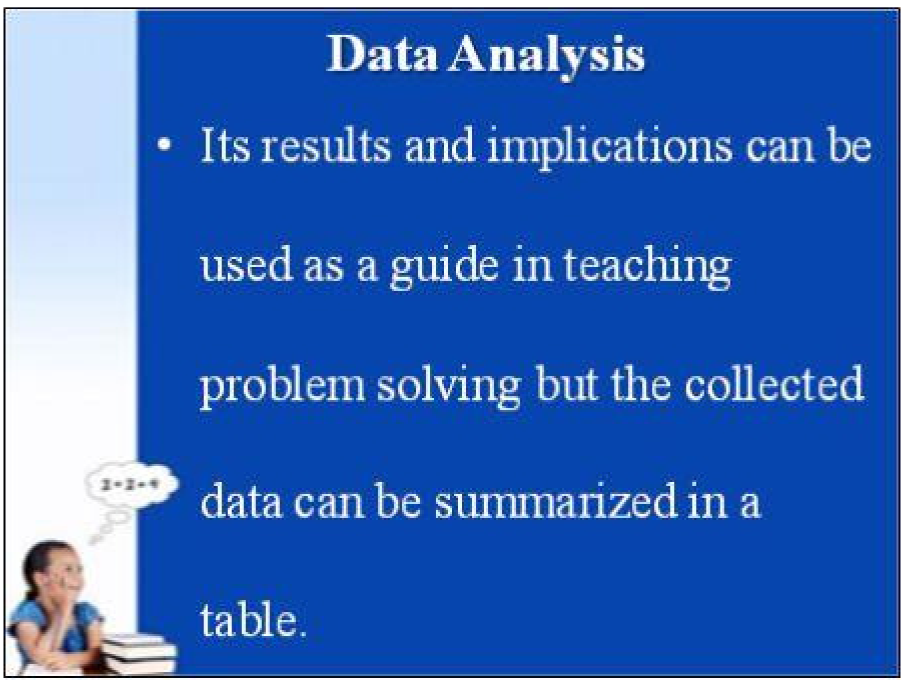

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Data Analysis

	Frequency of Problem Solving Strategy					
	Diagram List	Work backward	Equation	Writing logical reasons	Guess check	Other
Problem 1 (Percentage)	15	3	9	18	21	14
Problem 2 (Schools)	2	6	15	10	22	18
Total	17	9	24	28	43	32

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Data Analysis

	Number of Right and Wrong Answers		
	Right	Wrong	No answer
Problem 1 (Percentage)	33	35	12
Problem 2 (Schools)	15	54	11

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Data Analysis

	Percentage of Right and Wrong Answers	
	Right	Wrong
Problem 1 (Percentage)	41.2 %	44%
Problem 2 (Schools)	19%	68%

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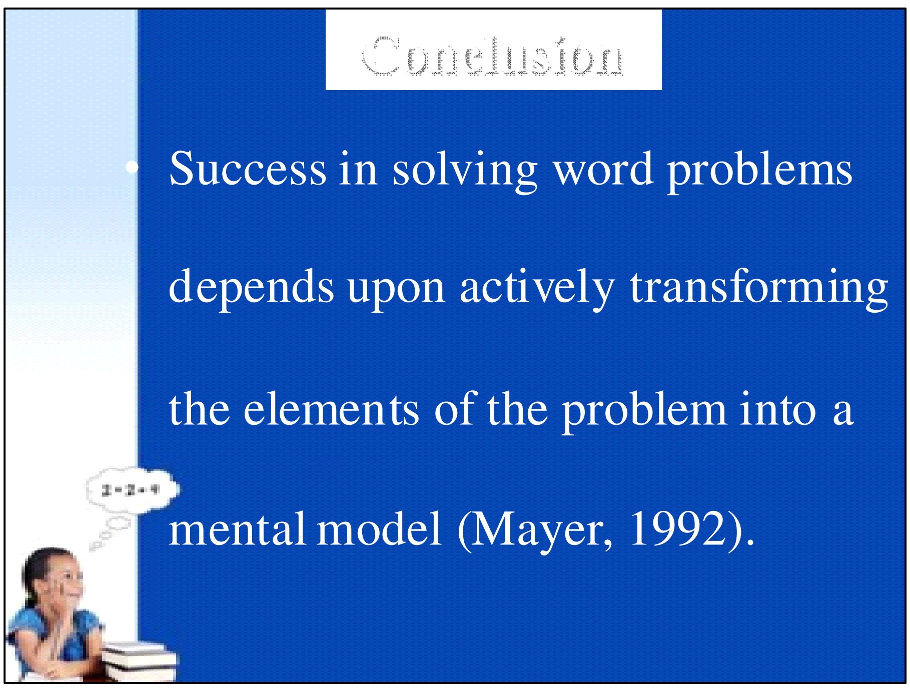

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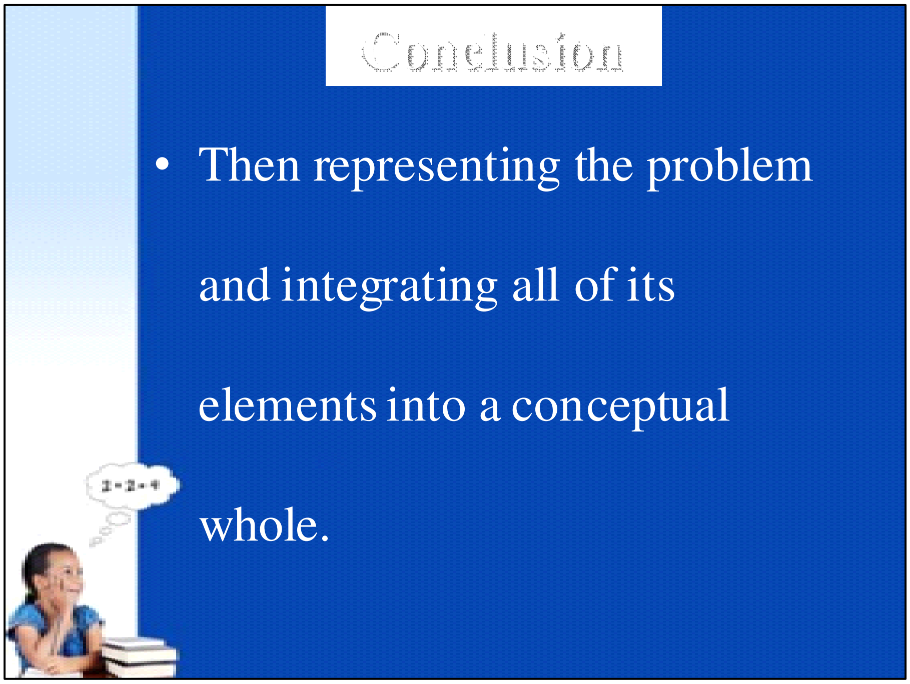

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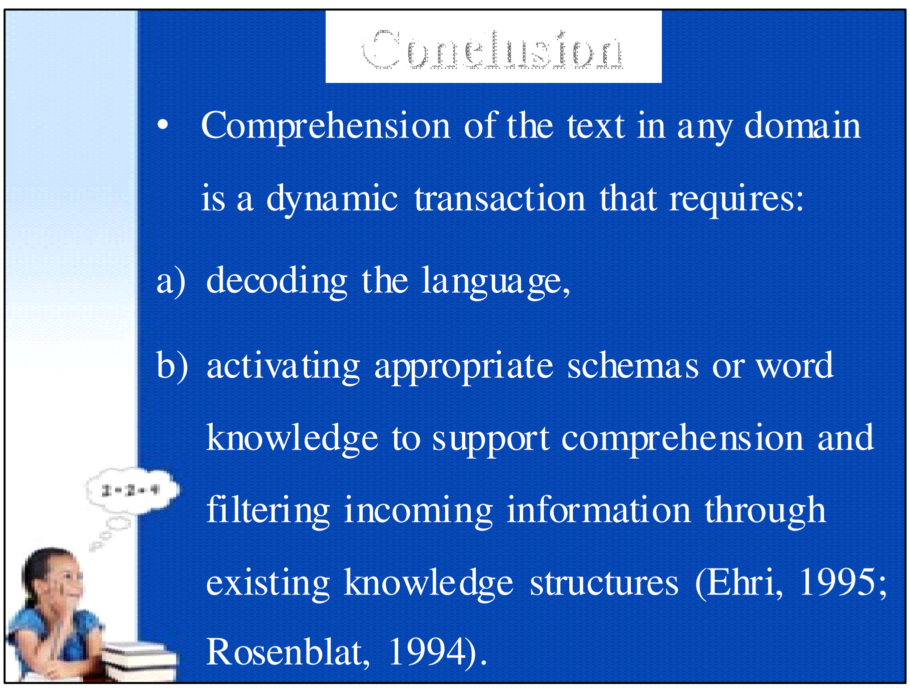

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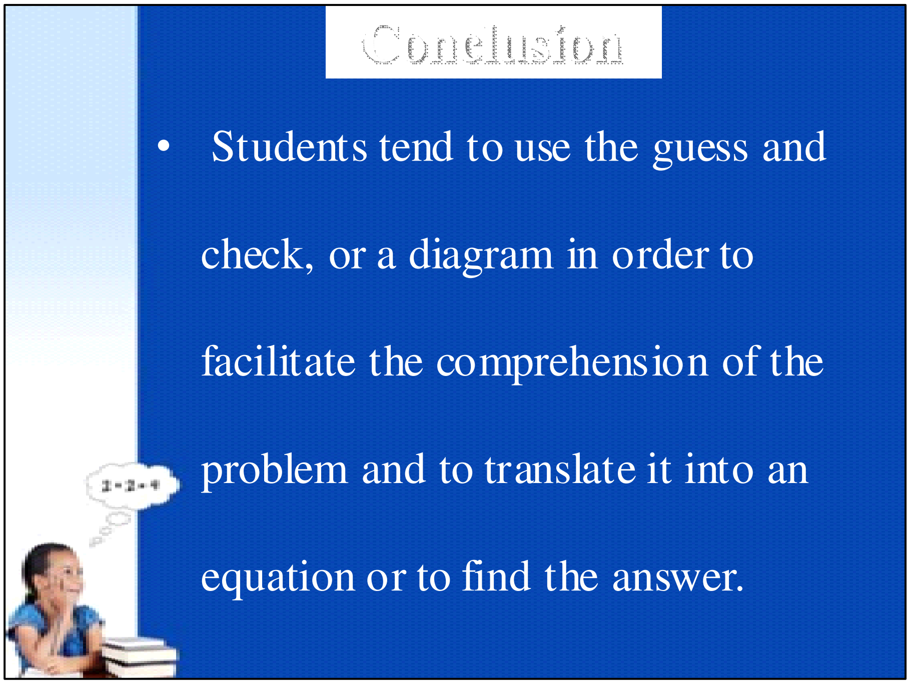

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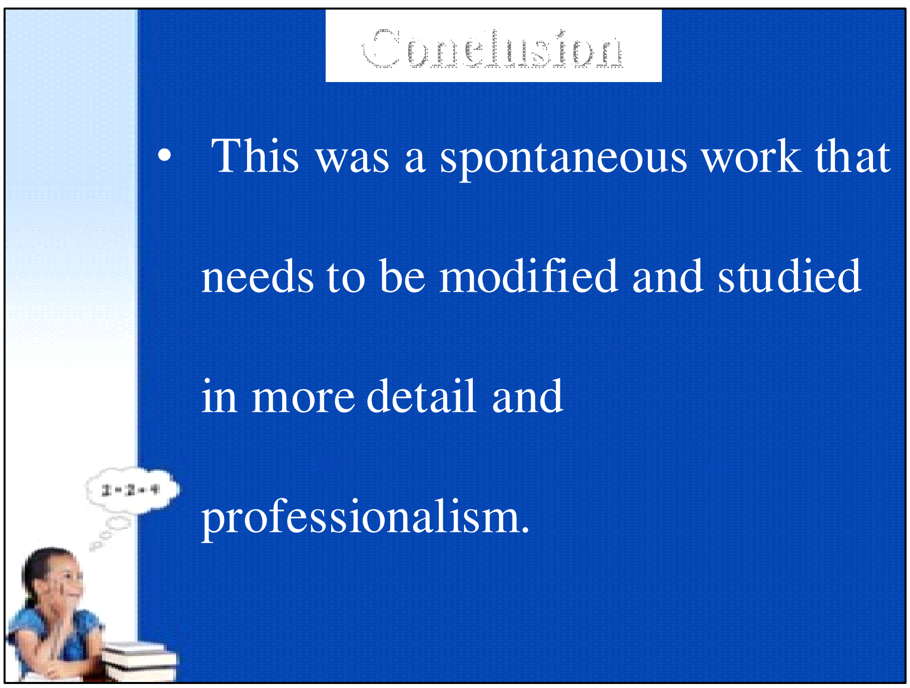

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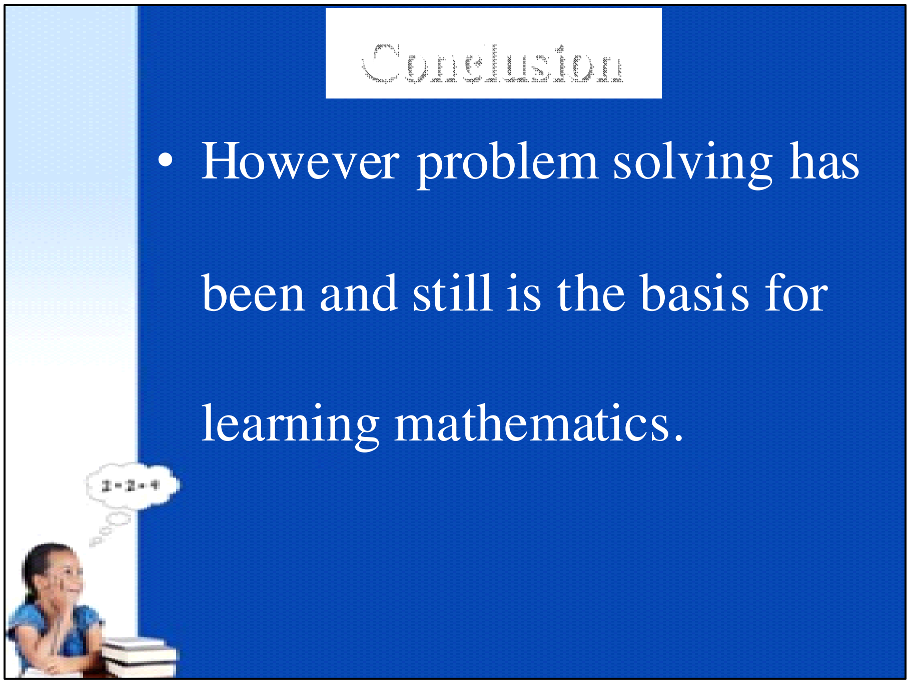

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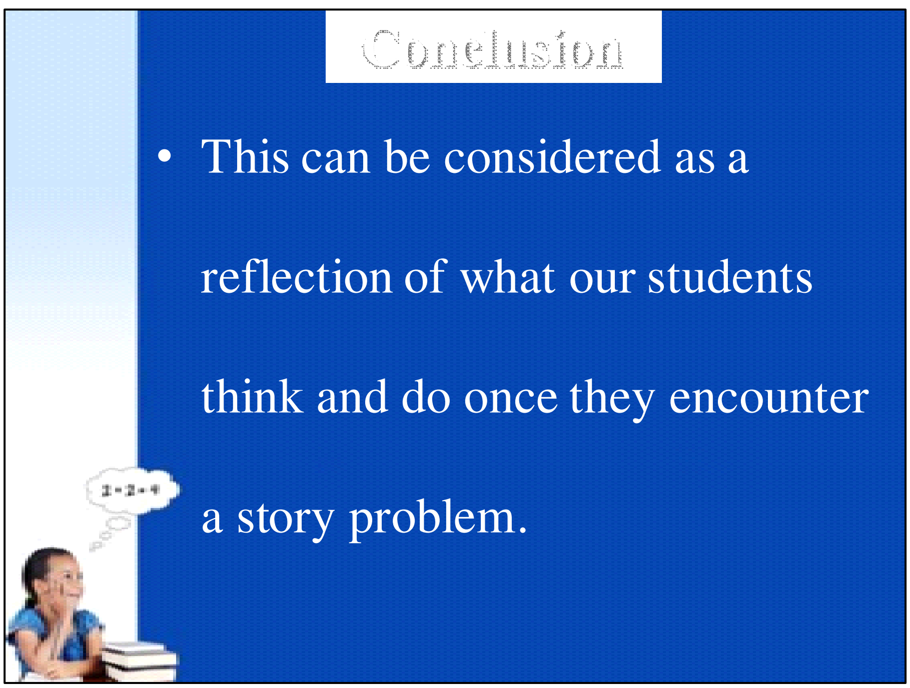

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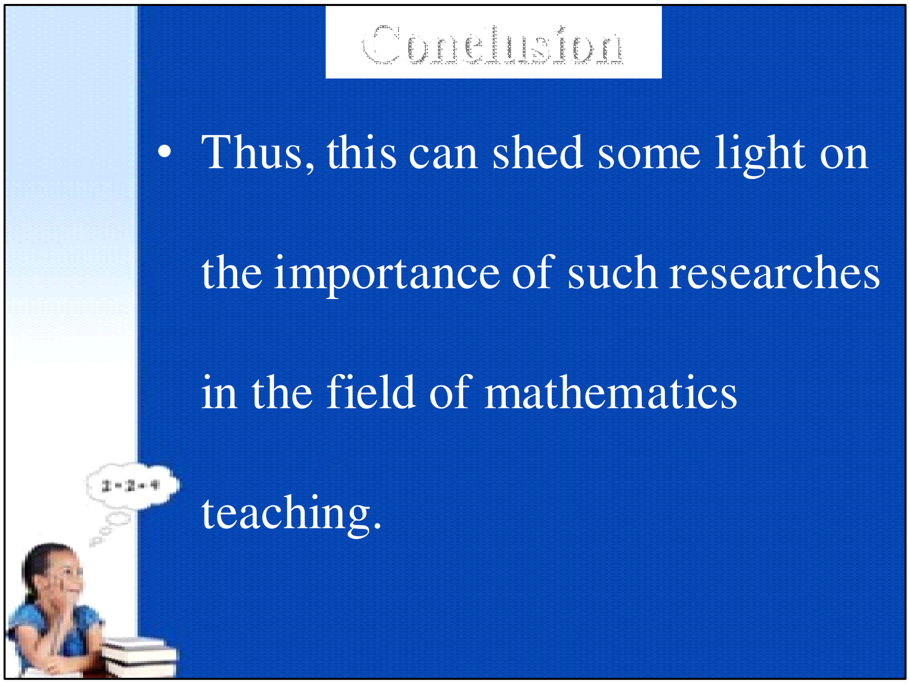

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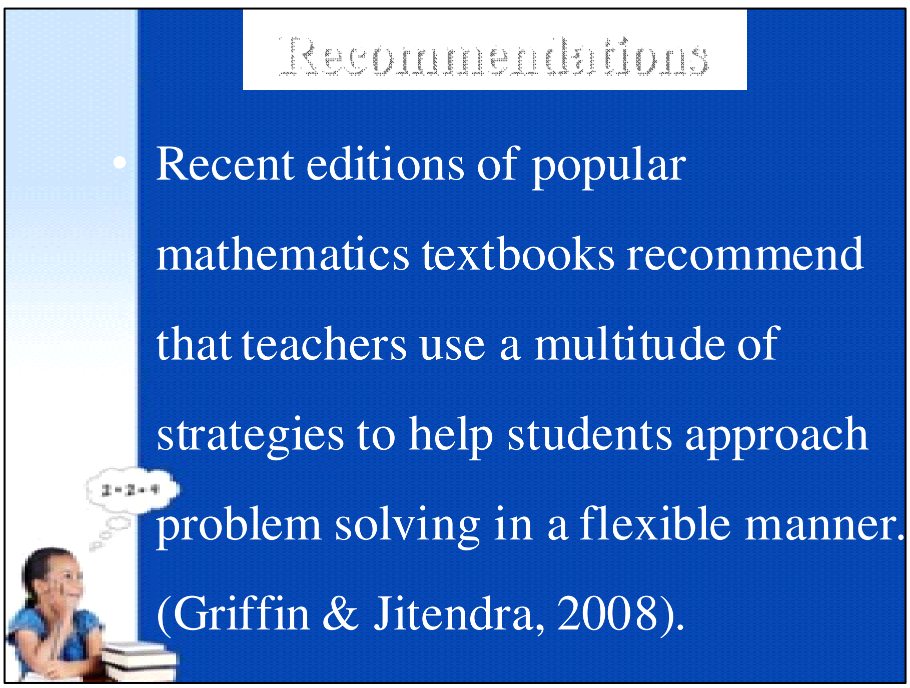

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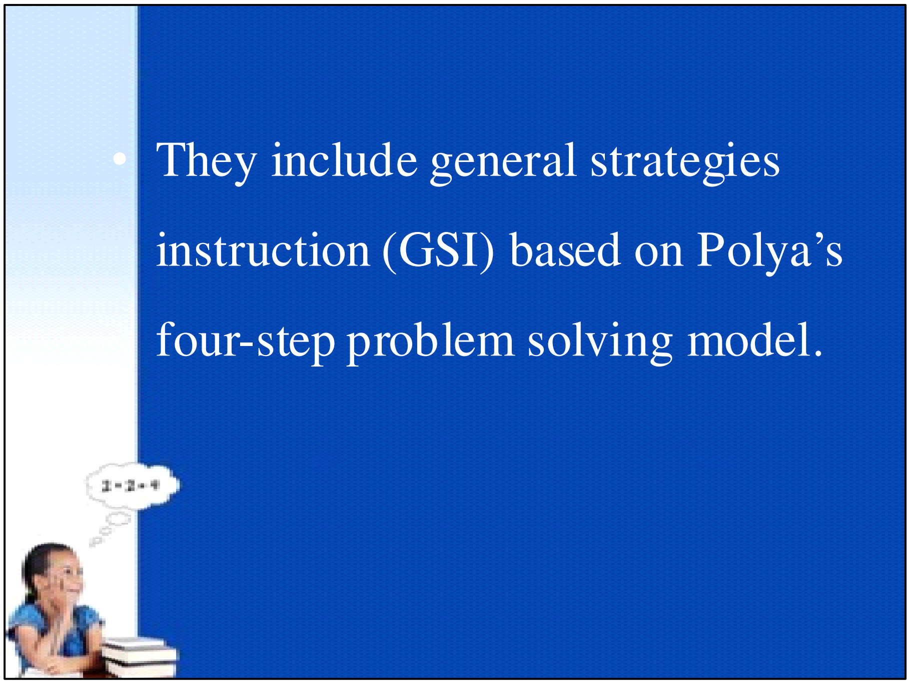

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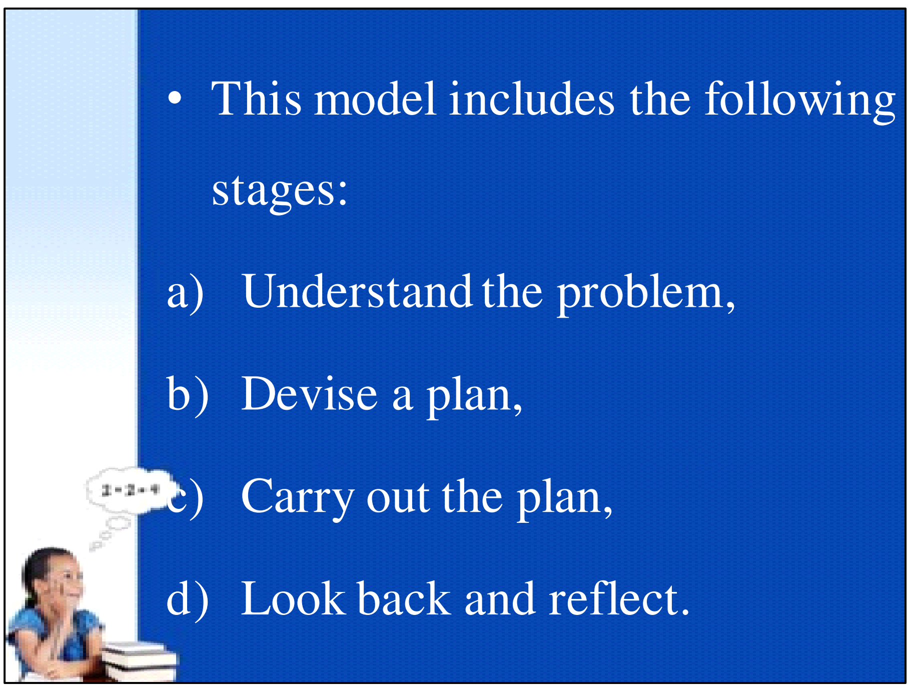

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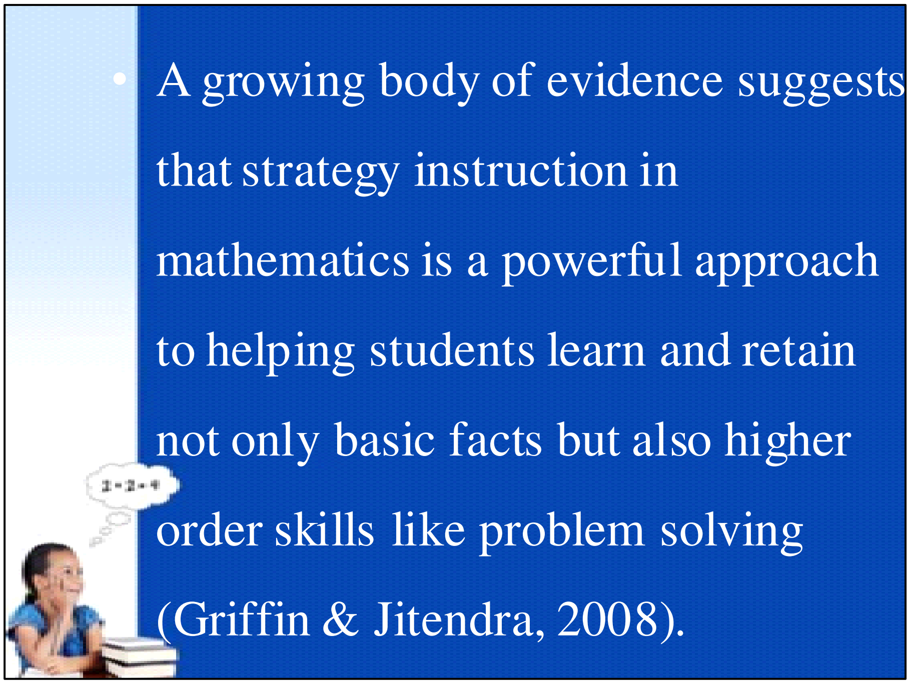

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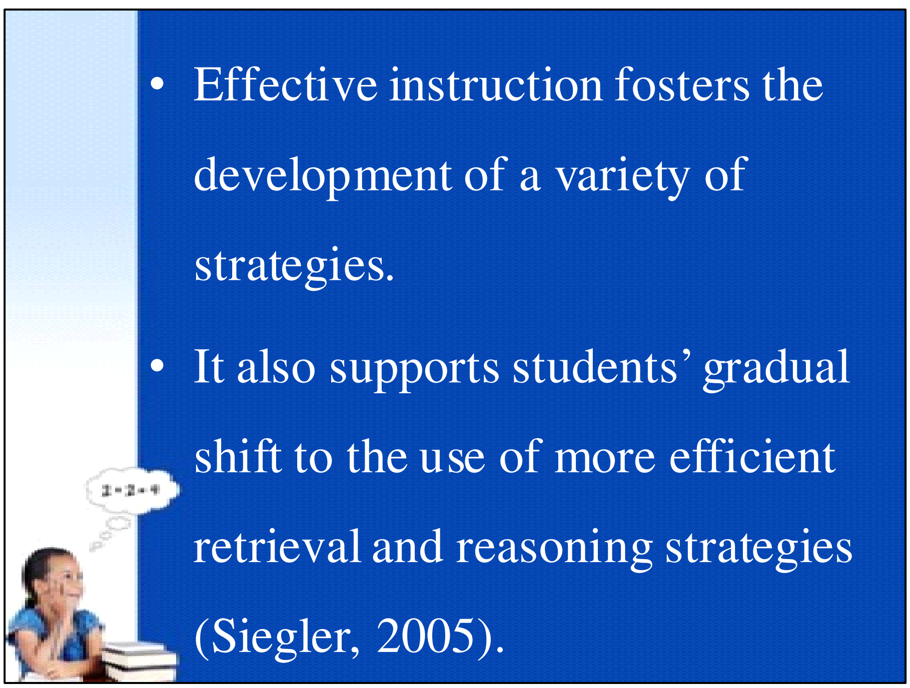

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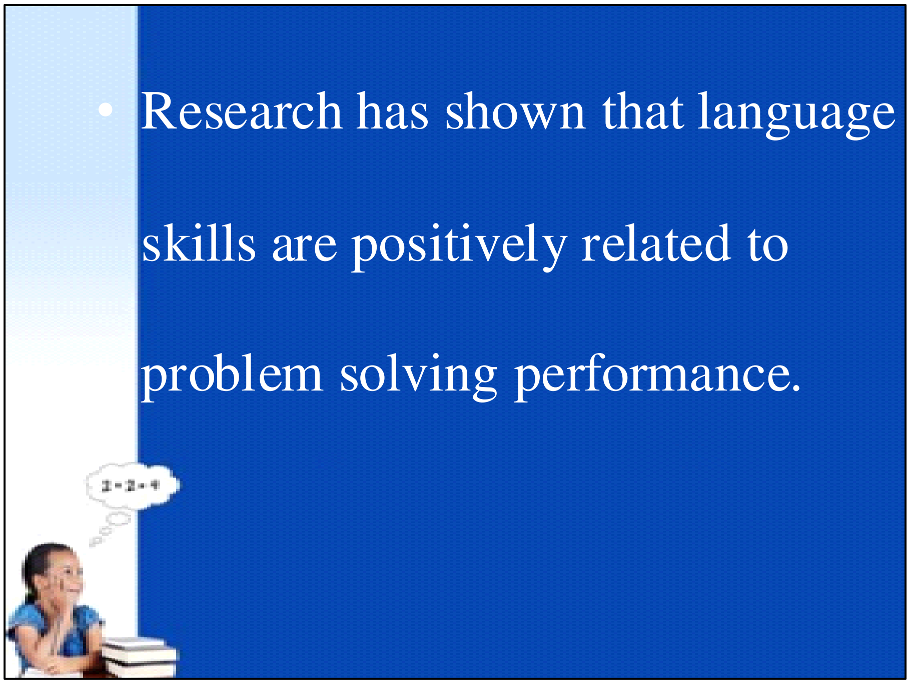

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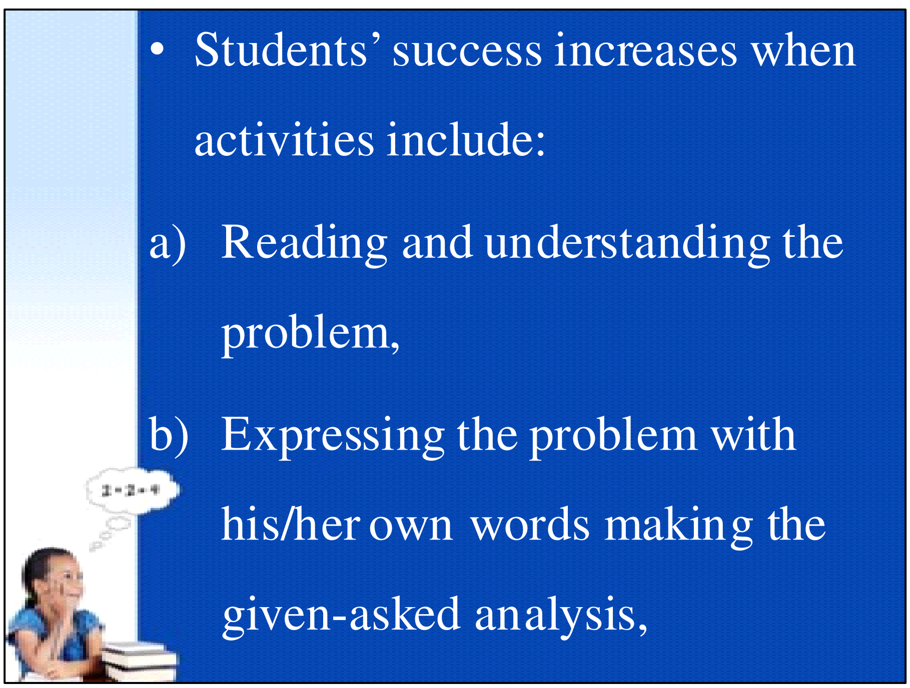

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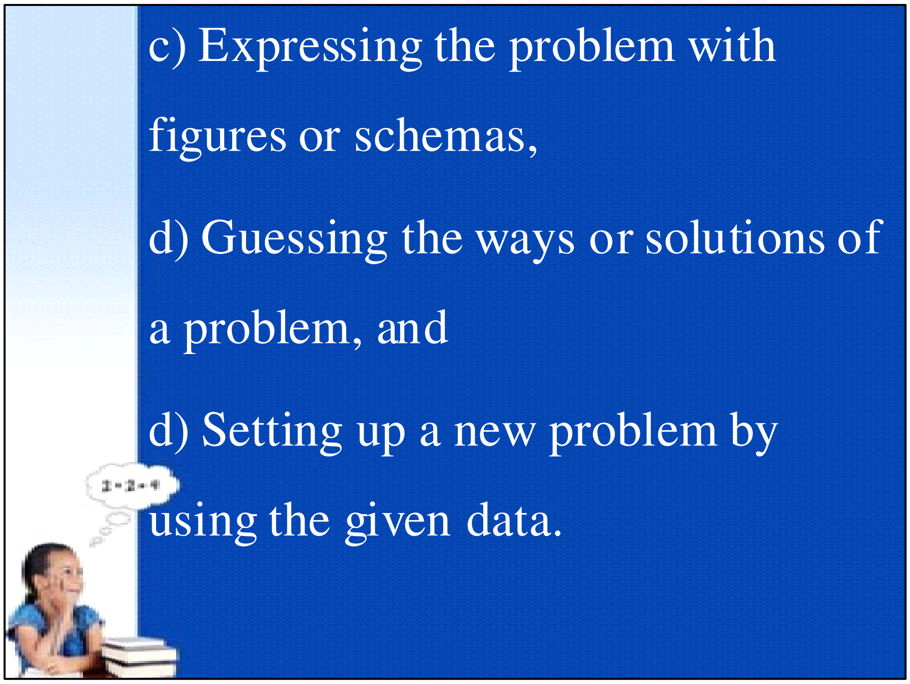

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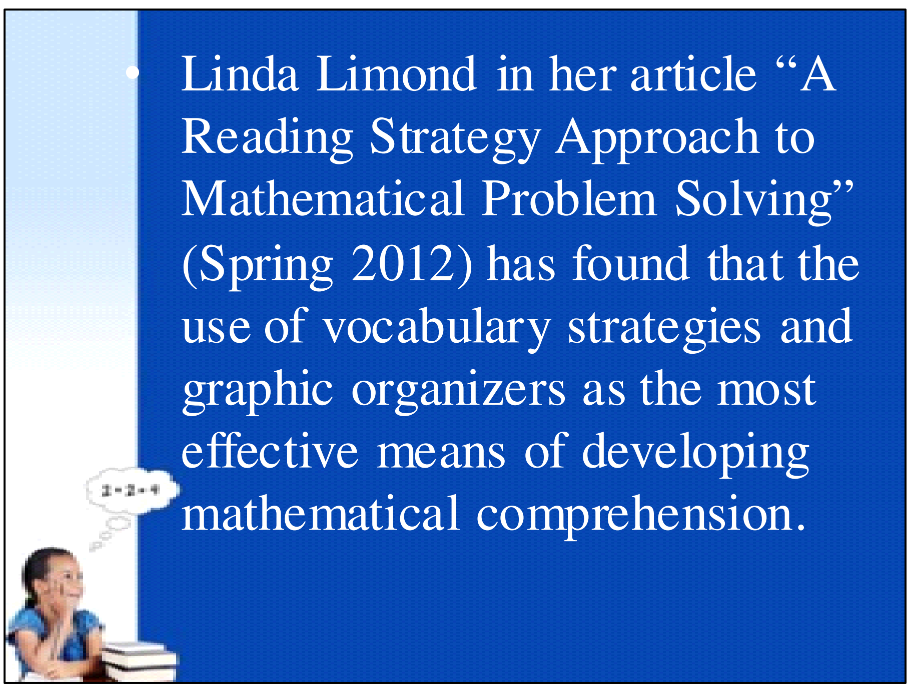

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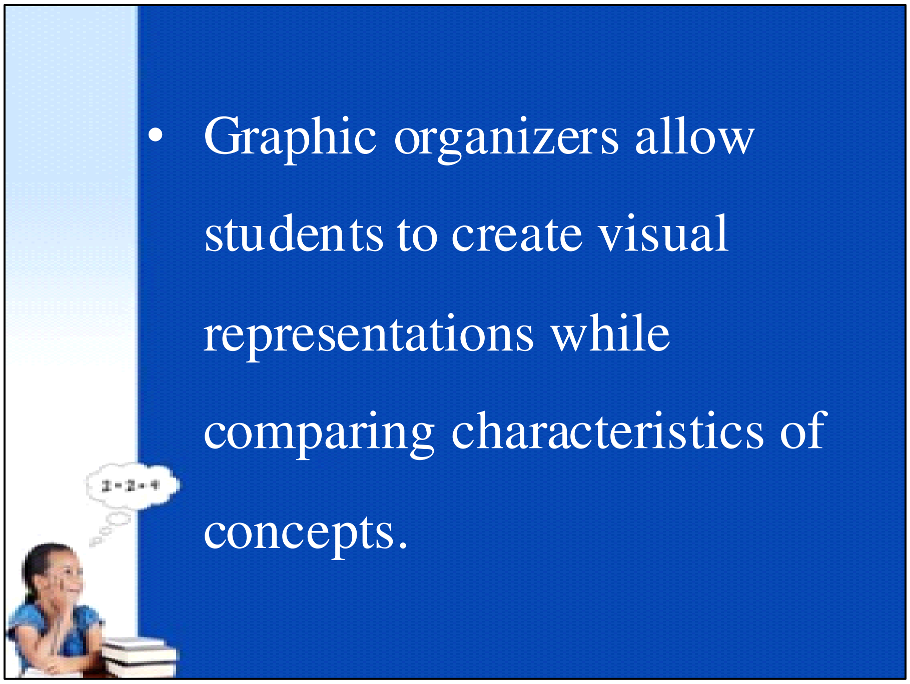

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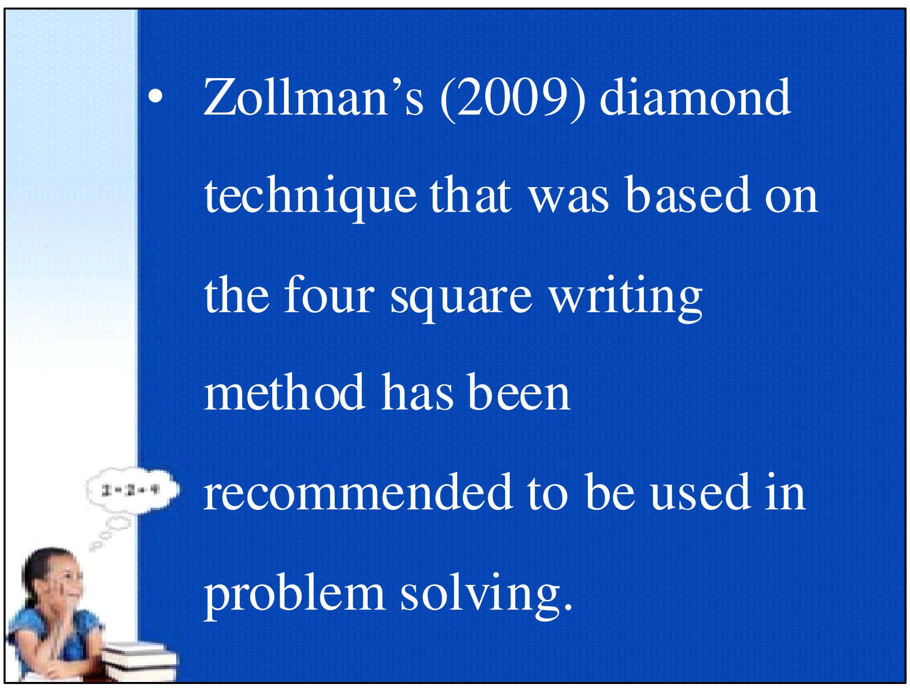

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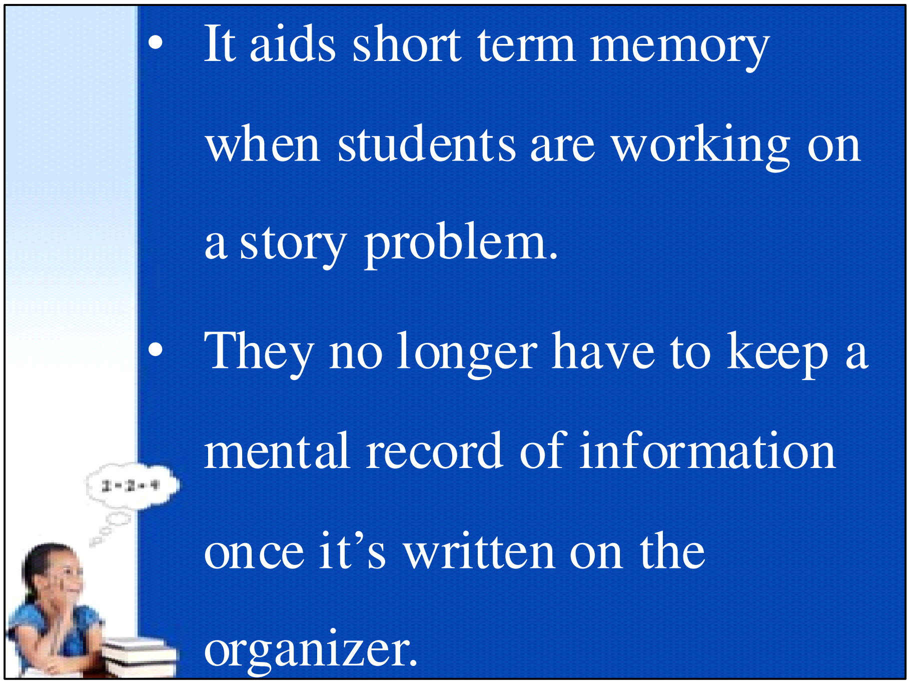

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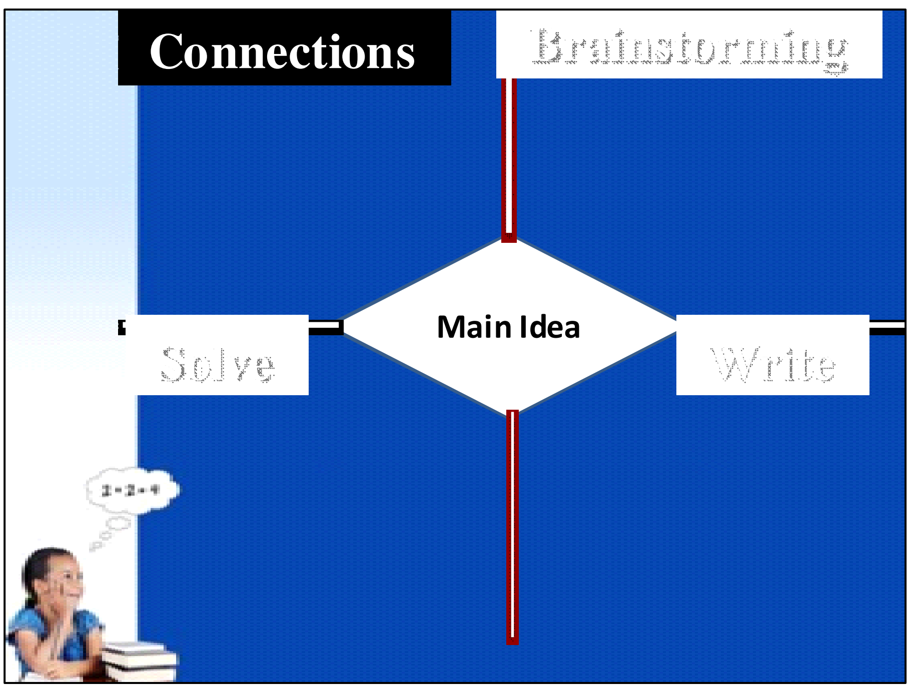

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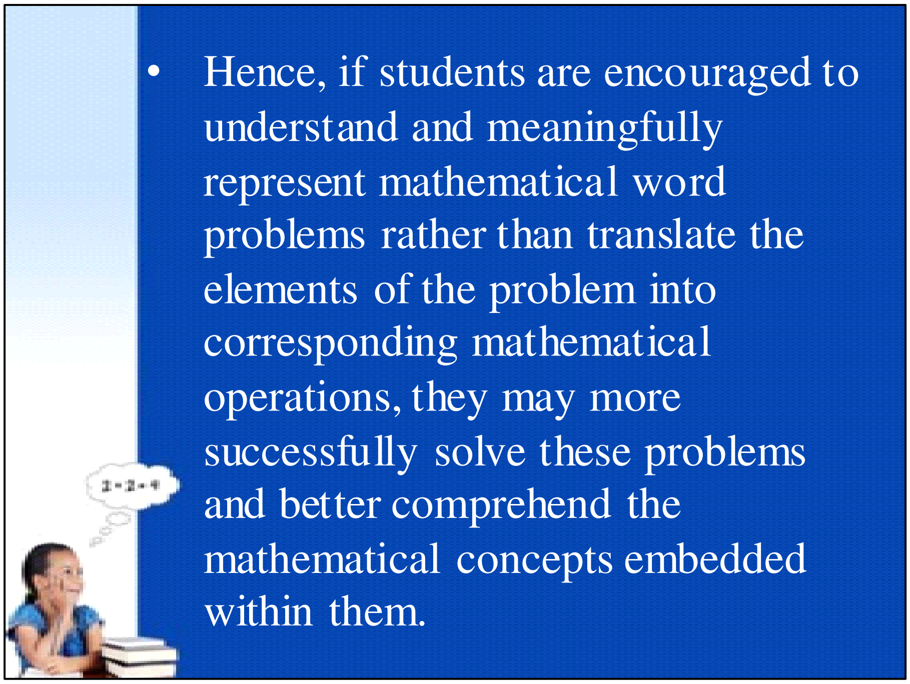

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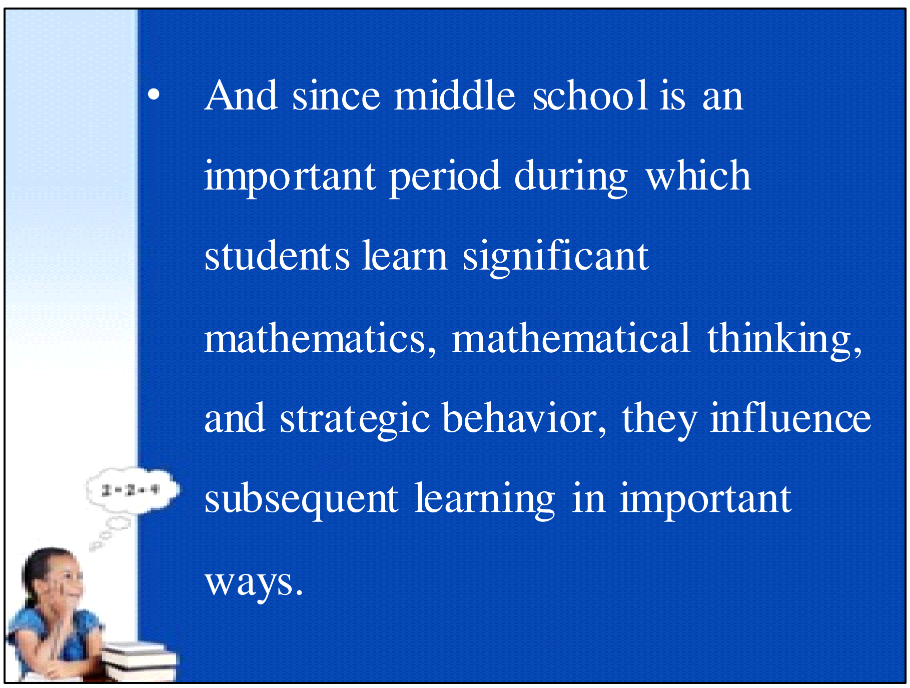

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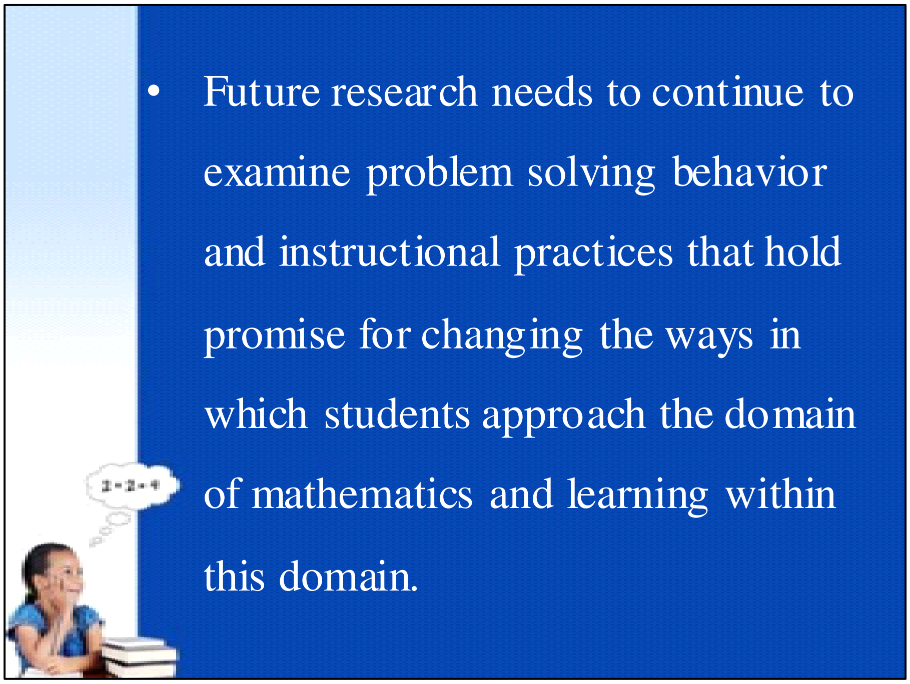

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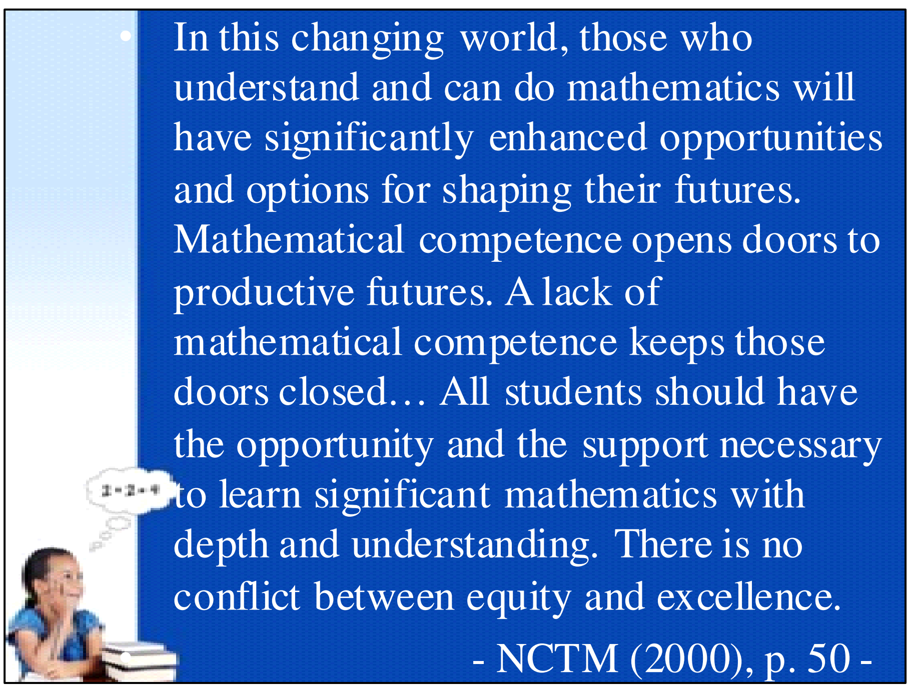

SLIDE 62

Students' Knowledge and Pre-service and In-service Lebanese Public School Teachers' Pedagogical Content Knowledge (PCK) of Absolute Value Concept

Samar Tfaili

Abstract

The aim of this research will be to investigate the in-service and pre-service teachers' pedagogical content knowledge related to the absolute value concept with regard to students' obstacles concerning this concept. The first part of the study will explore students' understanding of the absolute value and try to find out the major obstacles in mastering this concept as well as the reasons behind these obstacles. Data will be collected through an absolute value assessment designed by the researcher and validated by three experts. It will be administered to about 400 grade 11 students in around 20 public high schools in Nabatieh and South Lebanon regions in addition to 10 pre-service teachers in their last year at the university. The second part of the research will consist of interviews with the math teachers of the students in question. The interviews will aim to reveal teachers' abilities to identify students' obstacles, explain their causes, and propose instructional strategies to deal with them. Finally, the research will examine whether there is a relationship between the identification, causal attribution, and proposed instructional strategies of absolute value.

Introduction

As a math teacher, I have noticed that students have difficulties in understanding the concept of absolute value. Some informal interviews with secondary math teachers led to the same conclusion: "Students have difficulties in solving problems with absolute value and we don't know why". A quick review of some of the teachers' guides reveals what is commonly known about the absolute value. In the Hachette teacher's guide for grade 7, it was mentioned that all teachers have noted that students face difficulties when dealing with the absolute value notion. Similarly, in the Magnard series for grade 8, the teacher's guide mentioned "…we go slowly to paragraph III on absolute value because absolute value always distresses students". Unfortunately, although the difficulty of this concept is recognized, no advice is given to overcome it.

Alain Douroux (1983) noted that the experiences of secondary school teachers suggest that the absolute value is the "bête noire" in the manipulation of symbols and computations. One of the indices of difficulty is the collapse of the success rate in an exercise with absolute value, compared to a similar exercise without absolute value. Many other writers (e.g. Atherton, 1971; Parish 1992) have noted that secondary math teachers complain about their students' deficiency when working with absolute value problems. In their study, Kaur and Sharon (1994) assessed their first year college students' knowledge of concepts as $|x|$ and found out that they lack a good grasp of the mathematical meaning of $|x|$.

In their research, Chiarugi, Francassina and Furinghetti (1990) were convinced that the notion of absolute value "while does not present difficulties when used on numbers, originates errors and misconceptions when used on letters". According to them, the difficulty starts with the definition that contains a logical operation (if….then) while students are used to interpret and/or statements. They also assume that students cannot manipulate symbols since their use “has little or no meaning” for them (Booker, 1987). They focus their attention on the algebraic domain because the arithmetic domain doesn’t show any problem. They mentioned that “in passing from the arithmetic to the algebraic domain, students will face difficulties.” At the end of their research they recommended “further developments in the direction of analyzing more in details remedies in teaching. Cognitive science may be of good help.”

Arcidiacono (1983) in his report sees the problem of solving absolute value very difficult because students have to analyze it by breaking it down into cases. He suggests that a visual approach will illustrate and facilitate the breakdown of the problem into cases. According to experimentation, he found that a graphic approach was “very helpful in the classroom.” Parish (1992) states that the introduction of the concept of absolute value the way it is normally approached causes complications for many students. He suggests an approach different to the one teachers are used to and found in textbooks. This approach “involves considerations of the function concept as the graph generated by associated ordered pairs of real numbers rather than functional values as obtained from the standard definition of absolute value.” According to him, “once the students are comfortable with such a pictorial approach”, the teacher can introduce the usual abstract form of the definition of the absolute value.

The second part of the definition of the absolute value function ($|x| = -x$ if $x<0$) is another source of considerable confusion as Sink (1979) stated in his paper. He says that students are used to thinking that the absolute value of a quantity is equal to a nonnegative quantity. So, saying that $|x| = x$ if $x > 0$ passes without questioning and the majority of students do not take into consideration the condition $x > 0$. That’s why when they are told that $|x| = - x$ if $x < 0$, it contradicts the fact that the absolute value is non-negative. According to him, “we are only fooling ourselves if we believe that the average student does any more than read the condition $x < 0$ or even understands its significance”. He further stated that that here is “where the teaching begins” because one reason of our weakness is that we see the problem “through the eyes of many years of experience” while the student is seeing it for the first time (p. 193). He refers to the solution of this conflict as what he calls the “art of teaching”.

Some pedagogical and teaching strategies have been suggested to overcome the difficulties in the understanding the absolute value concept. Parish (1992) suggests considering the function concept as the graph generated by associated ordered pairs of real numbers. Also, Arcidiacono (1983) suggests that a visual approach will illustrate and facilitate the breakdown of the problem into cases. Furthermore, Ahuja (1976) suggests considering absolute value in terms of distance, making the definition of absolute value for real numbers x and y as $| x-y |$. Finally, according to Fennema and Franke (1992), to be able to present a topic using multiple representations, teachers must be equipped with all the components of a mathematics teacher’s knowledge: 1) Knowledge of mathematics; 2) Knowledge of mathematical representations; 3) Knowledge of students (students’ cognitions); and 4) Knowledge of teaching and decision making.

Theoretical Background

In analyzing students' work, I will refer to the notion of obstacle as defined by Duroux which is "*knowledge that acts in a certain way on a set of situations and for certain values of the variables of these situations. It is knowledge that produces special mistakes that can be observed and analyzed*". Duroux (1983) hypothesized that the persistent errors about the absolute value are caused by "concept-obstacles". This concept of epistemological obstacle was discussed and analyzed by Brousseau (1983). He stated that teachers play an important role in the teaching-learning process by creating a "milieu" that helps students to adapt their learning to new situations. Errors, according to him, are not symbol of ignorance, uncertainty, or chance, but a consequence of previous knowledge which was true and applicable in previous situations but has turned out to be inapplicable or wrong in new situations.

In analyzing teachers' interviews, I will refer to pedagogical content knowledge (PCK) as defined by Shulman (1986) as: 1) knowledge of subject matter; 2) understanding of students' conceptions of the subject; 3) teaching strategies; 4) curriculum knowledge; 5) knowledge of educational contexts; and 6) knowledge of the purposes of education.

With this background in mind, this research will aim to answer the following questions:

1. What is secondary students' knowledge of absolute value?
2. What pedagogical content knowledge of the misconceptions of absolute value is held by first secondary teachers?
3. To what degree do teachers seem to possess the knowledge to explain the causes of student's misconceptions of absolute value?
4. What are the instructional strategies proposed by mathematics teachers for dealing with students' misconceptions of the absolute value concept?
5. Is there a relationship between the identification, causal attribution, and proposed instructional strategies of absolute value misconceptions?

Method

Participants

Around 500 students from 20 public schools in the region of Nabatieh and South Lebanon will participate in this study. The schools will be chosen randomly, and one grade 11 class will be chosen randomly from each school. The students of the chosen classes will perform the absolute value test. Teachers of the chosen classes will also be interviewed (they will be around 20 teachers). The sample of pre-service teachers will be chosen from the students of Secondary School Teachers Diploma- on the condition that they do not have any teaching experience- at the faculty of education at the Lebanese university. The highest 10 achievers and the lowest 10 achievers will be chosen.

Instruments

This research study will involve several methods to evaluate content and pedagogical knowledge of the teachers and learners in the study. In order to diagnose students' content knowledge of the absolute value and identify their obstacles to learning absolute value, they will be administered a diagnostic test which was reviewed and validated by three experts. Teacher interviews will also be used to investigate their PCK in terms of identifying the problems that their learners might have with the absolute value concept and the causes of those problems as well as suggestions on how to address these misconceptions. The items of the interview will be developed from the students' responses on the diagnostic test

The diagnostic test will be evaluated based on the following obstacles:

- **Numerical framework:**
  - Didactical obstacles (related to the contract)
  - Obstacle of mirror answer
  - Obstacle related to order
- **Algebraic framework:**
  - -a or –x are negative.
  - $|ax+b|=c$ has one solution because it is an equation of the first degree; students refer to it as a linear equation.
  - Letter without sign is positive**.**
  - $|a+b|= |a|+ |b|$.
  - Studying the sign of x instead of the sign of the algebraic expression inside the absolute value**.**
  - Individuating the domain and the image of a function**.**
- **Geometric framework:** representation of absolute value on the graduated line.
- **Functional framework:** $|f|$ is two functions f and –f defined on the same domain of $|f|$.

Results

At this stage of the study, no final results are available.

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Elementary Students' Knowledge and Teachers' Pedagogical Content Knowledge of 2D Representations of 3D Geometric Objects

Sanaa Shehayeb

Abstract

In this research, we aim to investigate the knowledge of students and pedagogical content knowledge of in-service and pre-service elementary teachers of 2D representations of 3D geometric objects. The first part of the study will explore students' knowledge. Data will be collected through a test designed by the researcher and validated by three experts. The test includes four tasks to diagnose the students' content knowledge about 2D representation of 3D geometric objects. It will be administered on an individual basis through interviews to 84 elementary students from grades 4, 5 and 6 of three public and three private schools in the Aley region in Lebanon. The second part of the study will consist of interviews with the math teachers of the students under study in addition to 10 pre-service teachers in their last year at the university. The interviews should reveal teachers' abilities to identify students' misconceptions, explain their causes, and propose instructional strategies to deal with them. The research will also compare the pre-service and in-service teachers' abilities to identify, explain the cause and propose instructional strategies. Finally, the research will examine whether there is a relationship between the identification, causal attribution, and proposal of instructional strategies of 2D representations of 3D objects.

Introduction

The National Council of Teachers of Mathematics (NCTM, 2000) has advocated an increased emphasis on the teaching and learning of geometry at all levels. NCTM (2000) standards associate geometry with spatial sense considering it a fundamental component of mathematics learning. According to the national council of teachers of mathematics, geometry and spatial sense offer ways to interpret and reflect on our physical environment and can serve as tools for the study of other topics in mathematics and science. However, little time is reserved for teaching geometry in schools especially in primary schools; most of the time it is taught at the end of the year (Jirotkova & Littler, 2007).

When three-dimensional shapes are dealt with in primary schools, the teachers generally concentrate on terminology rather than concept building processes (Jirotkova, 2007). Moreover, 3D shapes are represented in plane representations in school textbooks, which makes it more difficult for students to distinguish between 2D shapes and 3D shapes. The representation of 3D in 2D is the ability to visualize the three dimensional objects in 2D and the ability to recognize and construct nets which is directly related to combining and analysis of visual images (Christou & Pittalis, 2010).

Content knowledge of the subject matter is not sufficient for teaching: what is needed is pedagogical knowledge, and the blend of knowledge content and pedagogy (Chinnappan & Lawson, 2005; Silverman & Thompson, 2008). This mathematical teachers' professional knowledge is referred to as pedagogical content knowledge (PCK). Jones (2000) substantiates the important role that elementary teachers play to make students understand the varied uses of geometry in everyday life and appreciate its cultural context. They lead students to grasp geometric concepts. However, previous research claims that there is a difficulty in good teaching of geometry in primary school (Dorier et.al, 2003). PCK, as defined by Ball and Bass (2002) is a unique kind of knowledge that intertwines content with aspects of teaching and learning. It requires the teachers, unlike mathematicians, to unpack knowledge and decompress ideas. It also requires connectedness across mathematical domains and across time (Ball & Bass, 2002). This type of knowledge cannot be obtained from subject content knowledge or from the curriculum but from practice. According to Ball (2000), PCK integrates reasoning and knowing with action.

<u>Theoretical Background</u>

The purpose of this research will be to study the students' content knowledge and elementary teacher's PCK of 2D representations of 3D geometrical figures and their connections with spatial ability. The Van hiele levels of reasoning in 3D geometry (visualization, analysis, informal deduction, deduction and rigor), in addition to Bruners' three modes of representation (enactive, iconic and symbolic) will be the basis of this research for knowledge of students. The teachers' pedagogical content knowledge will be based on Shulman's recommendations for the knowledge of teachers. Shulman (1987) outlines three categories of subject matter knowledge that a teacher of mathematics should possess; content knowledge (CK), PCK, and curriculum knowledge.

With this background in mind, this research will aim to answer the following questions:

1. What is elementary students' knowledge of 2D representations of 3D geometrical objects?
2. What is the extent to which elementary teachers can identify elementary students' misconceptions in 2D representations of 3D geometrical objects? How do pre-service and in-service elementary teachers compare?
3. What is the extent to which elementary teachers can explain the causes of elementary students' misconceptions in 2D representations of 3D geometrical objects? How do pre-service and in-service elementary teachers compare?
4. What is the extent to which elementary teachers can propose teaching strategies to deal with elementary students' misconceptions in 2D representations of 3D geometrical objects? How do pre-service and in-service elementary teachers compare?

5. Is there a relationship between teachers' ability to identify, explain the cause and propose effective teaching strategies to deal with elementary students' misconceptions in 2D representations of 3D geometrical objects?

Method

The participants will be 84 students from six schools in Aley, Mount Lebanon which will be chosen from four private schools and three public schools, representing different socioeconomic backgrounds. Four students from each of the elementary grades 4, 5 and 6 will be selected. Also, ten teachers of the chosen classes will be interviewed in addition to ten pre-service teachers in their last year in the Lebanese university from the faculty of education.

The research will involve several methods to evaluate students' knowledge and teachers' PCK of the representation of 3D geometrical objects in 2D. In order to diagnose students' content knowledge, they will be administered a diagnostic test through an interview. This test will consist of four tasks as illustrated in the following table:

	Ability	Description of the task
A	Recognition of 3D shapes from solids, pictures, drawings or nets.	1. Identification of cuboids. 2. Identification of cylinders. 3. Identification of pyramids.
B	Classification of the properties of 3D shapes from solids, pictures, drawings or nets.	1. Properties of cuboids. 2. Properties of cylinders. 3. Properties of pyramids. *Enumerating the vertices/faces/edges of 3D shapes.*
C	Comparison of 3D properties from solids, pictures, drawings or nets.	1. Properties of cuboids. 2. Properties of cylinders. 3. Properties of pyramids.
D	Construction of 3D shapes from nets.	1. Construction of cuboids. 2. Construction of cylinders. 3. Construction of pyramids.

The four abilities are associated with van Hiele levels 1, 2A, 2B and 3 as identified by Pegg (1995):

Level 1: Figures are identified according to their overall appearance.
Level 2A: Figures are identified in terms of a single property.
Level 2B: Figures are identified in terms of properties which are seen as independent of one another.
Level 3: Relationships between previously identified properties of a figure are established as well as relationships between the figures themselves.

On the other hand and in each task, three modes of representation are tested which are: photos of solid figures, drawings of solid figures and nets of solid figures. These three modes are, in turn, associated with Bruner's three stages: Enactive, Iconic and Symbolic. In the Enactive stage, knowledge is stored primarily in the form of motor responses. In the Iconic stage, knowledge is stored primarily in the form of visual images. Finally, in the Symbolic stage, knowledge is stored primarily as words, mathematical symbols, or in other symbol systems.

Teacher interviews will also be conducted with the aim of investigating the PCK of pre-service and in-service elementary math teachers in terms of identifying the misconceptions that their learners might have with 2D representations of 3D geometrical objects as well as the causes of these misconceptions and suggestions of teaching strategies as to how to address these misconceptions. The items of the interview will be developed based on the students' responses on the diagnostic test.

Results

At this stage of the study no final results are available.

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SCIENCE

Process Oriented Guided Inquiry Learning (POGIL) in Foundation Chemistry: A Progress Report

Sheila Qureshi and Phyllis Grifarrd

<u>Abstract</u>

POGIL has been successfully implemented in a variety of higher education institutes in the USA. However, this is the first time it has been instigated in Qatar where high schools are generally traditional and teacher-centered. While they come to our university with some experience with problem solving, they have little experience with conceptual fundamentals in chemistry, such as bonding and representations. In this study we compared student performance on the same assessment over two years, the latter in which POGIL was used to teach 8 topics. Although the class of 17 students came with similar academic records, their achievement was greater in the POGIL year. A survey to assess student perception of their learning reveals mixed preferences.

> *The POGIL technique presents a manageable transition from traditional lecture to more active student engagement and a methodology to move from sole focus of content to consideration of learner self-development. The POGIL workshops and published materials provide a foundation to enable instructors to more confidently shift their teaching practices. (Geiger, 2010)*

Introduction

The purpose of this session was to introduce the POGIL (Process Orientated Guided Inquiry Learning, Moog 2008) approach and to report on the outcomes of an action research project in which POGIL was introduced in Foundation Chemistry at our medical college in Qatar. Students come to our program with some experience with problem solving; however, they have little experience with conceptual fundamentals in chemistry, such as bonding and representations. The POGIL approach was chosen over others because it does not have to be implemented as a predominant teaching style but as it suits the topic, instructor and students. POGIL was chosen above PBL (Problem-Based Learning) and PLTL (Peer-Led Team Learning) as it was an easier transition with the materials readily available and no restructuring of the course or curriculum required. POGIL utilizes small group work, which helps to break down several cultural barriers in our institutional setting. The instructor's qualitative assessment is that the students in the POGIL year became comfortable working together in mixed groups much earlier than they had in previous years.

Process Oriented Guided Inquiry Learning (POGIL)

POGIL is a student-centered strategy where students work in small groups of maximum 3-4 students. Students are assigned specific roles such as manager, presenter, recorder, reflector or technician to ensure that students are fully committed in the team and engaged in the learning process. For example, the manager ensures that no student is left behind and that all the students understand the concepts they are learning. Roles are rotated throughout the course. The instructor explains the process and gives them the list of roles and what is required of that position.

POGIL activities focus on core concepts and encourage a deep understanding of the course material while developing higher-order thinking skills. POGIL develops process skills such as critical thinking, problem solving and communication through cooperation and reflection, helping students become lifelong learners and preparing them to become effective students and future doctors.

POGIL is a strategy where students take charge of their own learning in a classroom setting instead of lectures. Some POGIL activities need some introductory lectures while some are stand-alone and build on their high school content.

All the activities supply the students with information or data followed by leading questions designed to guide them towards forming their own valid conclusions are structured questions requiring students to build up key concepts. Some of the activities like the one on equilibrium require the students to analyze data to develop a much deeper understanding then they would normally in a lecture style class. At the end of the POGIL activities there are typical exercises that students would find in their chemistry textbook, this encourages students to use their textbooks more often than relying on lecture slides.

The instructor serves as a facilitator, observing and intervening when necessary.

What makes POGIL different?

- POGIL materials are designed for use with self-managed teams that interact with the instructor as a facilitator of learning rather than as a source of information.
- POGIL materials guide students through an exploration to construct understanding.
- POGIL materials use discipline content to facilitate the development of higher-level thinking skills and the ability to learn and apply knowledge in new contexts.

Our Study

Was the approach effective? In this study we compared student performance on the same assessment over two years, the latter in which POGIL was used to teach more than half of the course topics. Although the class of 17 students came with similar academic records, their achievement was greater in the POGIL year. A survey to assess student perceptions of their learning reveals mixed preferences, and some suggestion from their responses are that they are unaware of how much they are learning, and more than half still prefer the lecture style. Both outcomes are similar to that reported in other institutions (Geiger, 2010; Rajan & Marcus 2009). The instructor expressed anxiety about relinquishing traditional teaching obligations and about potential reluctance by students to engage in POGIL. Overall this experience was very similar to other POGIL practitioners in that students show a definite improvement but students show some resistance. Students may perceive themselves to be forced into participation. However, the value of a POGIL approach was noted by our course director from Cornell University in New York, who observed that the "POGIL exercise of the concept of weak and strong acids and the factors that control such behavior (X-H bond strength, and H partial charge)….is rigorous and I think the students really got the concept and exercised it in depth through small group collaboration…It looks like this will be a very successful experiment in getting students engaged in learning core concepts."

<u>Objectives of the Session</u>

1. Give participants a chance to experience learning with a POGIL session by role-playing in an actual chemistry lesson.
2. Share our experience and learning outcomes based on formative and summative assessments.
3. Share feedback provided by a student survey of their perceptions of their learning gains using POGIL.
4. Comparison of the POGIL approach to other student-centered approaches developed for chemistry
5. Description of why a student-centered approach is needed in our education setting

<u>Materials</u>

1. A prepared POGIL lesson (handouts, writing materials) that would be meaningful for even non-chemists at the session and doable in the time allotted (e.g. limiting reagents)
2. POGIL documents that explain the pedagogy behind the design
3. Video clip of students learning chemistry through POGIL

Description of the Session

After introducing POGIL briefly **(5 mins),** the participants were asked to form groups of three to four members in which they role-played a POGIL lesson on equilibrium **(15 mins).** The activity "Limiting reagents number 30 page 174, used was from Moog and Farrel's, Chemistry: A guided inquiry (5^{th}ed) New York: John Wiley and Sons. Not all the members of the audience were chemists. Therefore, the activity used in the presentation was about the limiting ingredient in a cookie recipe, which most people can relate to without knowing any chemistry. Following feedback from participants about their experiences **(5 mins),** the outcome of the students in our educational setting was shared using a power point presentation and a 2-minute clip of our students in Qatar engaged in the POGIL lesson. Handouts were distributed at the end of the session resources distributed **(5 mins).**

Description of Roles

Almost all of the class time in this course is spent working in groups of four. The membership of the groups will change at various times as the semester progresses. However, every day, every member of the group is assigned a role. Here are some roles that are commonly used:

Manager Manages the group. Ensures that members are fulfilling their roles, that the assigned tasks are being accomplished on time, and that all members of the group participate in activities and understand the concepts. *Your instructor will respond to questions from the manager only* (who should raise his or her hand to be recognized).

Presenter Presents oral reports to the class. These reports should be as concise as possible; the instructor will normally set a time limit.

Recorder Records the names and roles of the group members at the beginning of each day. Records the important aspects of group discussions, observations, insight …etc The recorder's report is a log of the important concepts that the group has learned.

Reflector Observes and comments on group dynamics and behavior with respect to the learning process. These observations should be made to the group on a regular basis (roughly 20 or 30 minutes between reports) in an effort to constantly improve group performance. The reflector will report to the group (and may be asked report to the entire class) about strengths of the group in terms of how it operates, and also about what needs improvement - and how these can be achieved.

Technician Performs all technical operations for the group, including the use of a calculator or computer. Unless otherwise instructed, only the technician in each group may operate equipment such as this.

Note: Not all roles will be assigned on any given day. It is up to the Manager to assign any additional roles as needed.

ChemActivity 30

Limiting Reagent

(How Much Can You Make?)

Model 1: The S'm ore.

A delicious treat known as a S'more is constructed with the following ingredients and amounts:

1 graham cracker
1 chocolate bar
2 marshmallows

At a particular store, these items can be obtained only in full boxes, each of which contains one gross of items. A gross is a specific number of items, analogous (but not equal) to one dozen. The boxes of items have the following net weights (the weight of the material inside the box):

box of graham crackers	9.0 pounds
box of chocolate bars	36.0 pounds
box of marshmallows	3.0 pounds

Critical Thinking Questions

1. If you have a collection of 100 graham crackers, how many chocolate bars and how many marshmallows do you need to make S'mores with all of the graham crackers?

2. If you have a collection of 1000 graham crackers, 800 chocolate bars, and 1000 marshmallows:

   a) How many S'mores can you make?

   b) What (if anything) will be left over, and how many of that item will there be?

Chemistry: A Guided Inquiry. R.S. Moog and J.J. Farrell
5th ed., New York, John Wiley & Sons.

Information

Chemists refer to the reactant which limits the amount of product that can be made from a given collection of original reagents as the **limiting reagent** or **limiting reactant**.

Critical Thinking Questions

3. Identify the limiting reagent for CTQ 2.

4. Based on the information given, which of the three ingredients (a graham cracker, a chocolate bar, or a marshmallow):

   a) weighs the most?

   b) weighs the least?

   Explain your reasoning.

5. If you have 36.0 pounds of graham crackers, 36.0 pounds of chocolate bars, and 36.0 pounds of marshmallows:

   a) which item do you have the most of?

   b) which item do you have the least of?

   Explain your reasoning.

6. a) If you attempt to make S'mores from the material described in CTQ 5, what will be the limiting reagent?

   b) How many gross of S'mores can you make?

   c) How many gross of each of the two leftover items will you have?

   d) How many pounds of each of the leftover items will you have?

   e) How many pounds of S'mores will you have?

Exercises

1. Given the balanced chemical reaction:

   $2\ NO(g) + O_2(g) \longrightarrow 2\ NO_2(g)$

   calculate the mass of nitrogen dioxide that can be made from 30.0 grams of NO and 30.0 grams of O_2.

2. Zinc, Zn, and iodine, I_2, react to form zinc(II) iodide, ZnI_2 (the reactants and the product are all solids at room temperature).

   a) Write a balanced chemical reaction for this process.
   b) Suppose that 50.0 g of zinc and 50.0 g of iodine are used to form zinc(II) iodide.
      1) Assuming that the reaction goes to completion, which element will be totally consumed in the formation of the zinc(II) iodide?
      2) What is the limiting reagent?
      3) How many grams of zinc(II) iodide can be produced?
      4) How many grams of the excess element remain unreacted?

3. Acetylene gas, HCCH, is commonly used in high temperature torches.

   a) Write a chemical equation for the reaction of acetylene with hydrogen gas (H_2) to form ethane (C_2H_6).
   b) How many grams of ethane can be produced from a mixture of 30.3 grams of HCCH and 4.14 grams of H_2?

4. Titanium (Ti) is a strong, lightweight metal that is used in the construction of rockets, jet engines, and bicycles. It can be prepared by reacting $TiCl_4$ with Mg metal at very high temperatures. The products are Ti(s) and $MgCl_2$.

   a) Provide a balanced chemical reaction for the reaction described above.
   b) How many grams of Ti metal can be produced from a reaction involving 3.54×10^4 g of $TiCl_4$ and 6.53×10^3 g of Mg?

5. The first step in the manufacturing process of phosphorous is the reaction below:

   $2\ Ca_3(PO_4)_2(s) + 6\ SiO_2(s) \longrightarrow 6\ CaSiO_3(s) + P_4O_{10}(g)$

   The MW of $Ca_3(PO_4)_2(s)$ is 310.2 g/mole and the MW of $SiO_2(s)$ is 60.1 g/mole. If 20.0 g of $Ca_3(PO_4)_2(s)$ and 20.0 g of $SiO_2(s)$ are reacted, how many grams of $P_4O_{10}(g)$ can be produced?

6. How many grams of N_2 (28.01 g/mole) can be obtained by reacting 24.5 g of NH_3 (17.03 g/mole) with 30.8 g of O_2 (MW = 32.00 g/mole)?

   $4\ NH_3(g) + 3\ O_2(g) \longrightarrow 2\ N_2(g) + 6\ H_2O(\ell)$

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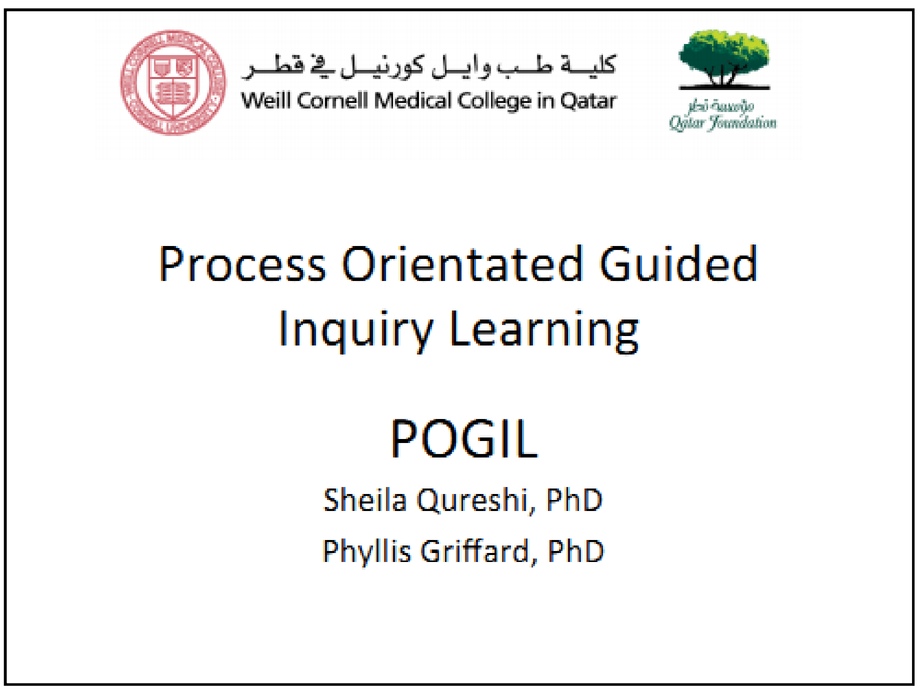
7. Using G as the symbol for graham cracker, Ch for chocolate bar, and M for marshmallow, write a "balanced chemical reaction" for the production of S'mores.

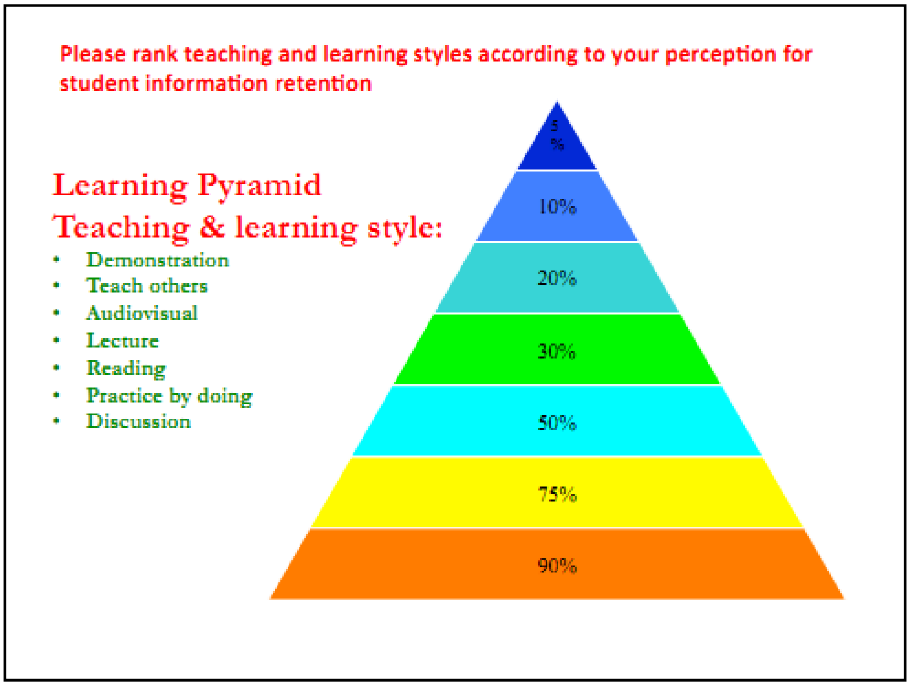
8. Using grammatically correct English sentences, explain why is it not correct to state that if we start with 36 pounds each of G, Ch, and M, then we should end up with 3 × 36 = 108 pounds of S'mores.

9. Given the "balanced chemical reaction" for the production of S'mores from CTQ 7, calculate the mass of S'mores that can be made from 416 pounds of chocolate bars, 142 pounds of graham crackers, and 58.2 pounds of marshmallows.

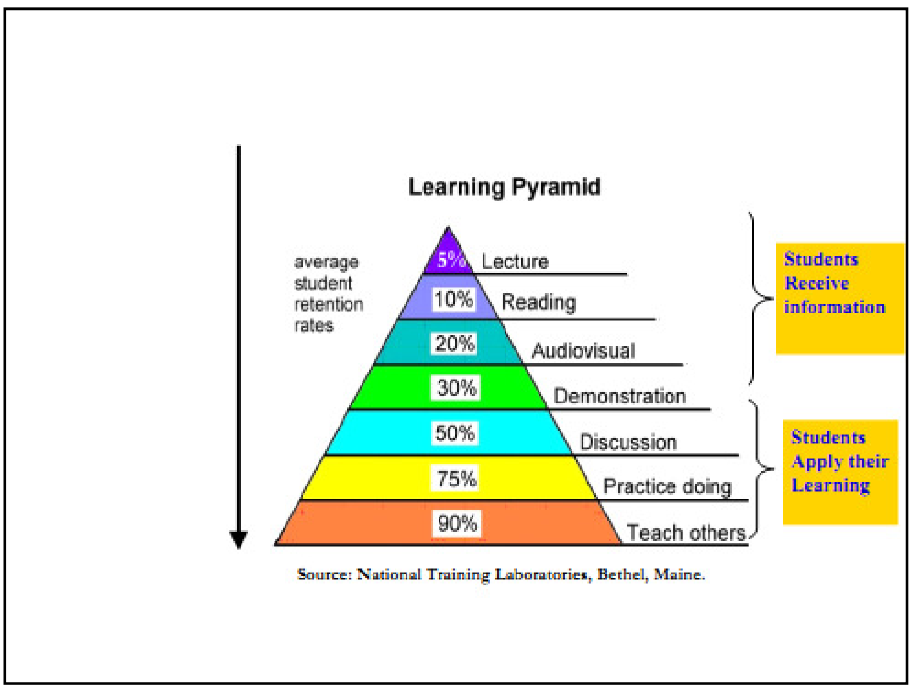
The PowerPoint Presentation



SLIDE 1



SLIDE 2



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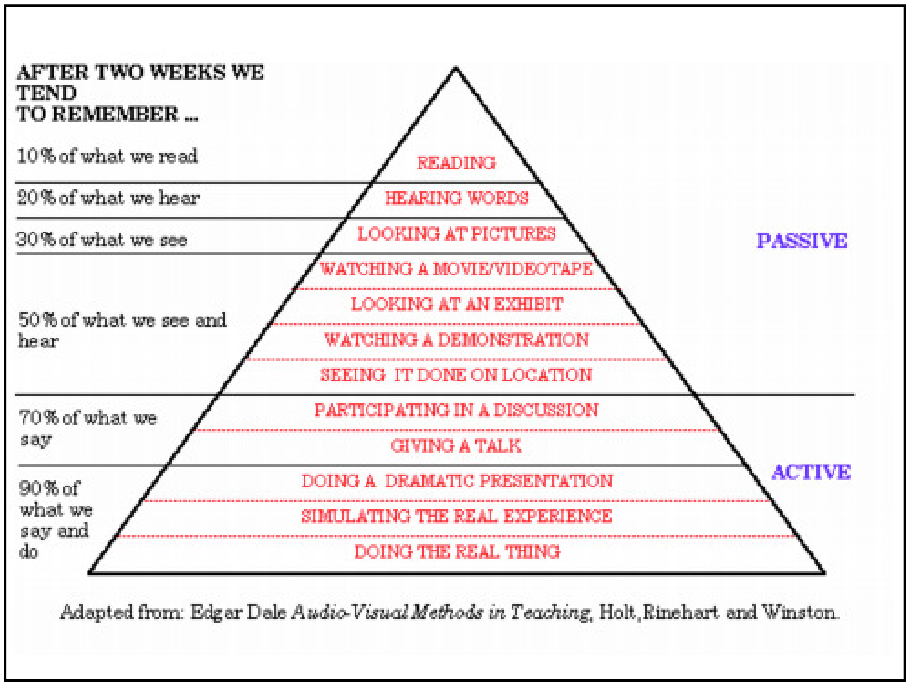


SLIDE 4

Summative assessment

- Fall final exam 2010 66.7%
- Fall final exam 2011 72.2%
- Spring mid-term 2011 72.3%
- Spring mid-term 2012 76.7%
- Overall assessment 2010 74.5%
- Overall assessment 2011 75.6

- Selected questions Integrated question
- 2010 6.8/10
- 2011 7.2/10
- Intermolecular bonding question
- 2010 0.9/3
- 2011 1.41/3

SLIDE 5

- How comfortable is the instructor where there is non-traditional teaching?
- Can POGILs be used for all the topics?
- The next slide is a video of the WCMC-Q students engaged in a POGIL session.

SLIDE 6

SLIDE 7

In end of year evaluations, students mentioned the following regarding *strengths of the chemistry class*

- The POGIL
- The activities distributed during class also, the divisions into groups and solving activities within groups
- Group work is completely useful
- Group work while doing the POGIL

SLIDE 8

In end of year evaluations, students mentioned the following regarding
What changes and/or improvements would you recommend

- More lecturing. Less working with clueless groups.
- I would love to see more lectures and homework from the textbook.
- More individual work rather than group work after giving a lecture on the activity.
- Have more lectures instead of solving POGILs during the class. This is because some of the students feel they are behind and a brief explanation from the instructor would be helpful.
- More lectures

SLIDE 9

Results of POGIL survey

SLIDE 10

In the POGIL survey, students made the following comments

I am a visual learner, it would be really helpful if we had more lectures in class than solving POGILs. However, those POGILs were helpful in the last topics. I loved the book more when I started reading.

More lectures.

More practice and lecture.

Getting more lectures that involve teaching us before solving any worksheets.

Classroom demonstrations and discussion helps in the overall understanding of the topic.

I think if more videos and lectures (slides) are provided, more understanding of the material is set.

SLIDE 11

In the POGIL survey, students made the following comments (continued)

More practice

On tougher questions that usually show up on exams, more homework that require individual problem solving. Practice more, which I am willing to do this course, and watch my time as I need more time during tests.

To have extra exercise with a difficult level of questions and to practice them gradually. To check every concept and have some meeting with the professor.

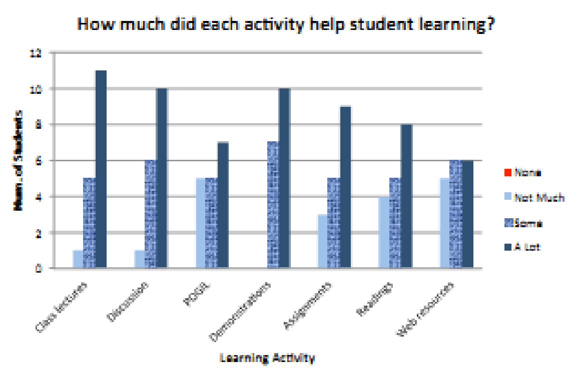
I need more explanation in class and more to practice. I feel happy but being confident of all the things to be learned in class is very important to me. This class is full of learning and fun especially the labs.

Provide countless sample sheets to practice questions for each topic we cover in the semester in order to practice and answer the questions in the nick of time. Also with the increased level of difficulty of the questions.

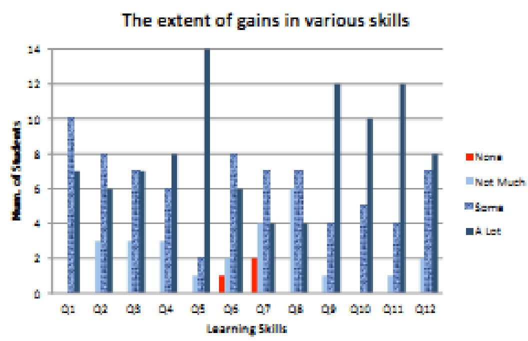
Understanding the questions clearly. I understand the material but often get confused or unsure of the question.

Nothing but more practice!

SLIDE 12

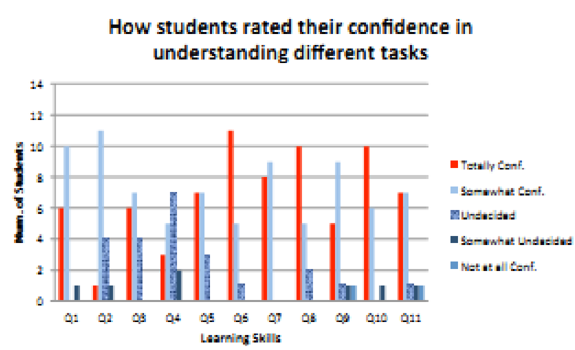


SLIDE 13



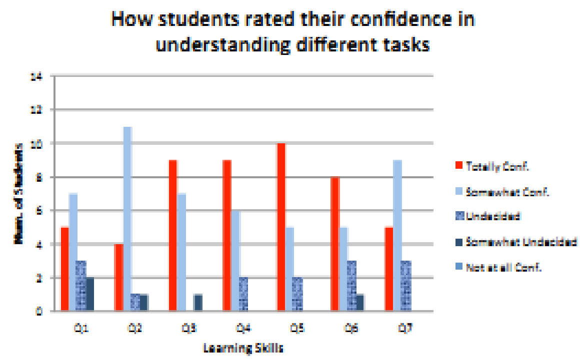
Question	To what extent did you make gains in each of the following?
Q1	Acquiring Data
Q2	Judging the quality of data and experimental results
Q3	Finding trends in data
Q4	Collecting, analyzing and applying information to solve problems
Q5	Finding and using resources to answer questions or solve problems
Q6	Applying concepts to new situations
Q7	Understanding the relevance of chemistry in real world issues
Q8	Factual knowledge of chemistry (terminology, classification methods, basic phenomena etc.)
Q9	Understanding the main concepts of chemistry (fundamental principles and theories)
Q10	Confidence in your ability to do chemistry
Q11	Working effectively with others
Q12	Using the language and concepts of chemistry to communicate effectively in oral and written form

SLIDE 14



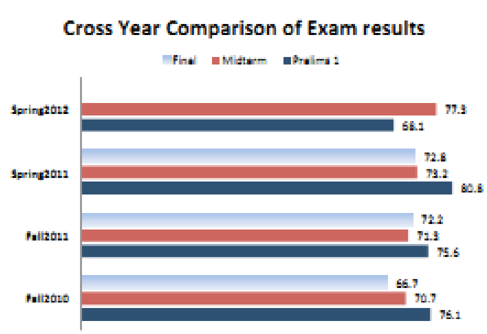
Question	
Q1	Reading the procedures for an experiment and conducting the experiment without supervision
Q2	Designing and conducting a chemistry experiment
Q3	Ensuring that data obtained from an experiment is accurate
Q4	Proposing a meaningful question that could be answered experimentally
Q5	Knowing how to convert the data obtained in a chemistry experiment into a result
Q6	After reading an article about a chemistry experiment, writing a summary of the main points
Q7	Determining the appropriate units for a result determined using a formula
Q8	Writing up the experimental procedures in a laboratory report
Q9	Applying theory learnt in a lecture for a laboratory experiment
Q10	Writing up the results section in a laboratory report
Q11	After listening to a public lecture regarding some chemistry topic, explaining its main ideas to another person

SLIDE 15



Question	
Q1	Tutoring another student in your chemistry course
Q2	Determining what answer is required from a written description of a chemistry problem
Q3	Explaining something that you learnt in this chemistry course to another person
Q4	Choosing an appropriate formula to solve a chemistry problem
Q5	Learning chemistry theory
Q6	After watching a video clip dealing with some aspect of chemistry, writing a summary of its main points
Q7	Achieving a good grade in a Part Two chemistry course

SLIDE 16



SLIDE 17

Questions asked during the presentation

Question 1: Doesn't it take longer to teach this way in class?

Answer 1: Yes initially it takes longer because the instructor is making sure the student does it properly according to the roles designated. The slow step is when the presenter from each group is verbally giving feedback of the tasks or records the results on the board. The other groups can then find anomalies in each other's work. The presenter of the session highlights the dilemmas of going slower and sacrificing material or reverting to lectures. The presenter referred to Rick Moog and he agreed it was time consuming and the instructor going around the students could resolve this by highlighting wrong answers/discussions at the time they occurred rather than all the groups presenting. The activities have exercises and problems at the end of the POGIL sessions, which can be completed as homework.

Question 2: are there resources for high schools?

Answer 2: Please refer to the POGIL website where all the resources are listed or email them and they would be happy to advise or help.

Question 3: Do they do POGIL for other subjects?

Answer 3: Yes

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Grade 7 Physics Students' Attitudes towards the Use of the QOMO Interactive Whiteboard and Its Effect on their Academic Achievement

Tarek Daoud

Abstract

One emerging aspect of integrating technology in classrooms is the "interactive whiteboard". Interactive whiteboards are recognized by teachers and students as a positive tool to

the learning teaching environment (DiGregorio & Sobel-Lojeski, 2010; Glover & Miller, 2001; Gregory, 2010; Hall & Higgins, 2005; Kennewell, 2001; Kennewell, 2004; Saltan & Arslan, 2009; Smith et al., 2005; Wall el al., 2005). The present study aimed to investigate grade 7 physics students' attitudes towards the use of the QOMO Interactive Whiteboard in addition to the effect of the QOMO Interactive Whiteboard on their achievement. Participants in this study were 68 grade 7 students (ages 11 -12 years) enrolled in a UNRWA boys school in the Saida area. The results of the study showed that the QOMO Interactive Whiteboard served as a useful tool in science classrooms. In addition, the use of the QOMO Interactive Whiteboard in physics grade 7 in contrast to traditional type of teaching did affect students' achievement.

Introduction and Literature Review

The Impact of Interactive Whiteboards on the Teaching-Learning Process

One emerging aspect of integrating technology in classrooms is the interactive whiteboard. Interactive whiteboards are recognized by teachers and students as a positive tool to the learning teaching environment (DiGregorio & Sobel-Lojeski, 2010; Glover & Miller, 2001; Gregory, 2010; Hall & Higgins, 2005; Kennewell, 2001; Kennewell, 2004; Saltan & Arslan, 2009; Smith et al., 2005; Wall el al., 2005). In general, integrating technology in education creates a motivating classroom environment which then leads to the improvement of learning and teaching processes (Wishart & Blease, 1999). Technology provides opportunities for teachers to meet the needs of students with various learning styles (Bryant & Hunton, 2000).

Students have positive attitudes towards the use of the interactive whiteboard in their classrooms (Mathews-Aydinli & Elaziz, 2010; Slay et al., 2008). Mathews-Aydinli, and Elaziz, (2010) explored the attitudes of students toward the use of interactive whiteboards in a foreign language teaching and learning context. Data was collected through questionnaires distributed to 458 students. Results revealed that students had positive attitudes toward the use of interactive whiteboards in language instruction. Saly et al. (2008) reported a case study of three South African government schools that had undertaken pilot roll-outs of interactive whiteboards. These researchers highlighted students' enthusiasm regarding the use of the interactive whiteboard in their classrooms. Similarly, the results of Wall et al.'s (2005) study which was conducted to investigate the effect of the use of the interactive whiteboard on the teaching and learning of year six students (ages 10 and 11) showed that students held positive views. Students also mentioned that the interactive whiteboard assisted the teacher in explaining concepts.

Positive attitudes towards the use of interactive whiteboards are due to the fact that the latter enhances students' motivation (Cuthell, 2006; DiGregorio & Sobel-Lojeski, 2010; Levy, 2002; Wall, Higgins & Smith, 2005) and has an obvious impact on students' behavior and expectations (Cuthell, 2006). Moreover, interactive whiteboards change the classroom environment to a more interactive one (Wall, et al. 2005) since it urges teachers to shift away from traditional ways of teaching (Cuthell, 2004; Saltan & Arslan, 2009). Such a shift in teaching strategies is accommodated with a pedagogical shift (DiGregorio & Sobel-Lojeski, 2010; Gillen et al., 2007). Teachers can easily present knowledge as problematic, open to multiple interpretations, which as a result leads to conversations that allow the class to create or negotiate understandings of subject matter. Furthermore, interactive whiteboards are flexible in comparison with traditional blackboards as they show data presentations and allow subject content to be supported with multi-visual tools such as pictures and movies.

Finally, interactive whiteboards affects students' academic achievement positively (Swan et al., 2008) by promoting higher order thinking and shifting students' focus from remembering the content to gaining a deeper understanding of the concepts being taught (Kent, 2006). Hennessy et al. (2007) claim that "the strength of the IWB lies in its support for shared cognition, especially articulation, collective evaluation and reworking of pupils' own ideas, and co-construction of new knowledge" (p.289). Swan et al. (2008) investigated whether the use of interactive whiteboards in English language arts and mathematics lessons improved student achievement in those areas by measuring student scores on state achievement tests. Results showed slightly higher performance among students in the interactive whiteboard group, with students in the fourth and fifth grades exhibiting the greatest advantage for interactive whiteboard instruction.

The QOMO Interactive Whiteboard

The QOMO Interactive Whiteboard is a hardware that looks like a standard whiteboard but is connected to a computer and a projector. When connected, the QOMO Interactive Whiteboard becomes a giant, touch sensitive version of the computer screen leading to a very powerful classroom educational tool. Instead of using the mouse, teachers and students can control the used computer through the Interactive Whiteboard screen just by touching it with their fingers. Special pens are also provided in case the user is more familiar with them. Anything that can be accessed through the computer can also be accessed and displayed on the Interactive Whiteboard, for example Word documents, PowerPoint presentations, photographs, websites or online materials. Through the QOMO Interactive Whiteboard, teachers and students can write, erase, and perform mouse functions with their fingers. They can also write directly over MS word documents, PDFs, MS power points, websites and videos. In addition, the QOMO Interactive Whiteboard can provide teachers with the ability to interact with images by changing their size, color and arrangement and by providing them with mathematical tools. Work can be captured, recorded and sent by email. The QOMO software can even be downloaded on personal computers and thus provides teachers with the ability to prepare their lessons, quizzes and activities at home. Moreover, students can review their lessons at home. These features offer more interactive experiences for both teachers and students compared to a standard whiteboard or a data projector. Finally, the QOMO Interactive Whiteboard is an easy tool to use. It is a 'one-stop-shop' that includes all teaching resources that can be accessed by touching the screen.

Rationale and Significance of the Study

The present study aimed to investigate grade 7 physics students' attitudes towards the use of the QOMO Interactive Whiteboard in addition to its effect on students' achievement. The study was guided by the following research questions:

(1) What are students' attitudes towards the use of the QOMO Interactive Whiteboard?

(2) Does the use of the QOMO Interactive White Board enhance students' achievement in grade 7 physics?

Despite the promising theoretical work regarding the use of interactive whiteboards, there is limited research regarding this brand of interactive whiteboards. Moreover, there is very limited research on the effect of using interactive whiteboards in grade 7 physics classrooms. This study may help to provide empirical support for the theoretical arguments about the use of interactive whiteboards in teaching in general and particularly in sciences. Moreover, it may offer recommendations for improving the use of the QOMO Interactive Whiteboard.

Method

Participants

Participants in this study were 68 grade 7 (ages 11 -12 years) enrolled in an UNRWA boys school in the Saida area where the language of science instruction is English. Two sections out of the total four sections were randomly chosen. One of the sections was randomly assigned to be the experimental group while the other one was randomly selected as the comparison group. There were 35 students in the experimental group and 33 students in the control group.

The two groups covered the same subject matter and shared the same academic objectives. In the experimental group session, the teacher used the QOMO Interactive Whiteboard while in the control group sessions the teacher used traditional methods of teaching. The teacher who implemented the intervention was trained to use the QOMO Interactive Whiteboard and was provided with lesson plans for each of the lessons designed for the purposes of this study. The same teacher taught the experimental and the control group.

Instruments

Instruments used in this study included the IWB Students Attitudes Scoring Questionnaire (Appendix I), and the Physics Evaluation Sheet (Appendix II). These instruments are described below.

IWB Students Attitudes Scoring Questionnaire. Students' attitudes towards the QOMO Interactive Whiteboard were measured by using the IWB Students Attitudes Scoring Questionnaire. This scale consisted of 12 items in the form of positive statements. Participants responded to these statements on a five-point Likert scale (5 = *strongly agree* and 1 = *strongly disagree*). This scale was administered to only to the experimental group students after the intervention period. The analysis showed a reliability (Alpha coefficient) of .91 which is considered highly reliable.

Physics Evaluation Sheet. An instrument for assessing student achievement in grade 7 physics was developed for the purpose of this study. This achievement test was designed to identify students' conceptions about gaseous state characteristics. The test was composed of five parts and was given to both the experimental group and control group.

Data Analysis

Data was analyzed based on the two research questions. In order to answer the first research question "What are students' attitudes towards the use of the QOMO Interactive Whiteboard?", students' responses on the IWB Students Attitudes Scoring Questionnaire were analyzed comparing the means and percentages for each item. To answer the second question

"Does the use of the QOMO Interactive White Board enhance students' achievement at grade 7 physics?", a t-test was used to test the existence of differences between the scores of the physics evaluation sheet in the control group and experimental group.

Results

To identify participants' perceptions regarding the use and usefulness of the QOMO Interactive Whiteboard (the first research question), data from students' responses on the IWB Students Attitudes Scoring Questionnaire of the *experimental* group was used. Table 1 and Table 2 respectively show the results of the mean for each item out of a maximum score of five and the percentage analysis of the students' responses to the IWB Students Attitudes Scoring Questionnaire.

Students' responses to the first item of the IWB Students Attitudes Scoring Questionnaire (I like going out to the front to use the whiteboard) showed that the mean was 4.69. In addition, 91.5 % of students responded that they like to use the QOMO Interactive Whiteboard in their classrooms in comparison to 2.9 % who dislike and 5.7 % who were undecided.

The second item which explores if it is easier for students to understand the work when the teacher uses the QOMO Interactive Whiteboard (M = 4.69) shows that 97.1% of the students agreed while 2.9% disagreed. In addition, 94.3% of the students' insisted that the QOMO Interactive Whiteboard makes learning more interesting and exciting (M = 4.71) in comparison to 2.9% who opposed. Moreover, only 40.0% of the students think that their peers behave better during the sessions of the QOMO Interactive Whiteboard (M = 3.00) in comparison to 37.1% of the students who do not think that and 22.9% who were undecided.

Ninety seven percent (97.1%) of the students claimed that using the QOMO Interactive Whiteboard makes the teacher's drawing and diagrams easier to see (M= 4.77). In opposition only 2.9% of the students were against. Likewise, 91.4% of the students preferred lessons which are taught with QOMO Interactive Whiteboard (M = 4.51) compared to 8.6% of the students who did not prefer. Furthermore, 94.3% of the students mentioned that QOMO Interactive Whiteboard makes it easy for the teacher to repeat, re-explain, and summarize (M = 4.63).

Investigating whether or not students would work harder or study more if their teachers used the QOMO Interactive Whiteboard (M = 4.57) showed that 91.4% of the students agreed in comparison to 5.8% who disagreed and 2.9% who were undecided. In addition, 88.5% of the students thought that teachers' lessons were more prepared and organized when they used QOMO Interactive Whiteboard (M =4.54). On the other hand, 5.7% of the students disagreed. Moreover, 94.3% of the students agreed that they participated more when the teacher used the QOMO Interactive Whiteboard M = 4.54) in comparison to 2.9% who disagreed. Furthermore, 85.7% of the students revealed that they concentrate better in class when the QOMO Interactive Whiteboard (M= 4.49) was used whereas only 2.9% of the students were in disagreement with that and 2.9% were undecided. Finally, 94.3% of students declared that they learned more when their teacher used the QOMO Interactive Whiteboard (M = 4.83) in comparison to 2.9% of students who disagreed and 2.9% who were undecided.

Table 1

Mean Scores of the Experimental Group on the IWB Students Attitudes Scoring Questionnaire.

Item	M
1. I like going out to the front to use the whiteboard	4.69
2. It is easier to understand the work when my teacher uses an IWB	4.69
3. IWBs make learning more interesting and exciting	4.71
4. I think students behave better in lessons with IWBs	3.00
5. I think IWBs make the teacher's drawings and diagrams easier to see	4.77
6. I prefer lessons which are taught with an IWB	4.51
7. IWBs makes it easy for the teacher to repeat, re-explain and summarize	4.63
8. I would work harder if my teacher used the IWB more often	4.57
9. I think teachers. lessons are more prepared and organized when they use an IWB	4.54
10. We get to join in lessons more when my teacher uses an IWB	4.54
11. I concentrate better in class when an interactive whiteboard is used	4.49
12. I learn more when my teacher uses an IWB	4.83

Table 2

Percentages of the Experimental Group on the IWB Students Attitudes Scoring Questionnaire.

	Percentage (%)				
Item	SD	D	U	A	SA
I like going out to the front to use the whiteboard	2.9	0	5.7	8.6	82.9
It is easier to understand the work when my teacher uses an IWB	2.9	0	0	20.0	77.1
IWBs make learning more interesting and exciting	2.9	2.9	0	8.6	85.7
I think students behave better in lessons with IWBs	25.7	11.4	22.9	17.1	22.9
I think IWBs make the teacher's drawings and diagrams easier to see	2.9	0	0	11.4	85.7
I prefer lessons which are taught with an IWB	8.6	0	0	14.3	77.1
IWBs makes it easy for the teacher to repeat, re-explain, and summarize	5.7	0	0	14.3	80.0

I would work harder if my teacher used the IWB more often	2.9	2.9	2.9	17.1	74.3
I think teachers. lessons are more prepared and organized when they use an IWB	5.7	0	5.7	11.4	77.1
We get to join in lessons more when my teacher uses an IWB	2.9	0	2.9	28.6	65.7
I concentrate better in class when an interactive whiteboard is used	2.9	0	11.4	17.1	68.6
I learn more when my teacher uses an IWB	2.9	0	2.9	0	94.3

Note. SD = Strongly Disagree, D = Disagree, U = Undecided, A= Agree, SA = Strongly Agree.

Regarding the second research question, which aimed at examining the effect that the QOMO Interactive Whiteboard had on students' achievement, the results of the Physics Evaluation Sheet were used. As shown in Table 3, the mean score of students in the experimental group was 6.84 while that of the control group was 3.81. A t-test for independent samples was carried out to test whether students in the experimental group differed significantly on the scores of the Physics Evaluation Sheet. Significant differences were found with $t = 4.23$ ($p < .05$).

Table 3
Mean Scores and Standard Deviations of the Control Group and Experimental Group on the Physics Evaluation Sheet.

	Scores on the Physics Evaluation Sheet		
Group	N	M	SD
Control	33	3.81	2.72
Experimental	35	6.84	3.13

<u>Discussion</u>

This section discusses the results of the study in light of the research literature regarding the use of interactive whiteboards in teaching and presents recommendations for further research as well as teaching implications.

Students' Attitudes towards the Use of the QOMO Interactive Whiteboard

A positive attitude towards the use of the QOMO Interactive Whiteboard in grade 7 physics was expected. This prediction was verified as evident in the results. Results yielded that students liked to go out to the front of the classroom in order to use the QOMO Interactive Whiteboard, worked harder (studied more), participated in lesson discussions and concentrated more. In addition, students understood the work explained, learned more and considered drawings and diagrams easier to see. Based on the obtained results, the QOMO Interactive Whiteboard can be seen as a positive tool that enhances the teaching learning process. The results of the present study are consistent with those obtained by previous studies examining the use of interactive whiteboards in classrooms (e.g. Gregory, 2010; Kennewell, 2001; Kennewel, 2004; DiGregorio & Sobel-Lojeski, 2010 ; Glover &Miller, 2001; Hall & Higgins, 2005; Saltan & Arslan, 2009; Smith et al., 2005 Wall el al., 2005). Moreover, results indicated that the use of the QOMO Interactive Whiteboard makes teacher lessons more prepared and organized. In addition, teachers can repeat, re-explain and summarize.

Finally, students preferred lessons taught by QOMO Interactive Whiteboard to traditional blackboards and reported that learning as more interesting and exciting. Students built positive attitudes towards the usage of the QOMO Interactive Whiteboard in their classroom and this was expressed in terms of increased motivation and enthusiasm. The results of the present study were consistent with those obtained by previous studies done by Cuthell (2006), DiGregorio and Sobel-Lojeski (2010), Levy (2002) and Wall, Higgins and Smith (2005).

The QOMO Interactive Whiteboard and Achievement

Using the Interactive Whiteboard was expected to result in improved students' achievement. These expectations were based on the notion that interactive whiteboards promote higher order thinking and shift students' focus from remembering the content to gaining a deeper understanding of the concepts being taught and support the shared cognition. Results showed that there were significant differences between the two groups. The experimental group which was exposed to the QOMO Interactive Whiteboard scored higher than those of the control group. Results of the present study were consistent with previous studies that examined the effect of the interactive whiteboard on students' achievement and showed higher achievement (e.g. Hennessy et al., 2007; Kent, 2006; Swan et al., 2008).

Conclusion

This study provided some insight into students' attitudes towards the use of the QOMO Interactive Whiteboard in grade 7 physics and its effect on students' achievement. The results of the study showed that the QOMO Interactive Whiteboard served as a useful tool in science classrooms. In addition, compared to traditional teaching methods, the use of the QOMO Interactive Whiteboard in grade 7 physics resulted in better student achievement since students were able to understand the material more. This might be attributed to the positive impact of the QOMO Interactive Whiteboard on students and teachers. The use of the interactive whiteboard also showed overall positive student attitudes whereby students were more motivated, interested and enthusiastic during the use of the QOMO Interactive Whiteboard. Students were also more willing to work hard and to participate and concentrate during class. Teachers, who are considered as second partners of the teaching- learning process, were also more prepared and organized when they used the QOMO Interactive Whiteboard. Moreover, teachers were able to repeat, re-explain and summarize since the QOMO Interactive Whiteboard software can record all the actions that took place during teaching.

APPENDIX I
IWB Students Attitudes Scoring Questionnaire

This instrument consists of 12 statements about the QOMO Interactive Whiteboard. Please express your opinion regarding each statement by checking one of the five items as follows:

5 'strongly agree'
4 'agree'
3 'undecided'
2 'disagree'
1 'strongly disagree'

There is no time limit. Please respond to all items. Thank you.

	1	2	3	4	5
1. I like going out to the front to use the whiteboard					
2. It is easier to understand the work when my teacher uses an IWB					
3. IWBs make learning more interesting and exciting					
4. I think students behave better in lessons with IWBs					
5. I think IWBs make the teacher's drawings and diagrams easier to see					
6. I prefer lessons which are taught with an IWB					
7. IWBs makes it easy for the teacher to repeat, re-explain, and summarize					
8. I would work harder if my teacher used the IWB more often					
9. I think teachers. lessons are more prepared and organized when they use an IWB					
10. We get to join in lessons more when my teacher uses an IWB					
11. I concentrate better in class when an interactive whiteboard is used					
12. I learn more when my teacher uses an IWB					

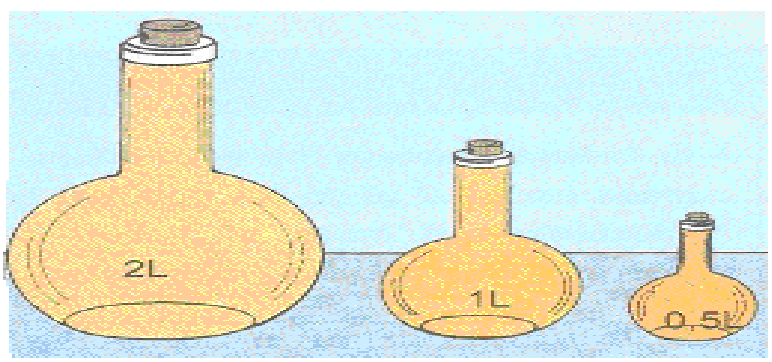
APPENDIX II
Physics Evaluation Sheet

Time: 30 min
Answer the following questions:

A. We plunge an empty bottle into a container, holding water, as shown in the below figure.

Water does not enter into the bottle. We incline a little over the water surface; the bubbles appear and water enters into the flask. Explain why?

B. The three flasks of the figure below are filled with the same quantity of nitrogen dioxide gas.



1- What shape does the gas take in each of the flasks?
2- What volume does the gas occupy in each of the flasks?
3- What can you then conclude about the shape & the volume of the gas?

C. True / False Questions

1- Air is a gas ……………….
2- Air has no mass ………………….
3- A gas may occupy all the available volume ………………….
4- Gases are not compressible ……………………
5- Air has no definite volume ………………….
6- Air is not a fluid …………………..

D. Complete the following table:

	Solid	Liquid	Gas
Volume			
Shape			
Mass			

E. I am invisible, colorless, occupy all the empty space around me and have mass. What am I?

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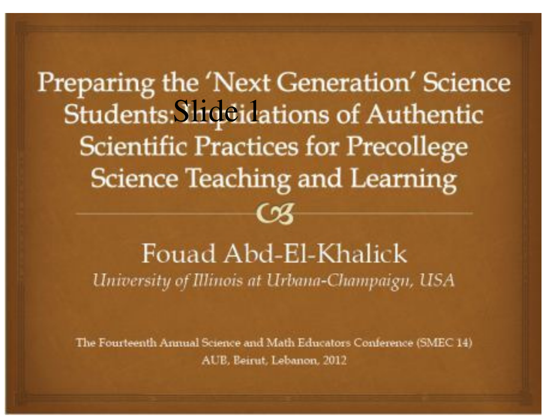
Preparing the Next Generation Science Students: Implications of Authentic Scientific Practices for Precollege Science Teaching and Learning
Fouad Abd El-Khalick



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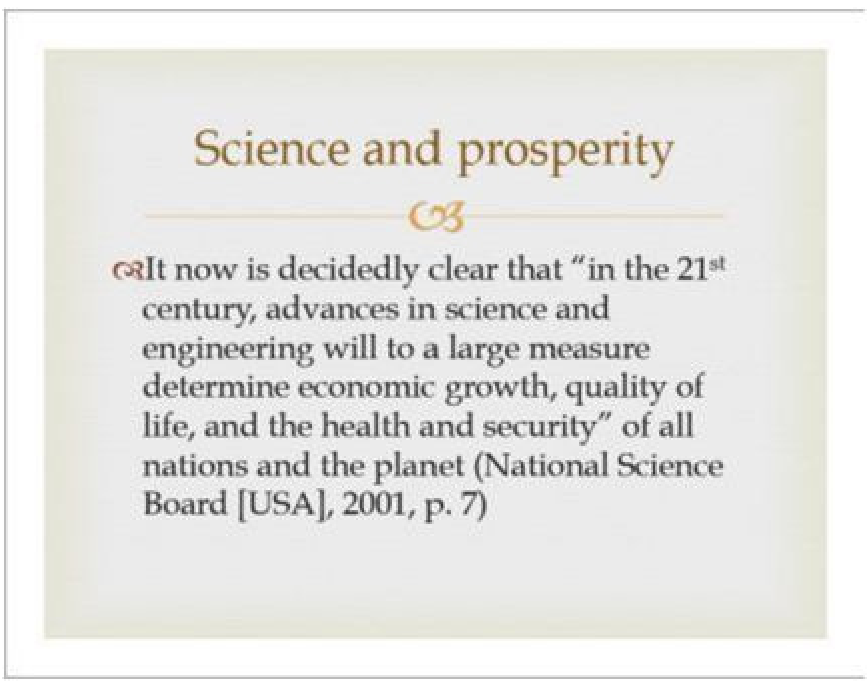

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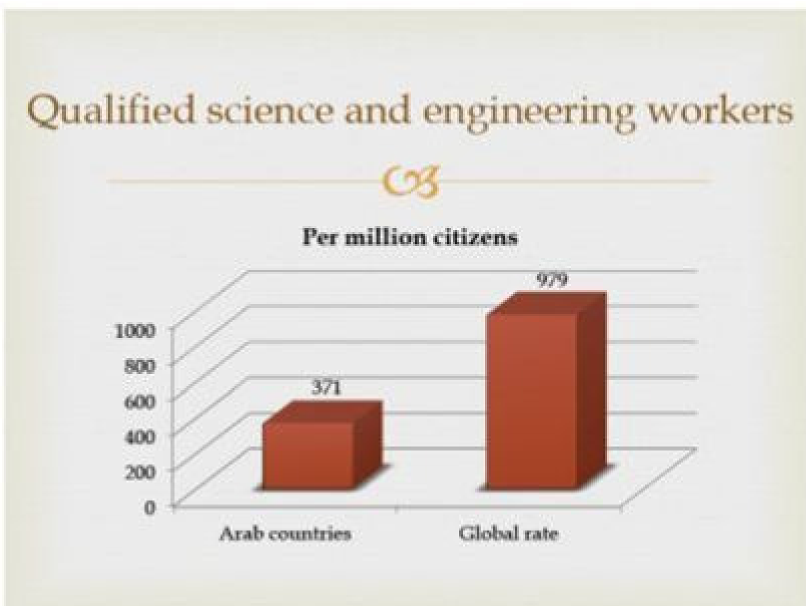

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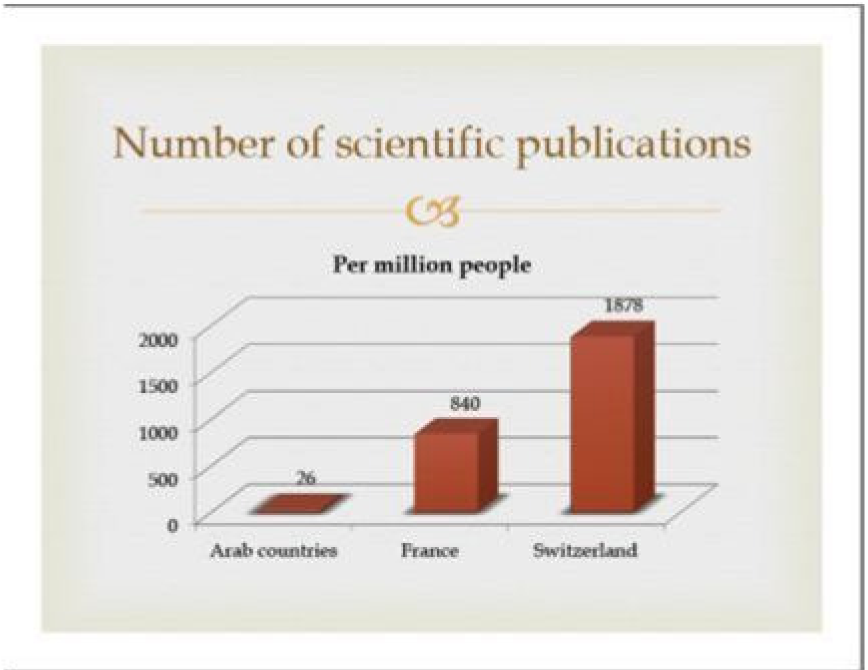

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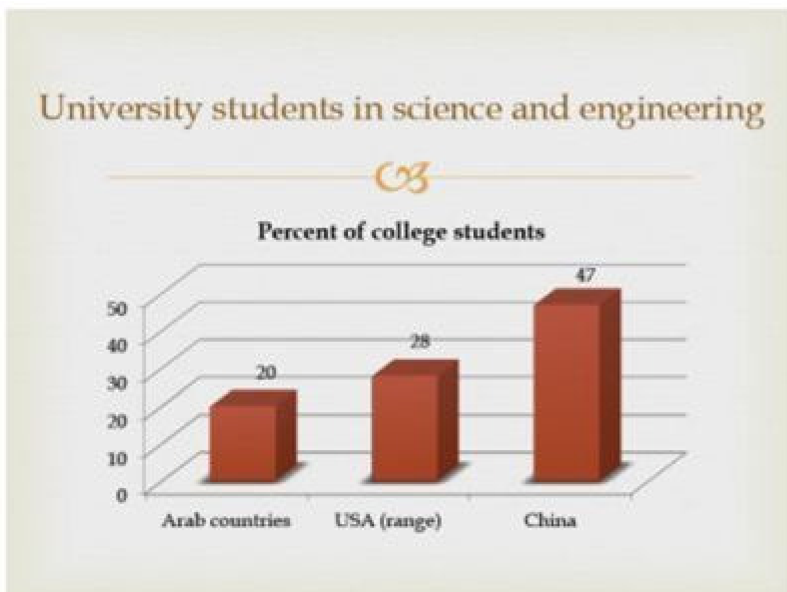

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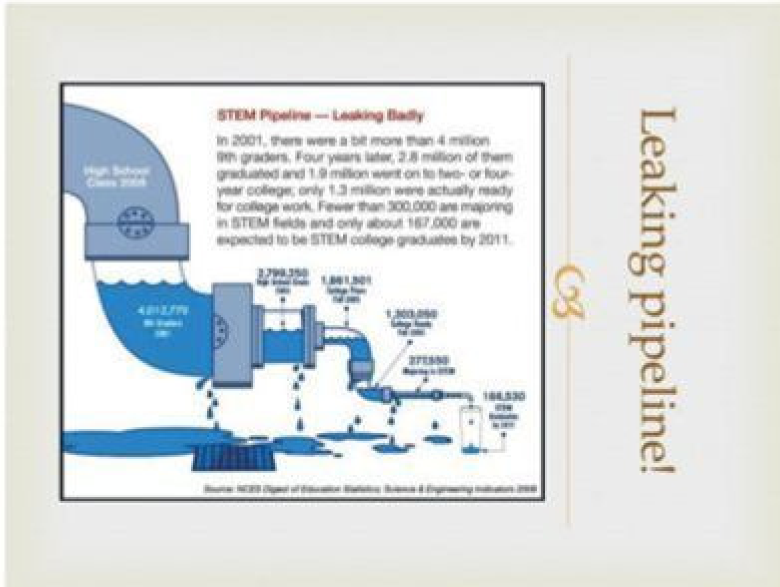

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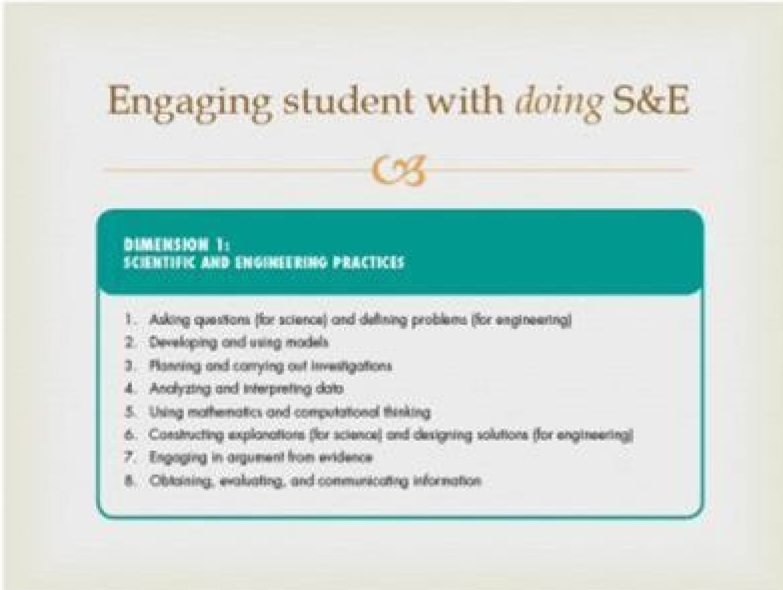

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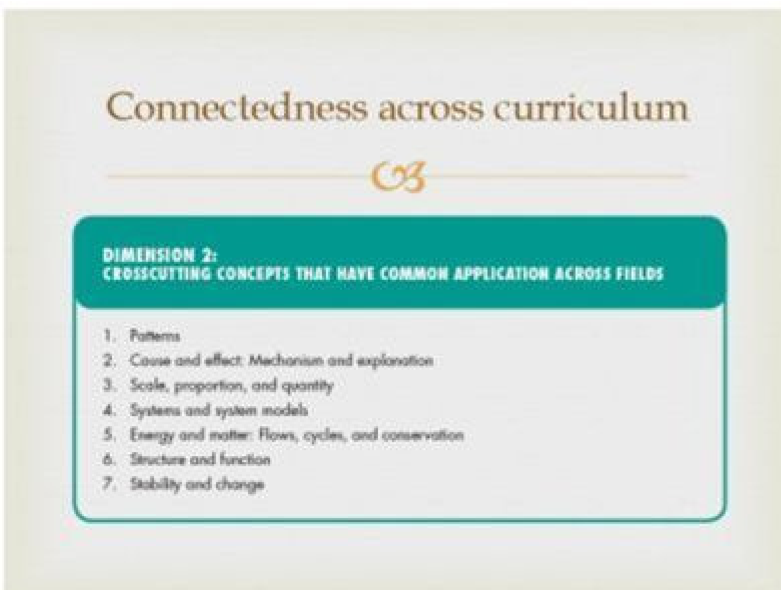

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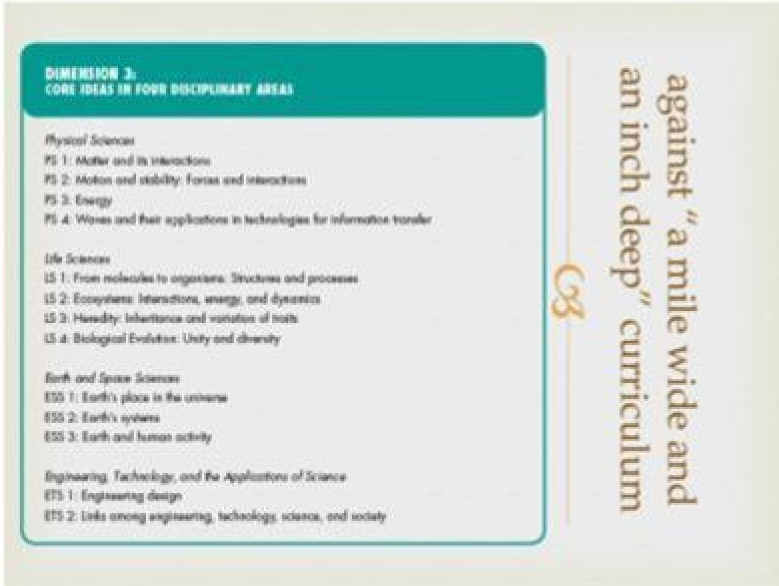

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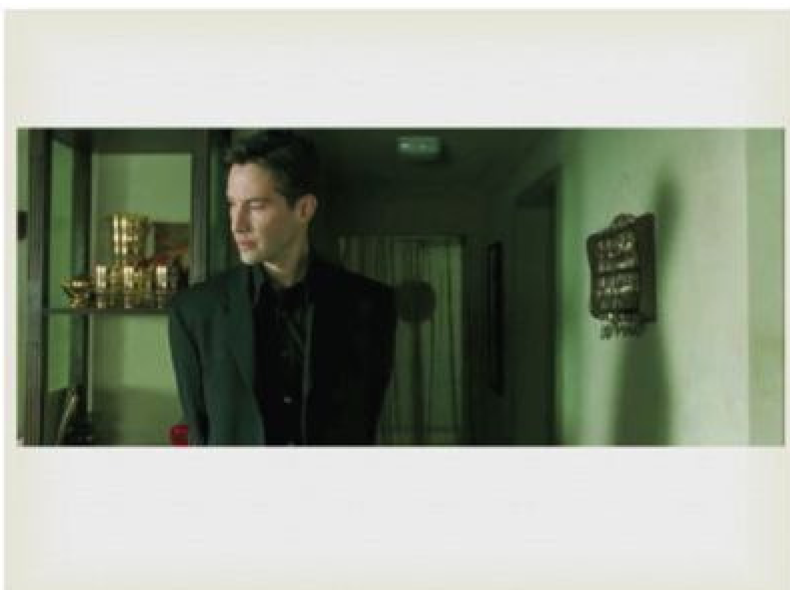

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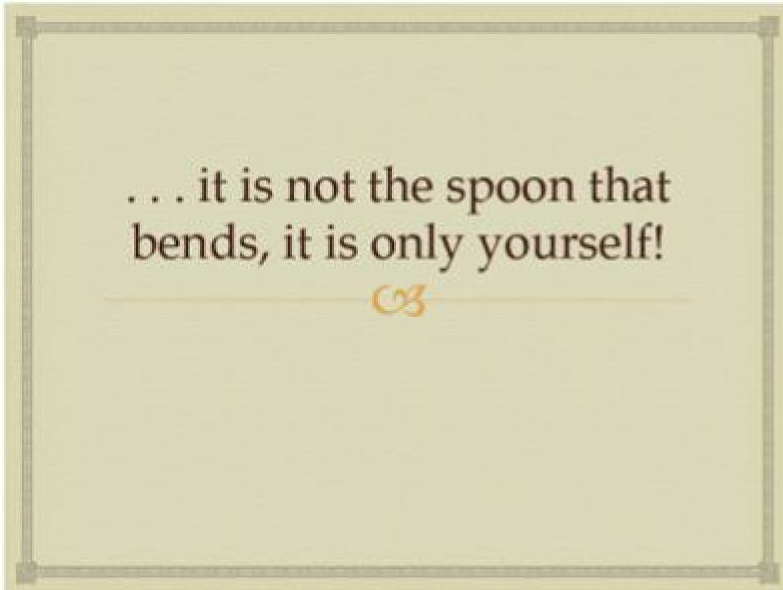

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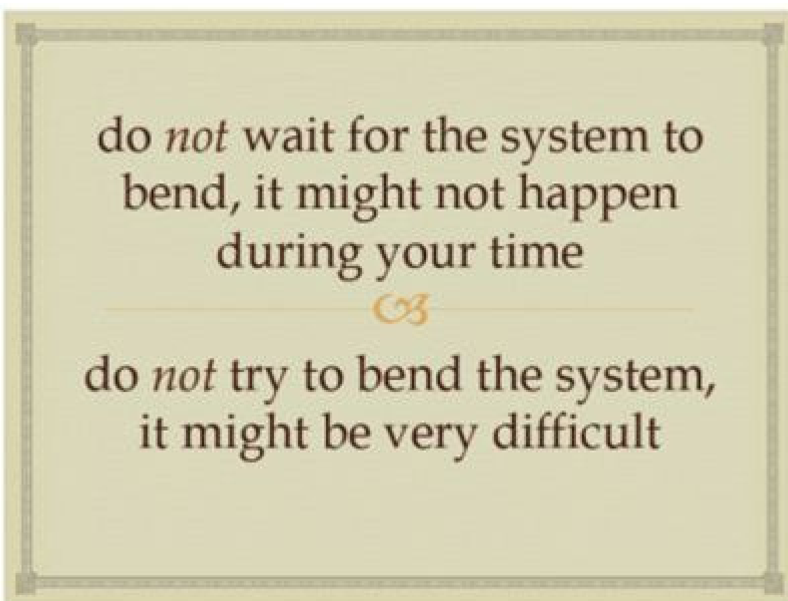

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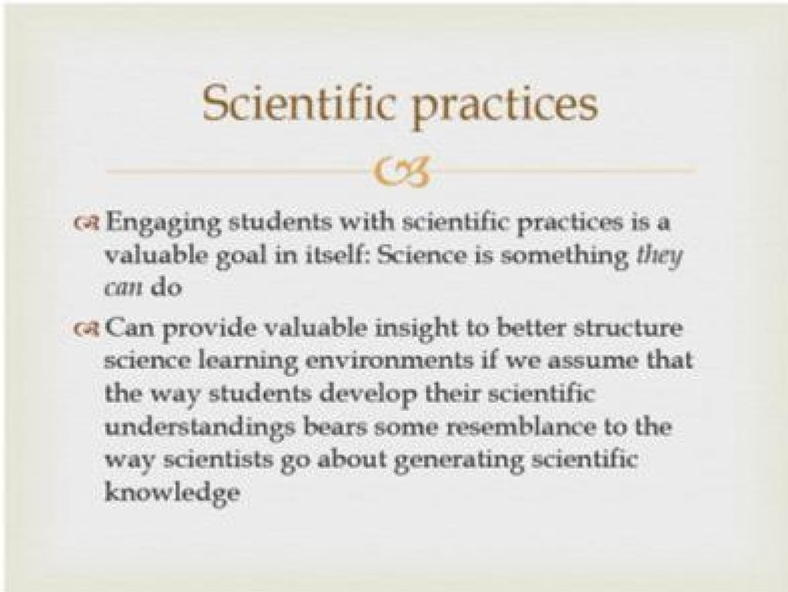

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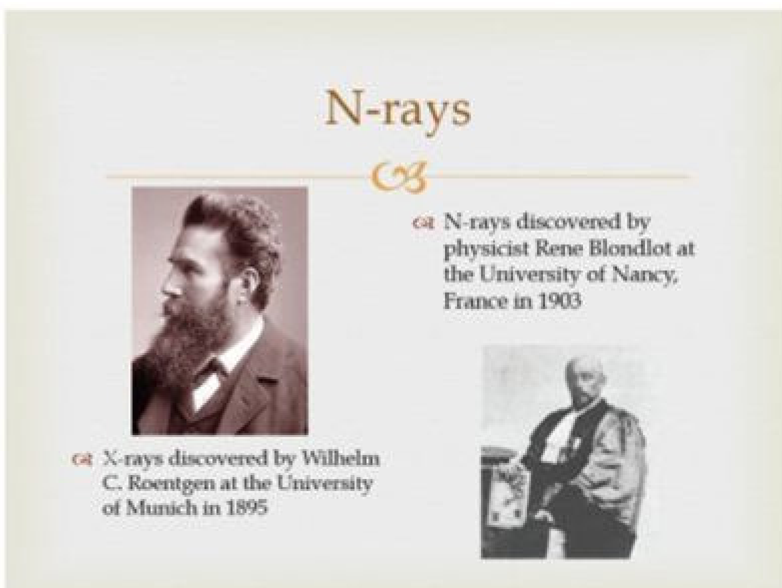

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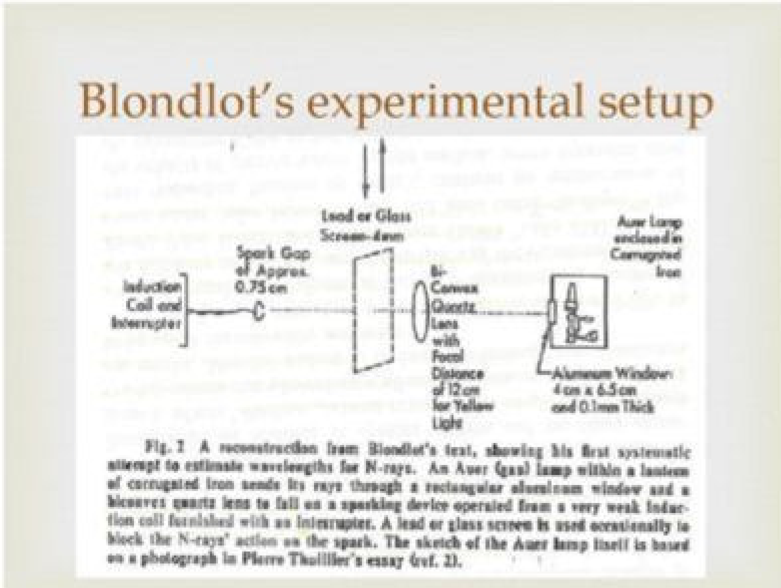

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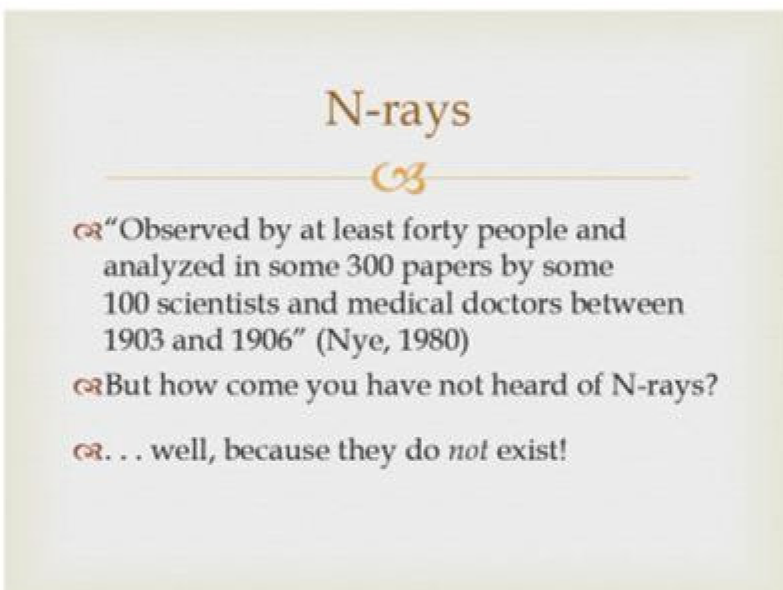

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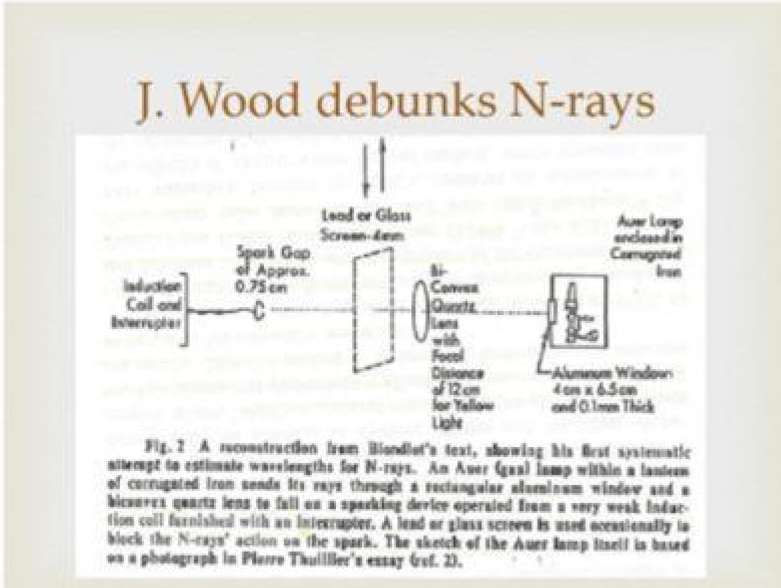

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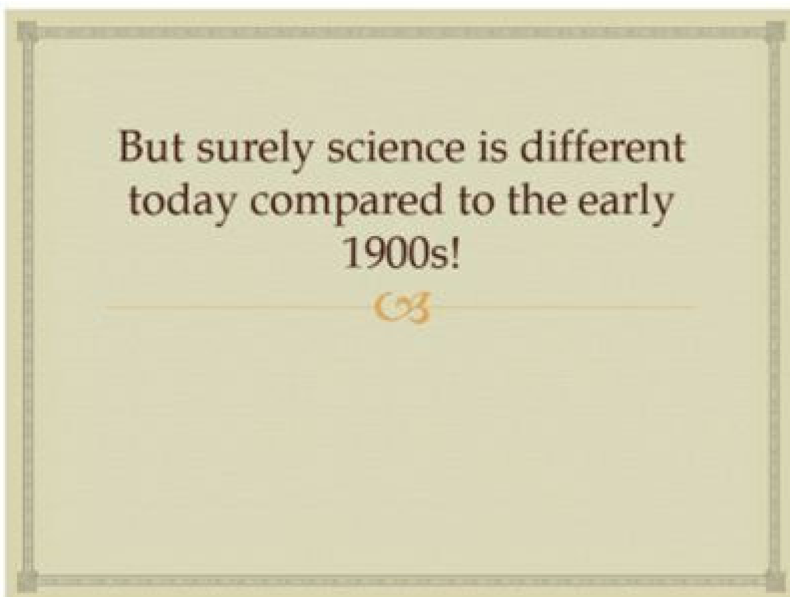

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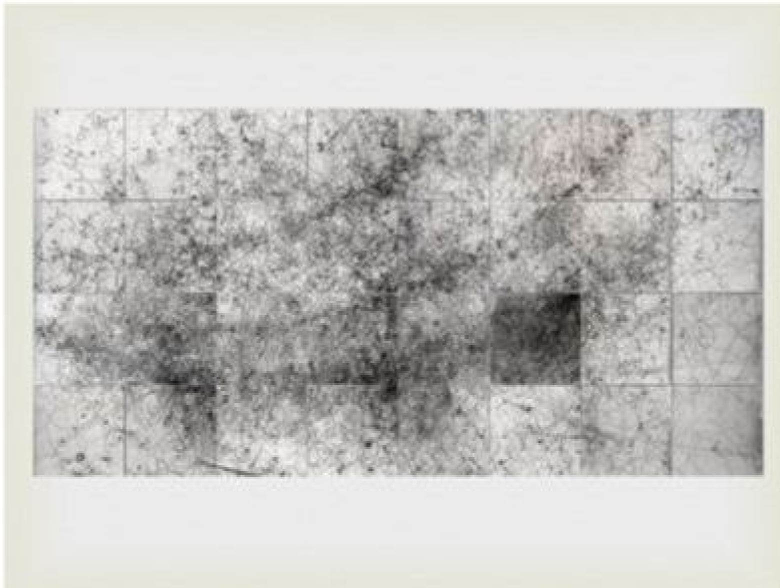

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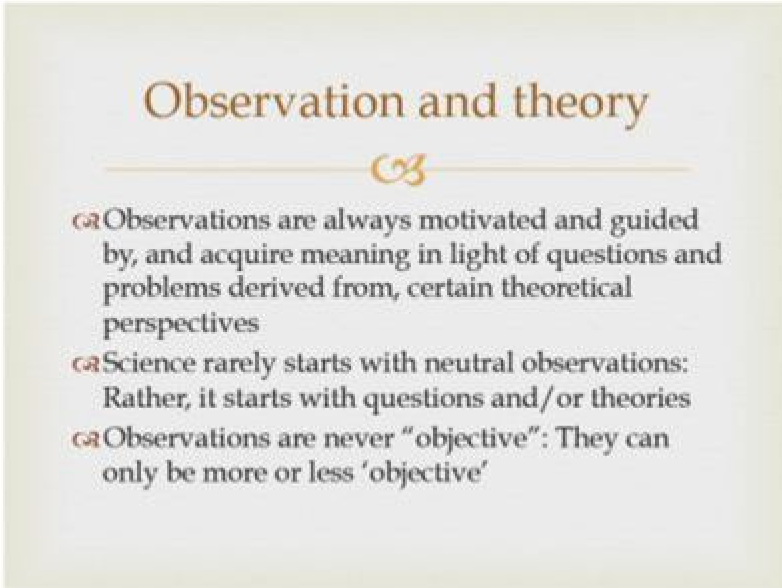

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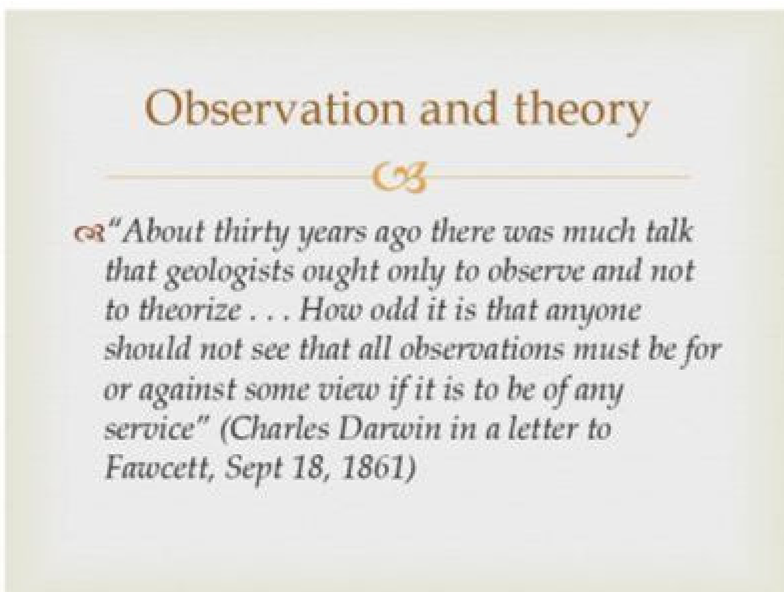

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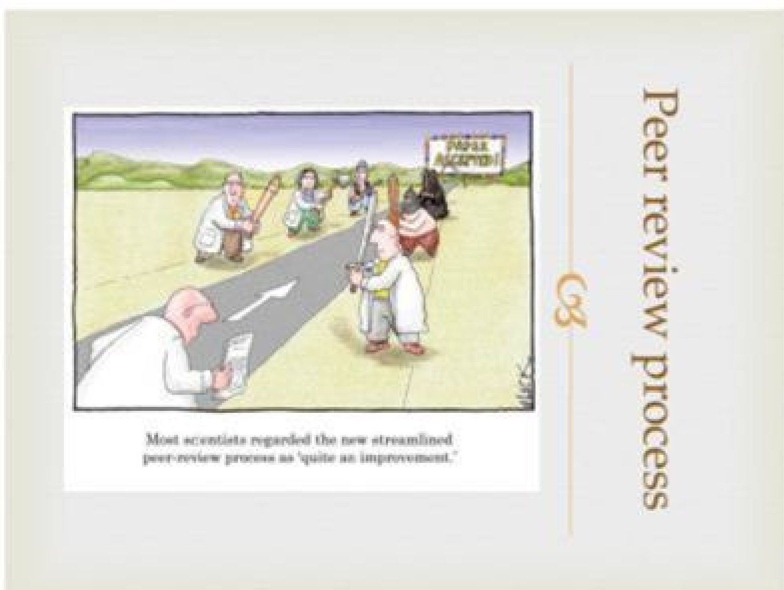

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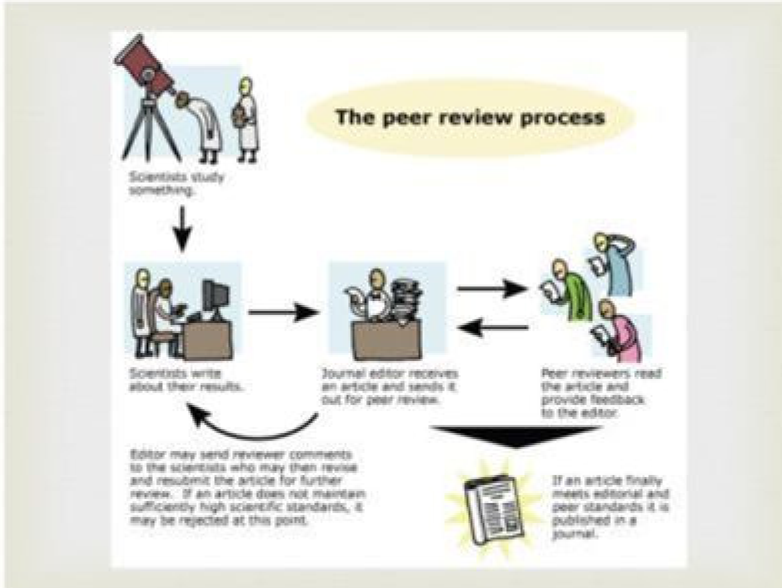

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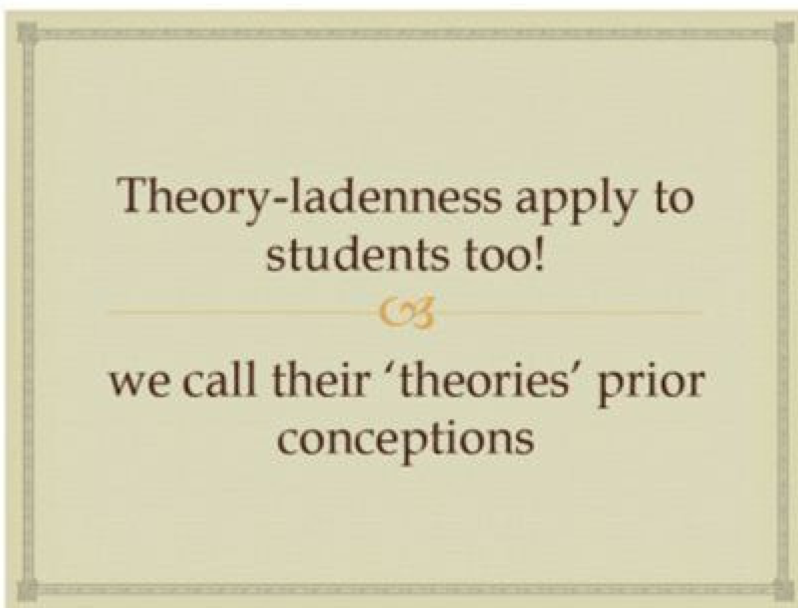

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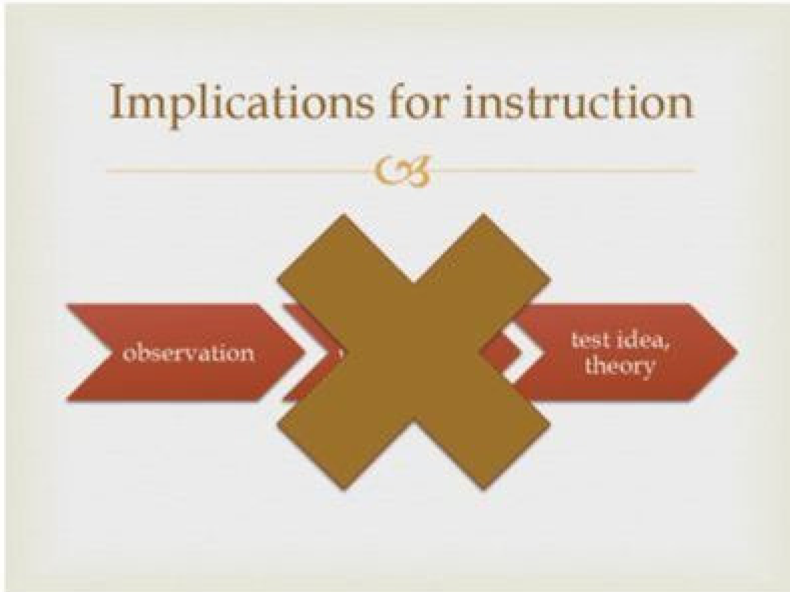

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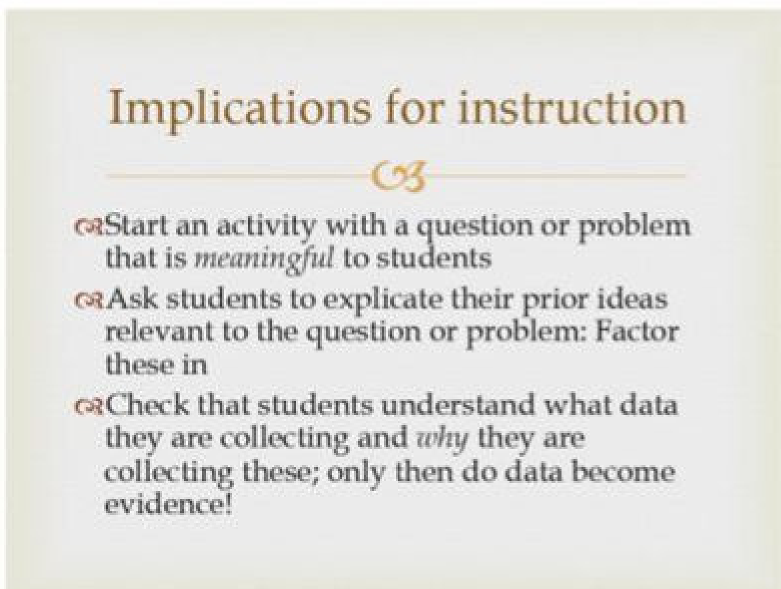

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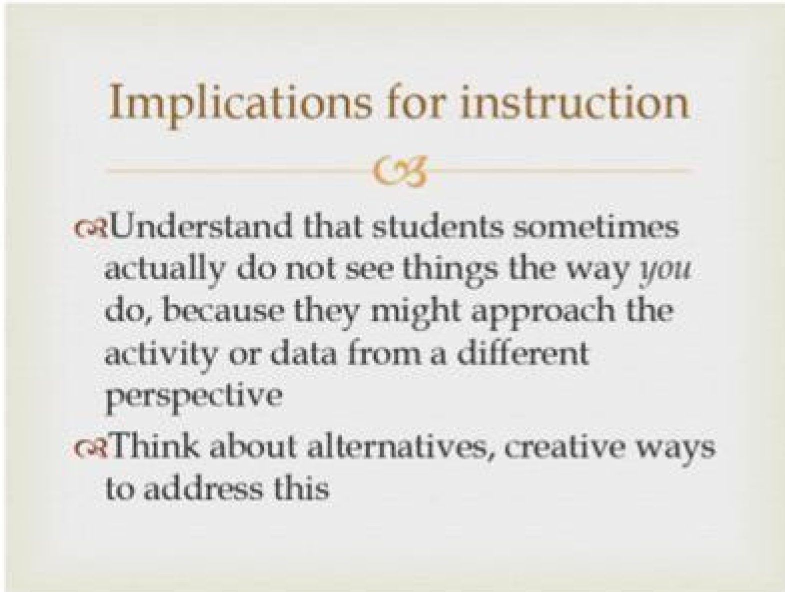

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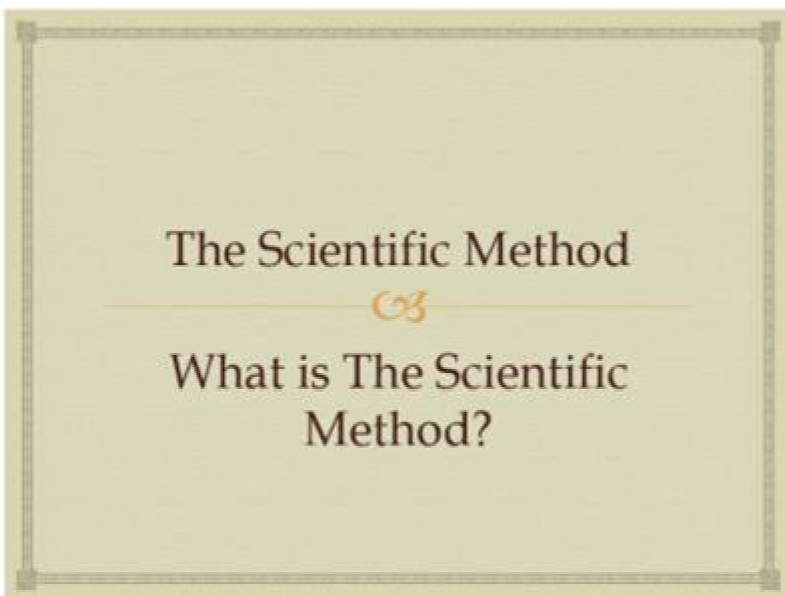

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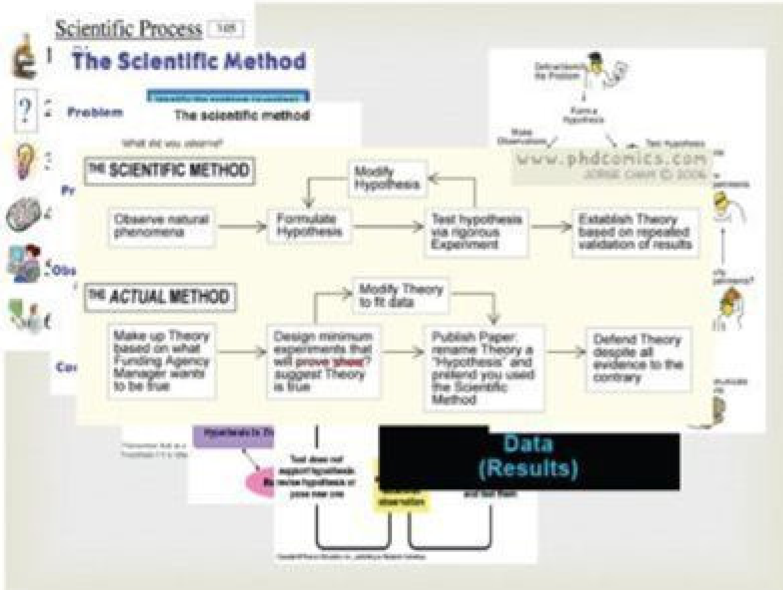

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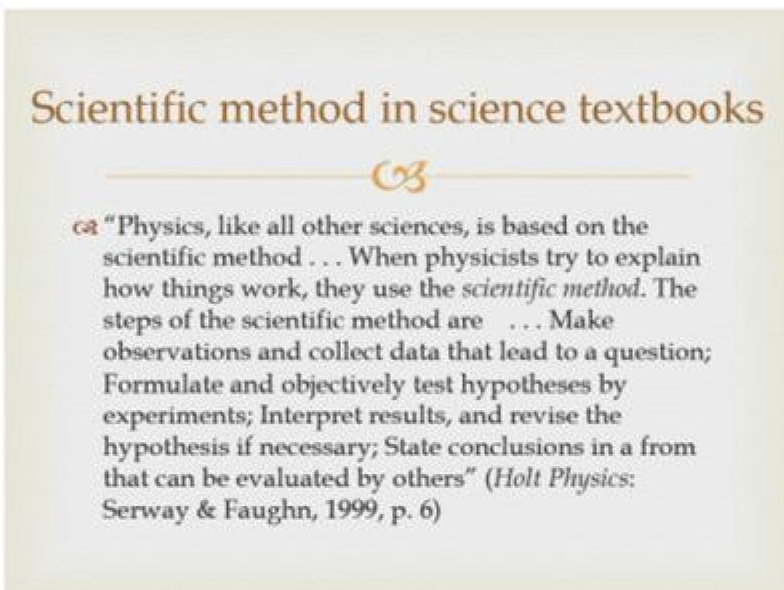

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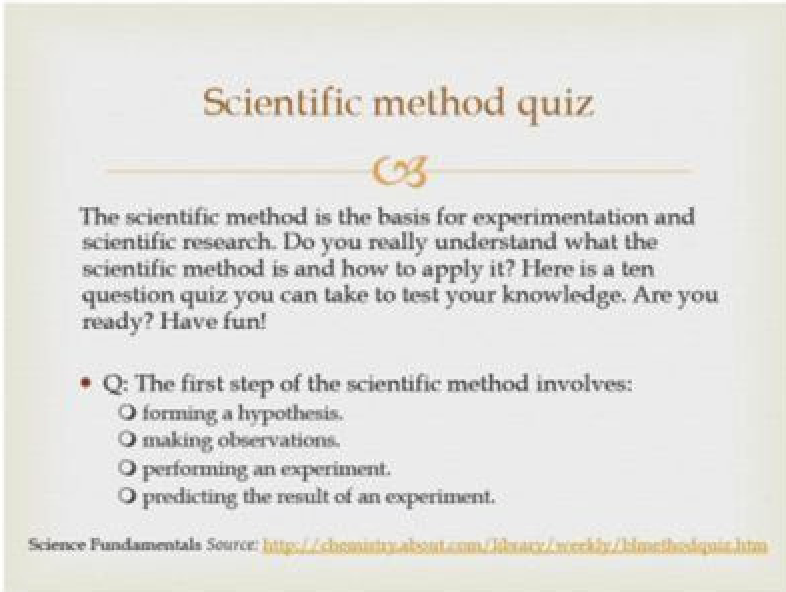

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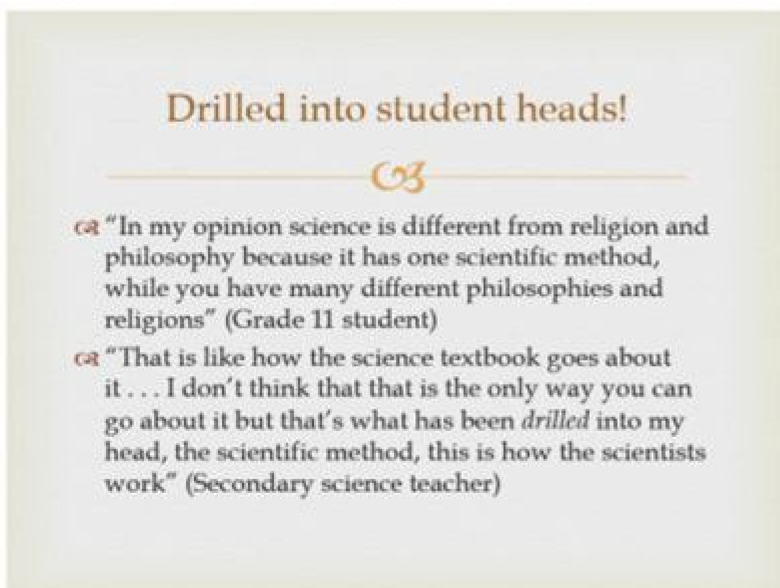

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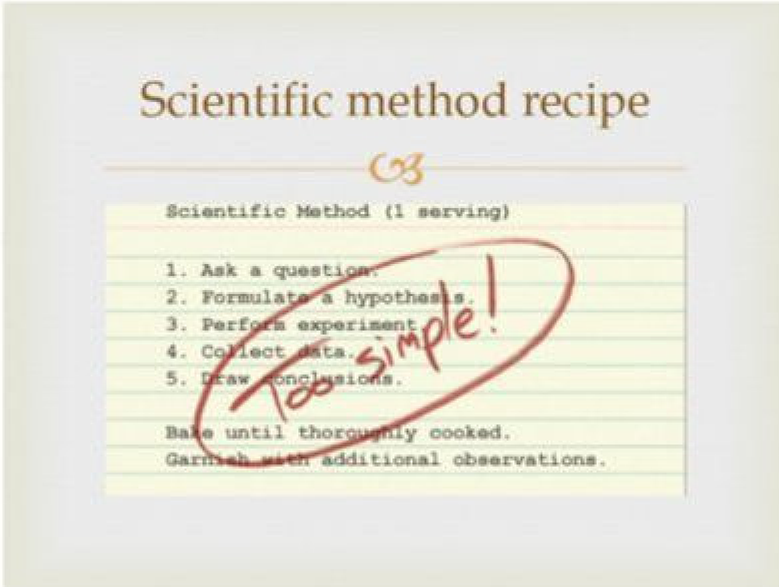

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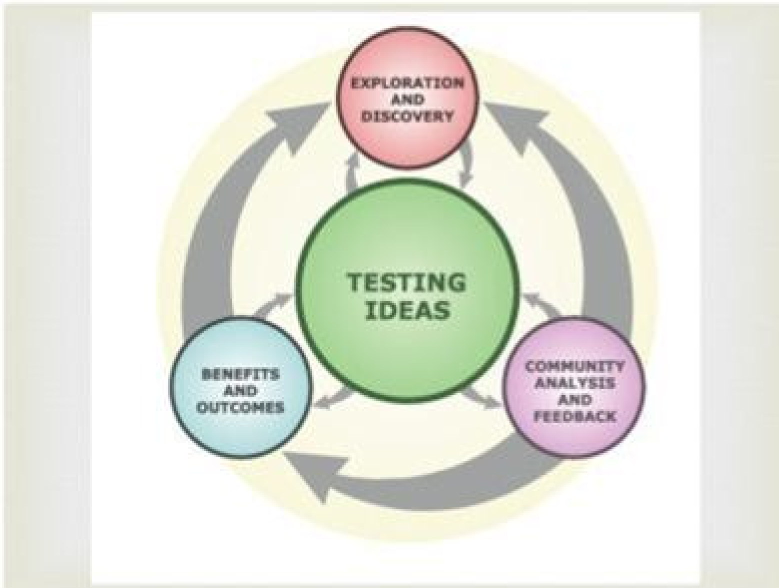

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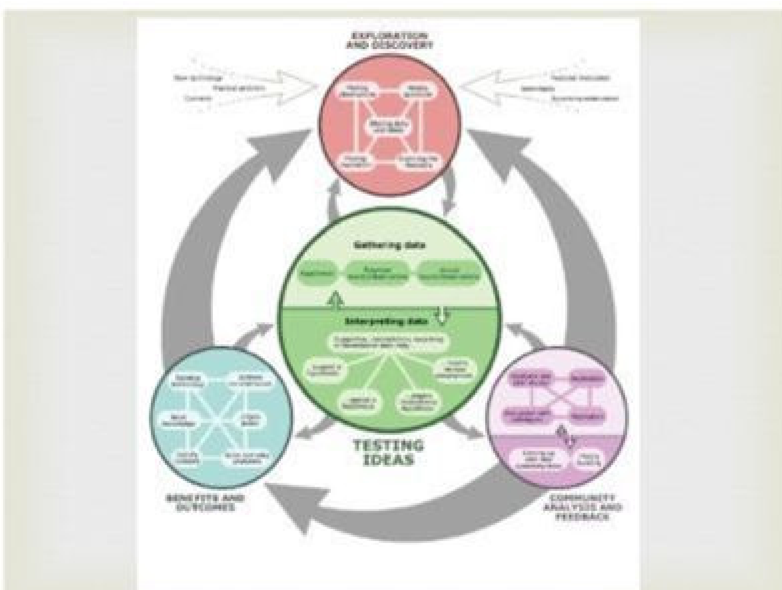

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Going more sophisticated

- Case study: "Exploring Aerosols"
  http://undsci.berkeley.edu/article/0_0_0/howscienceworks_04
- The whole story with ozone depletion
  http://undsci.berkeley.edu/article/0_0_0/ozone_depletion_13

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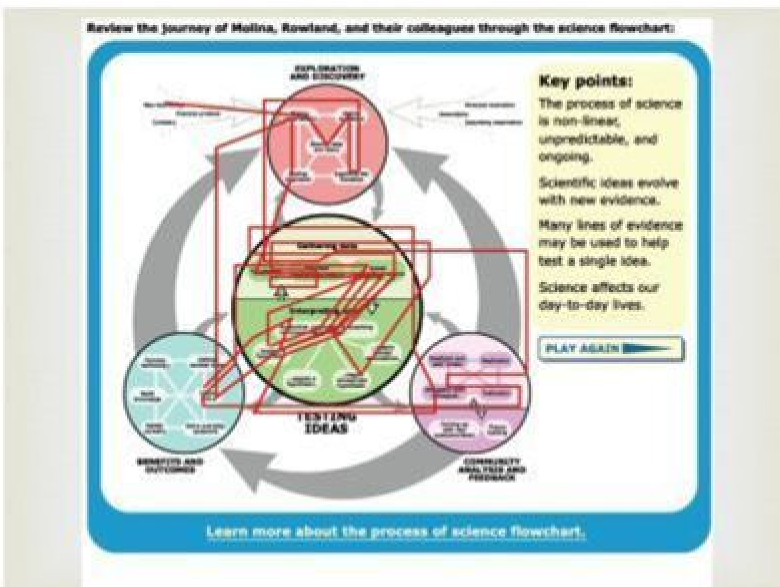

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Going more sophisticated

- Case study: "Asteroids and dinosaurs: Unexpected twists and an unfinished story" http://undsci.berkeley.edu/article/alvarez_01
- The whole story with dinosaur extinction http://undsci.berkeley.edu/article/0_0_0/alvarez_10

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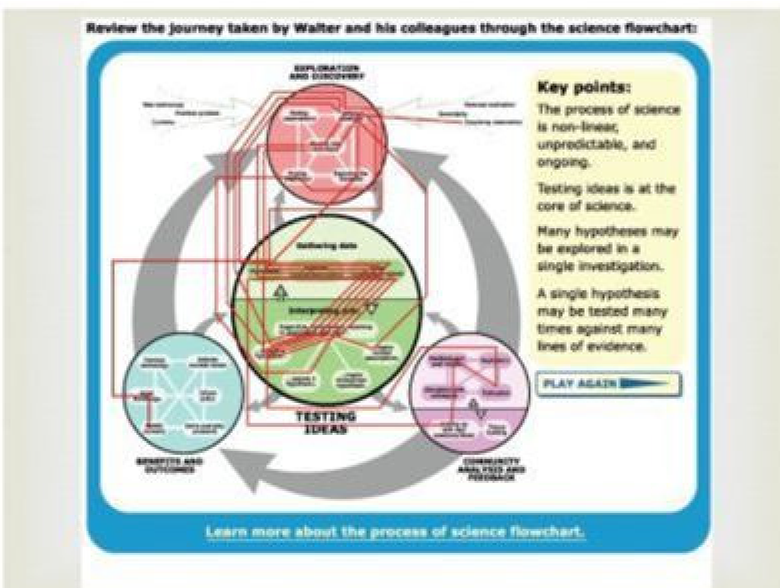

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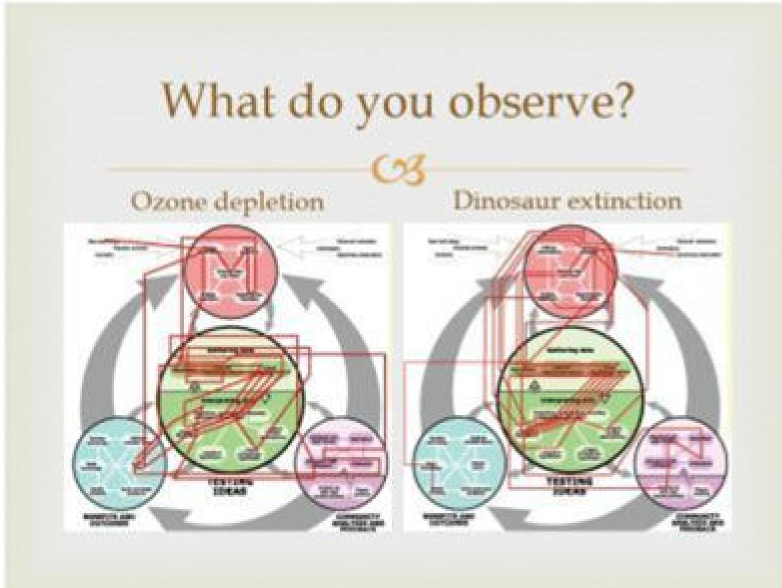

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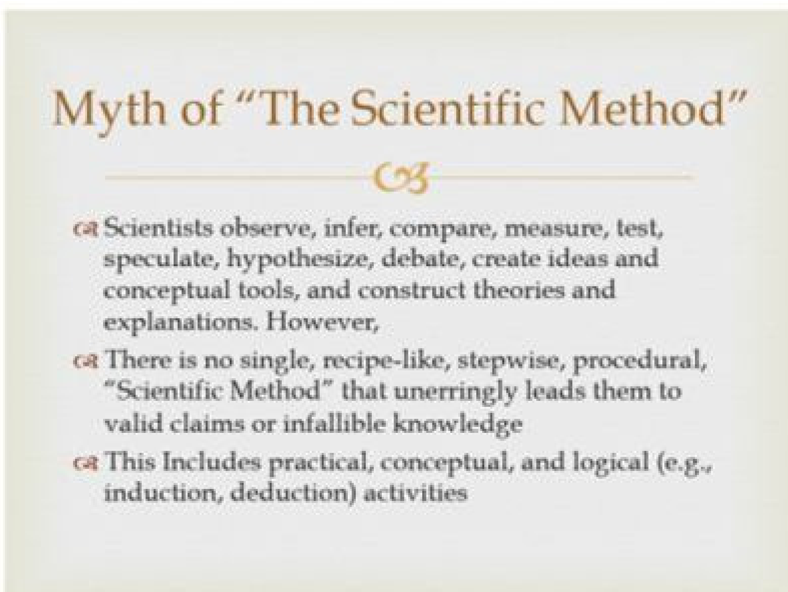

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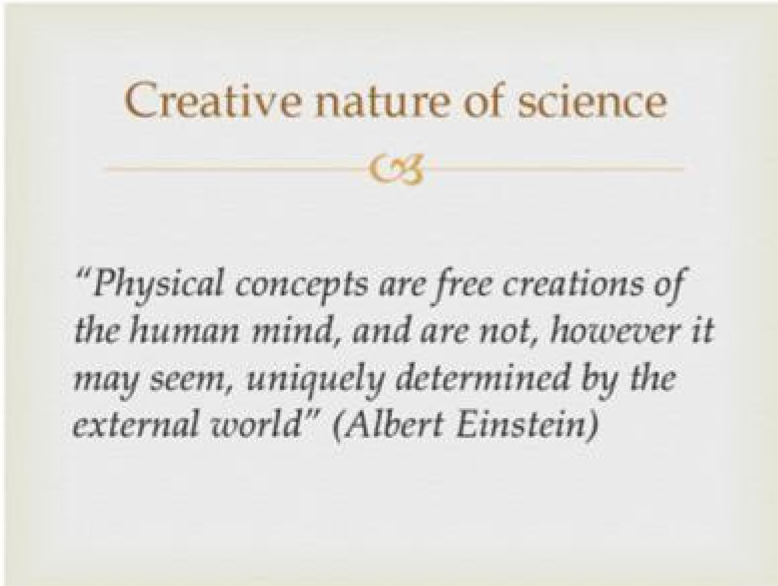

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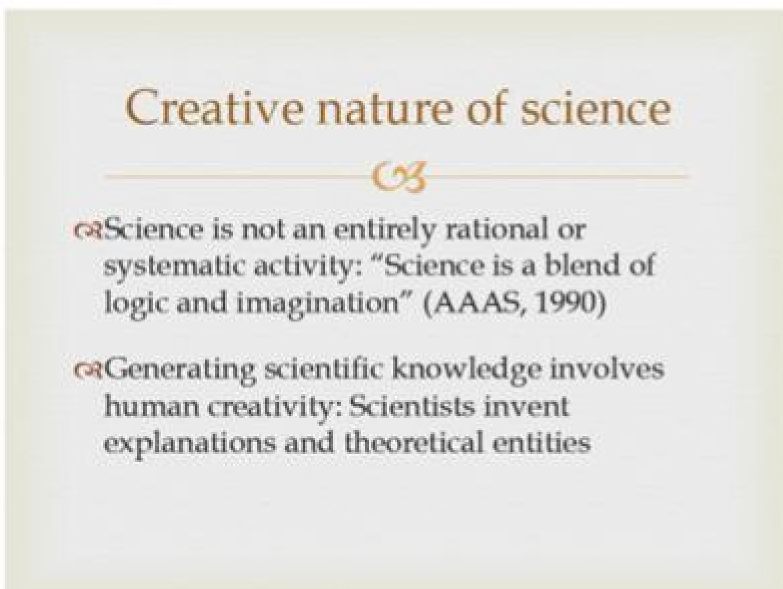

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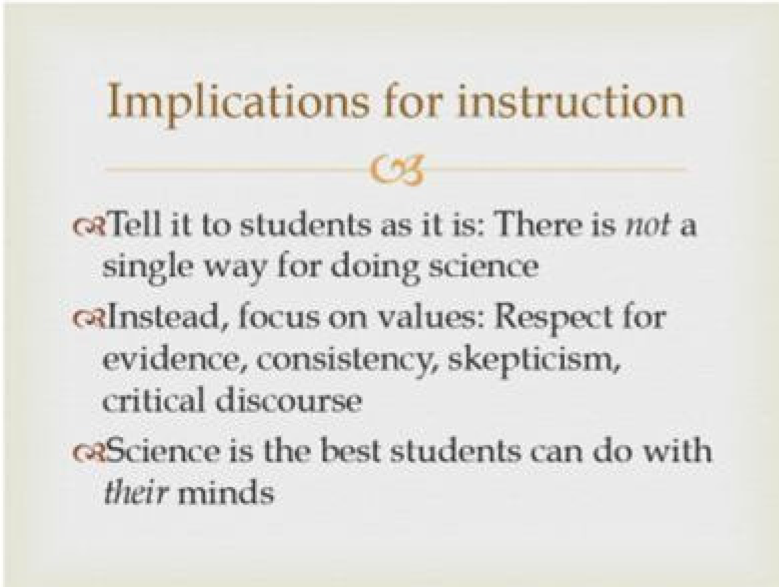

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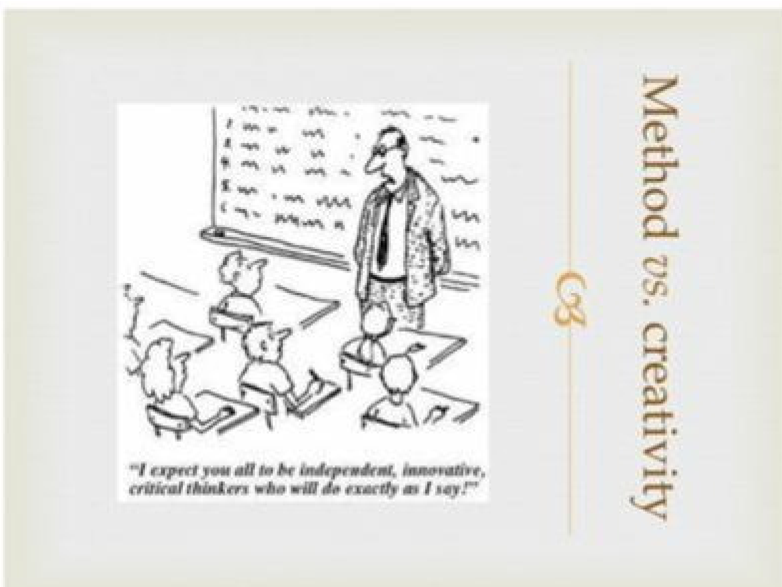

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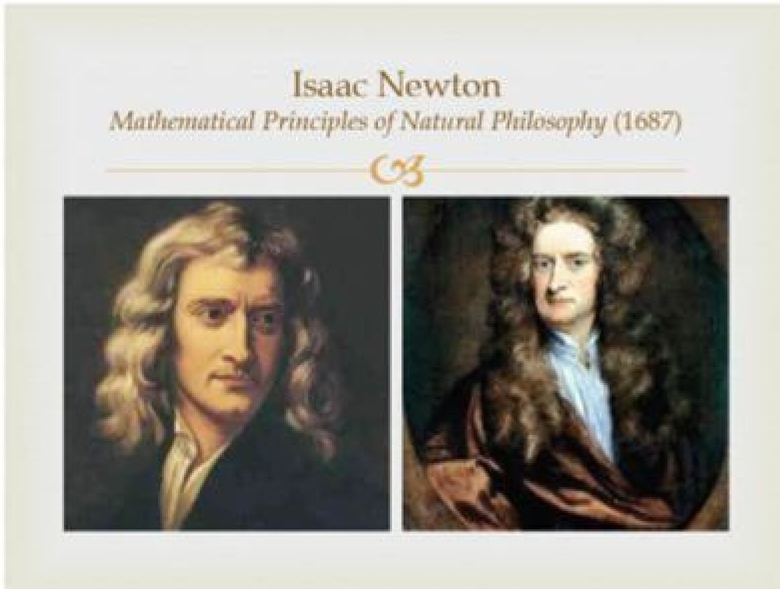

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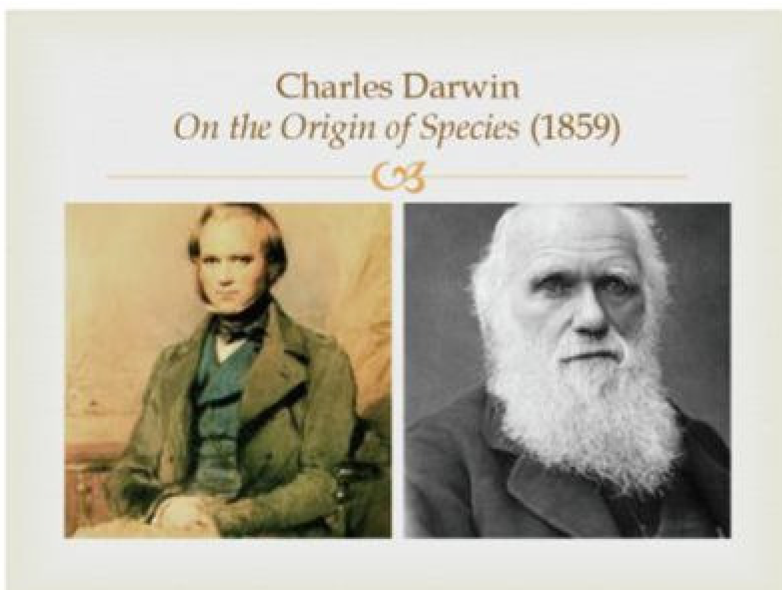

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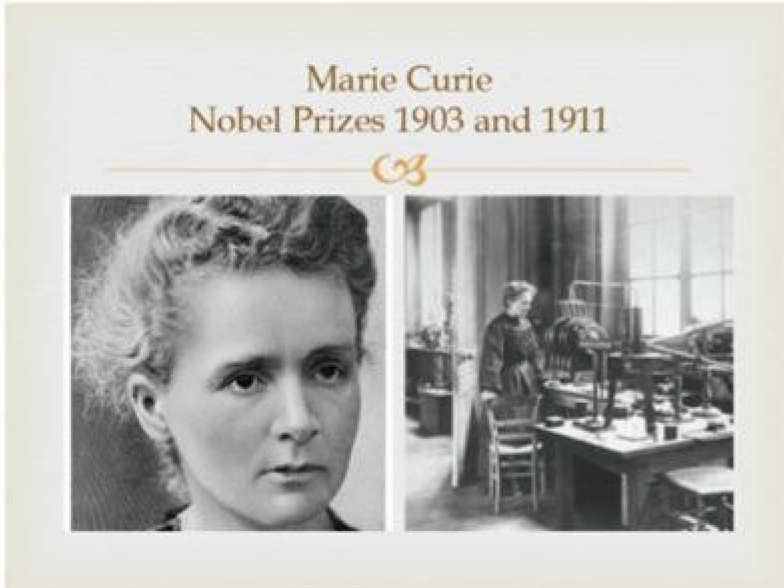

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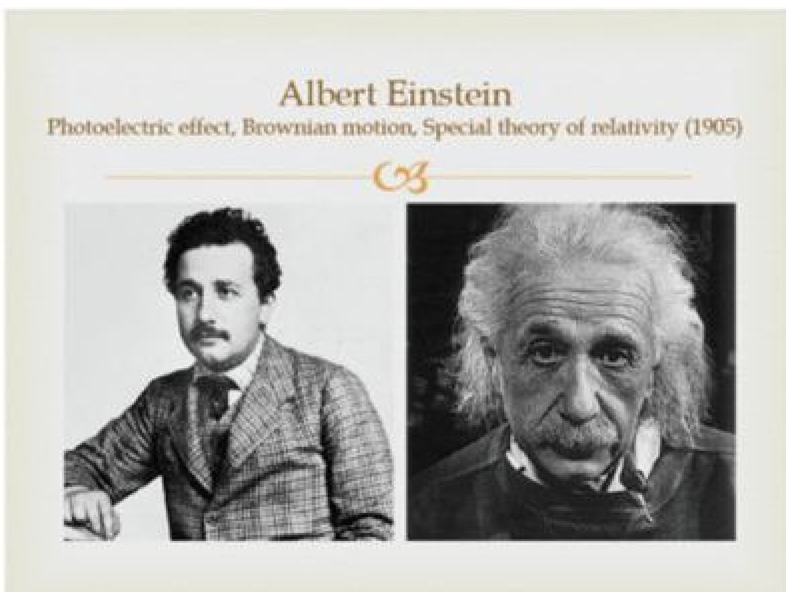

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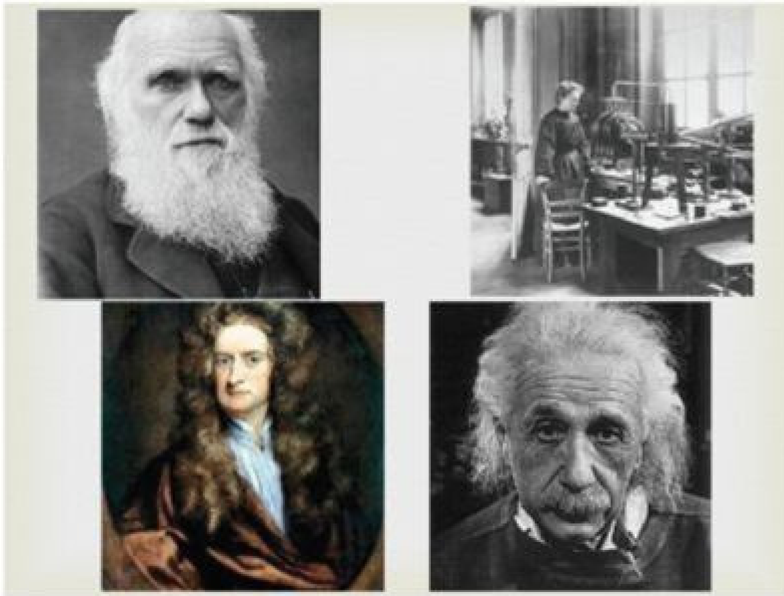

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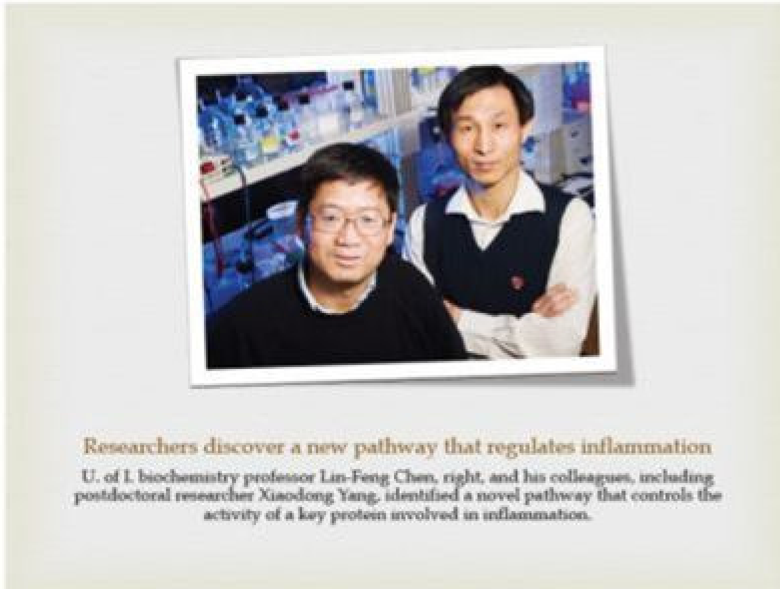

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SLIDE 63


Diversity-Oriented Synthesis of Functionalized Phenols by Regioselective [3+3] Cyclocondensations of 1,3-Bis(silyloxy)-1,3-butadienes with 3-Alkoxy-2-en-1-ones and Related Substrates

1. INTRODUCTION

SLIDE 64


Editorial

Gauge/String Duality

Wolfgang Mück, Carlos Núñez, Leopoldo A. Pando Zayas, Alfonso V. Ramallo, Radoslav C. Rashkov, and Kadayam S. Viswanathan

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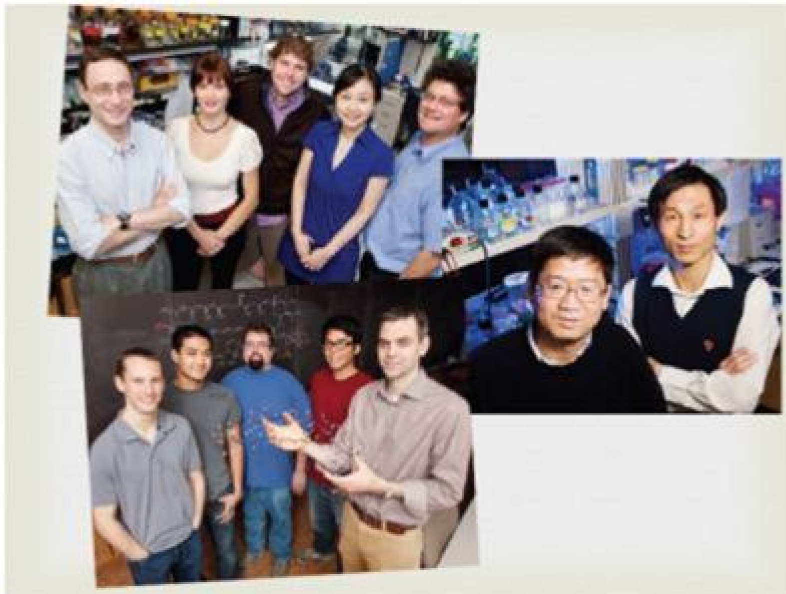

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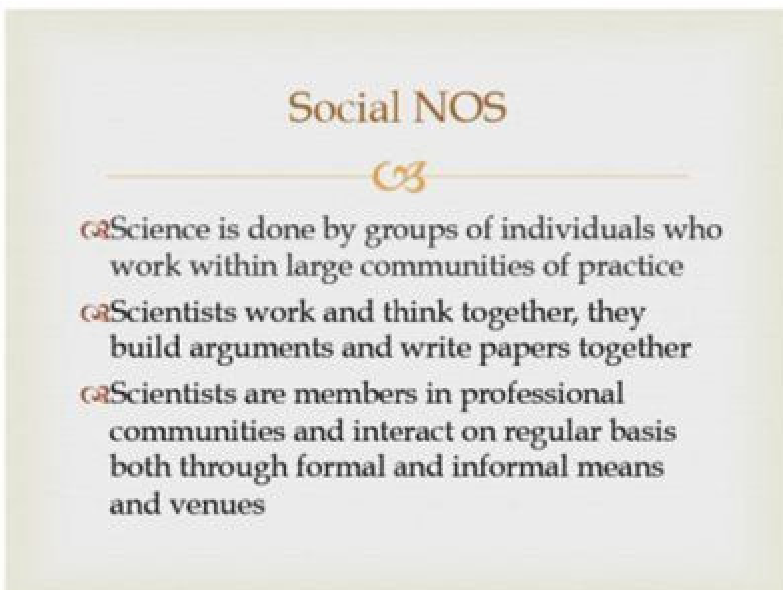

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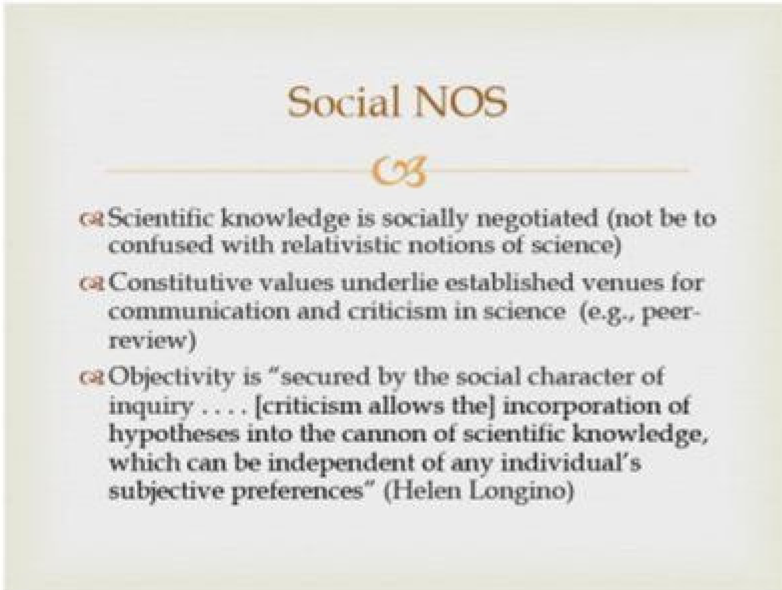

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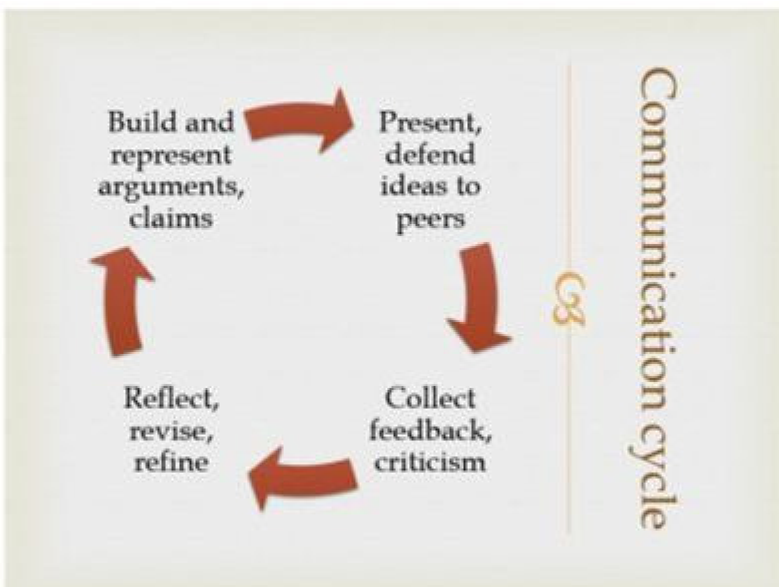

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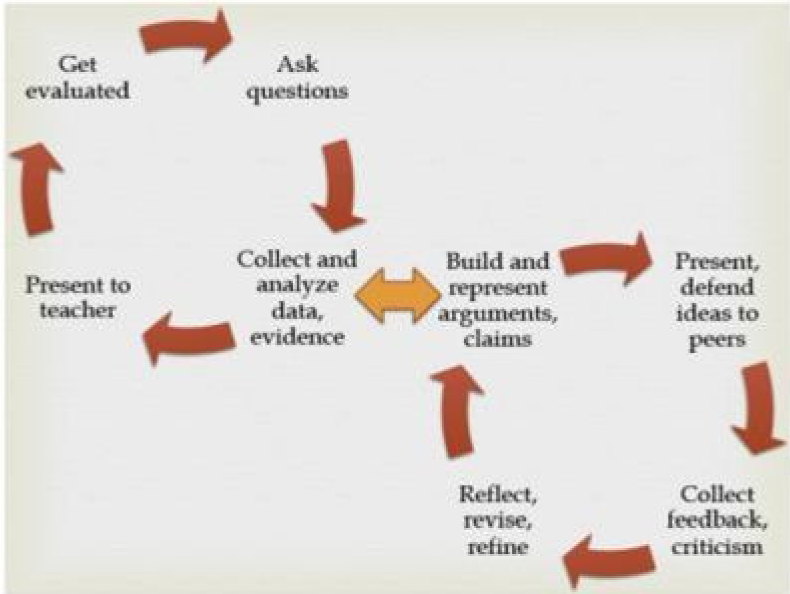

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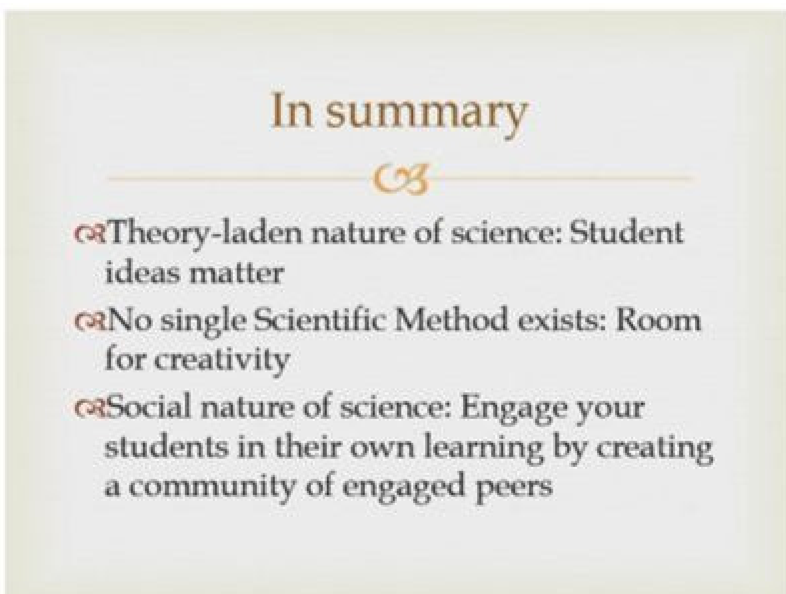

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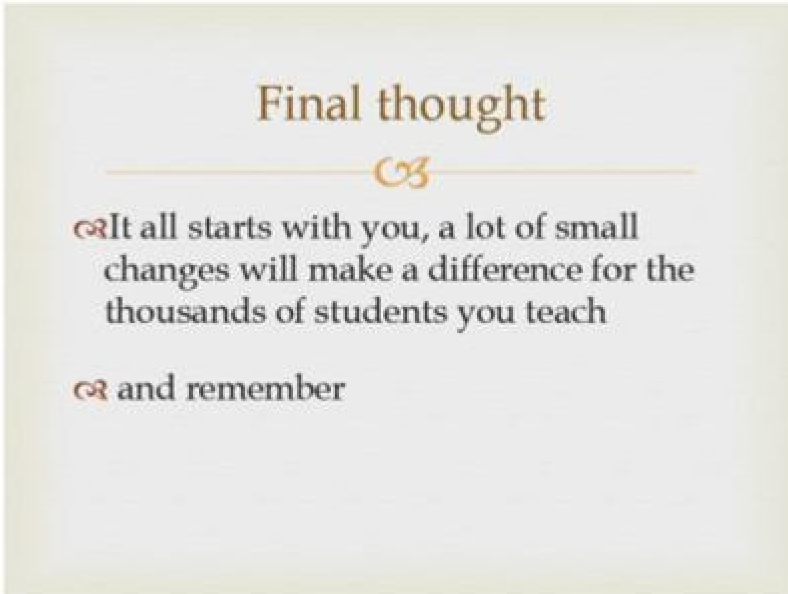

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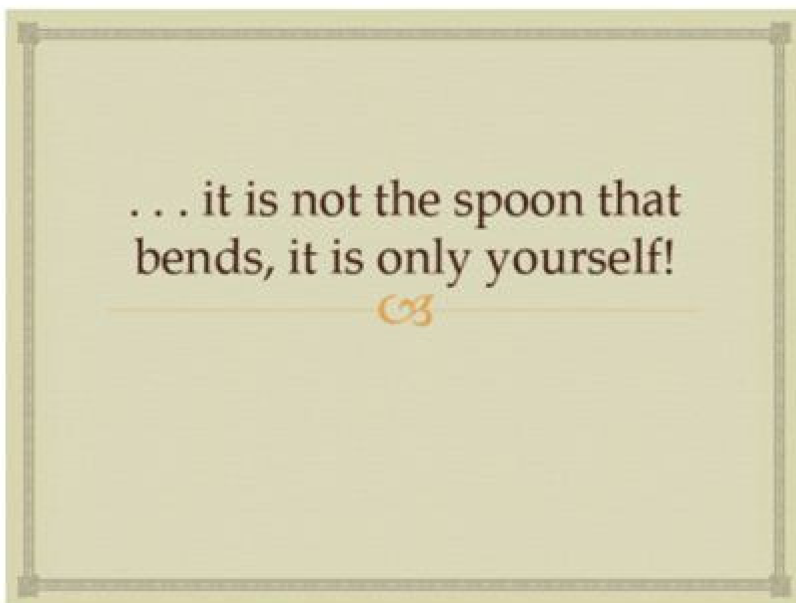

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MATHEMATICS AND SCIENCE

Inquiry-Stance toward One's Own Practice as an Essential Element of Good Teaching

Marjorie Henningsen

Introduction

Using examples from real classrooms, we engaged with what it means to have an inquiry-stance toward our own teaching practices, our students' learning, and the learning environment we create with them. We discussed various specific ways in which teachers might inquire into their own practice in mathematics and science. Research is a necessary and implicit part of the practice of all teachers, but perhaps we need to consider the value of making it a more explicit and systematic part of our planning, teaching and reflecting practices.

Description of Session

The session began with a discussion of the traditional definition of “action research” as being primarily problem-solving oriented. The question was raised whether there could be another perspective that focuses not on solving a specific problem of practice, but rather on gaining deeper understanding of a particular phenomenon in our practice.

Next, “action research” was renamed and redefined in terms of having an inquiry stance toward one’s own practices. More specifically, different purposes of teacher inquiry were discussed including the following: 1) to solve a problem, 2) to effect change, 3) to guide change, 4) to understand the nature of a phenomenon, 5) a way of thinking and a way of relating to others in solidarity in the act of trying to understand and 6) to establish and maintain a culture of uncertainty or the unknown in the learning environment. The latter three purposes are related to the idea of an inquiry stance toward practice.

I then spent significant time elaborating and emphasizing on the importance of *uncertainty* in any inquiry learning process. I also elaborated on the notion that in a classroom setting there are clear parallels between the role of the students and the role of the teacher in the inquiry process. Next, participants were engaged actively in analyzing a concrete example (a learning story) from preschool measurement. Participants did a gallery walk of student artifacts and were asked to generate their own inquiry questions about the example learning story as well as reflect on what mathematical ideas and processes students could have been learning or using in their inquiry in the example.

Following some sharing out from the gallery walk activity and discussion about school curriculum, I ended the session with a discussion of the question of whether teacher practice-based research is real research or not—i.e., to what extent it should be valued and in what ways it can be viewed as very powerful.

I shared the following final thoughts:

- Taking an inquiry stance toward our own complex teaching practice is not only desirable; it's a natural and essential element of being a good teacher.
- Inquiry is a site for relating theory and practice, but it is not a one-way relation. Through inquiry we move back and forth from theory to practice and back to theory again, continually refining both.
- A commitment to an inquiry stance transforms our practice. It transforms learning environments, the profession and us.

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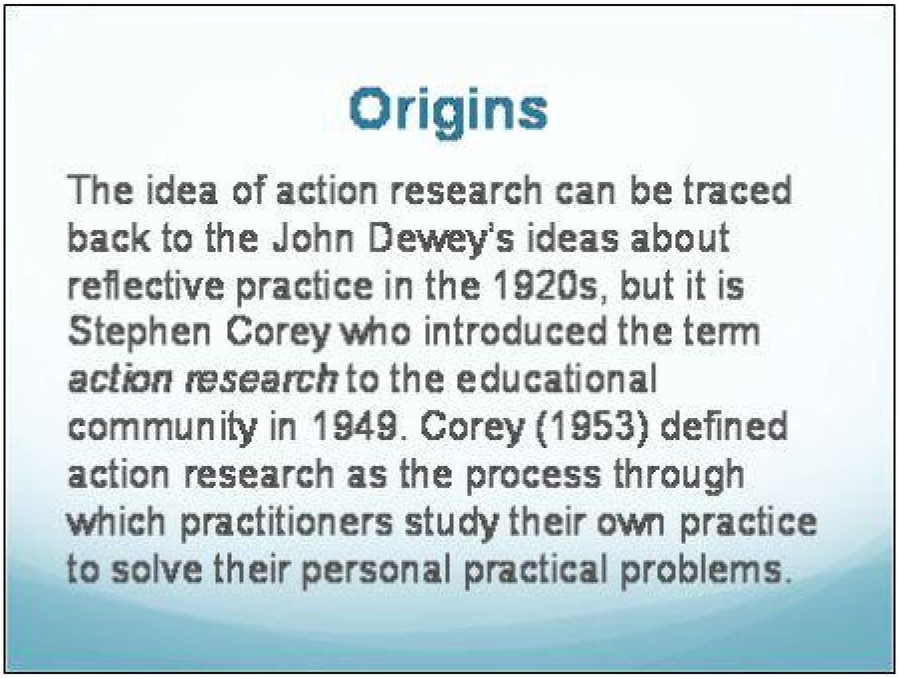

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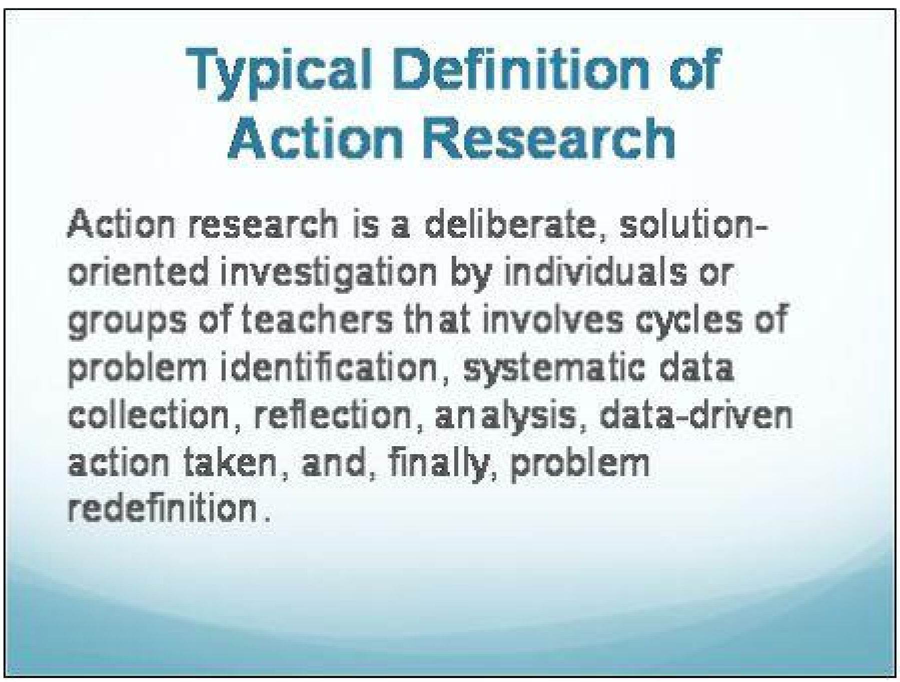

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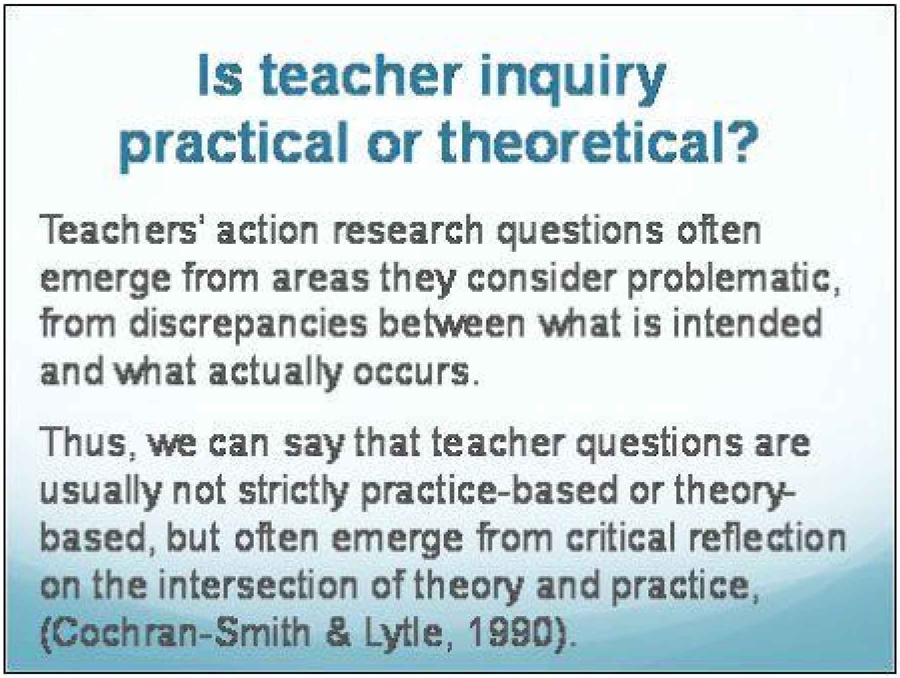

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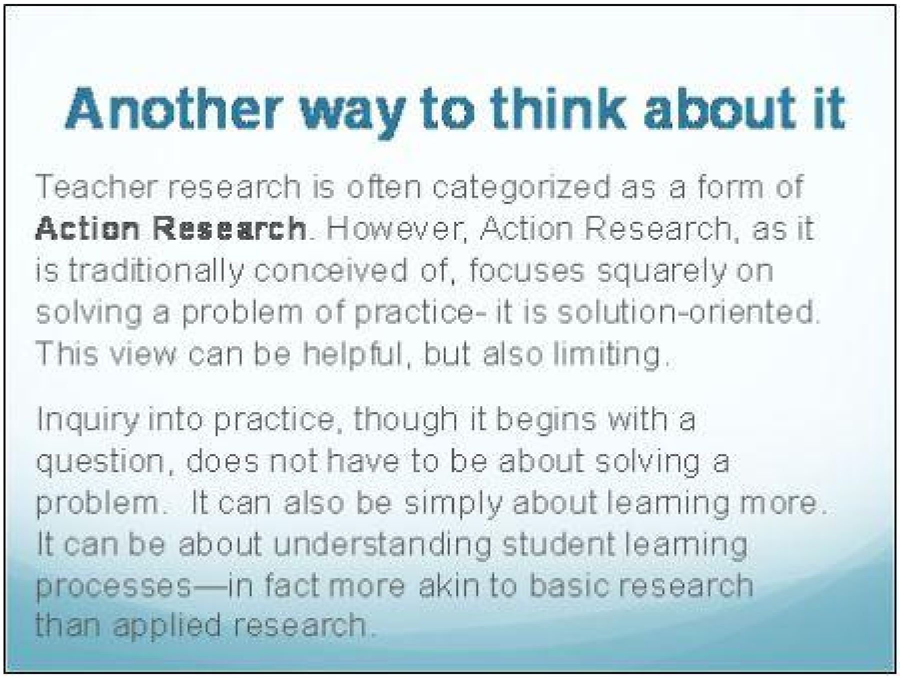

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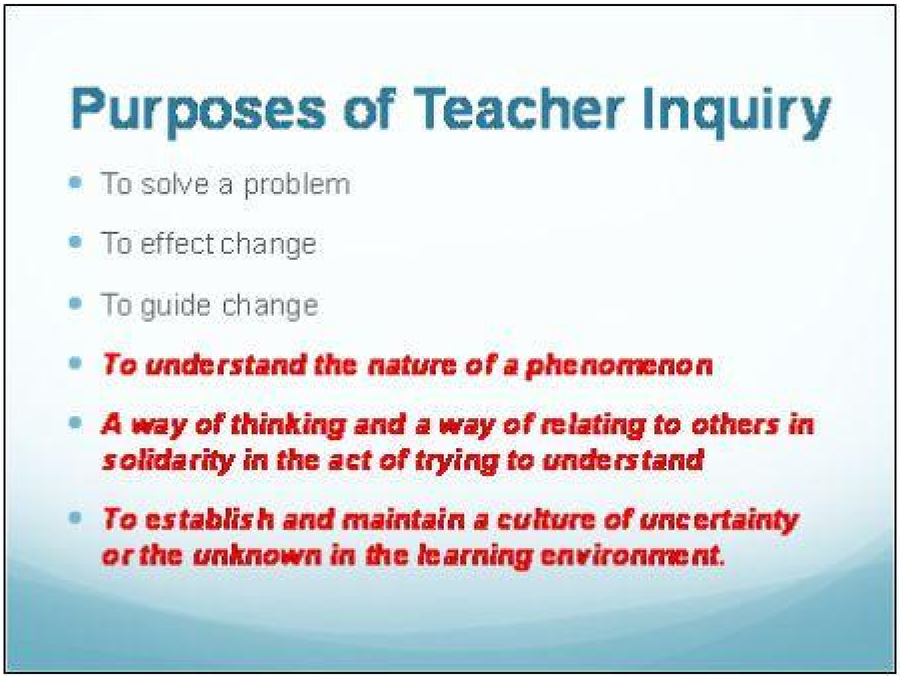

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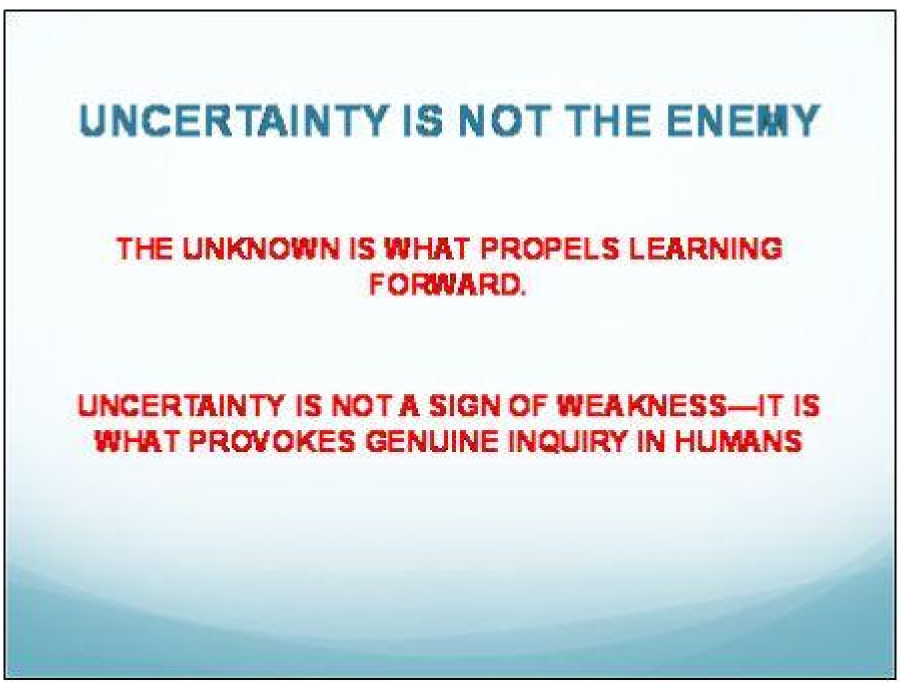

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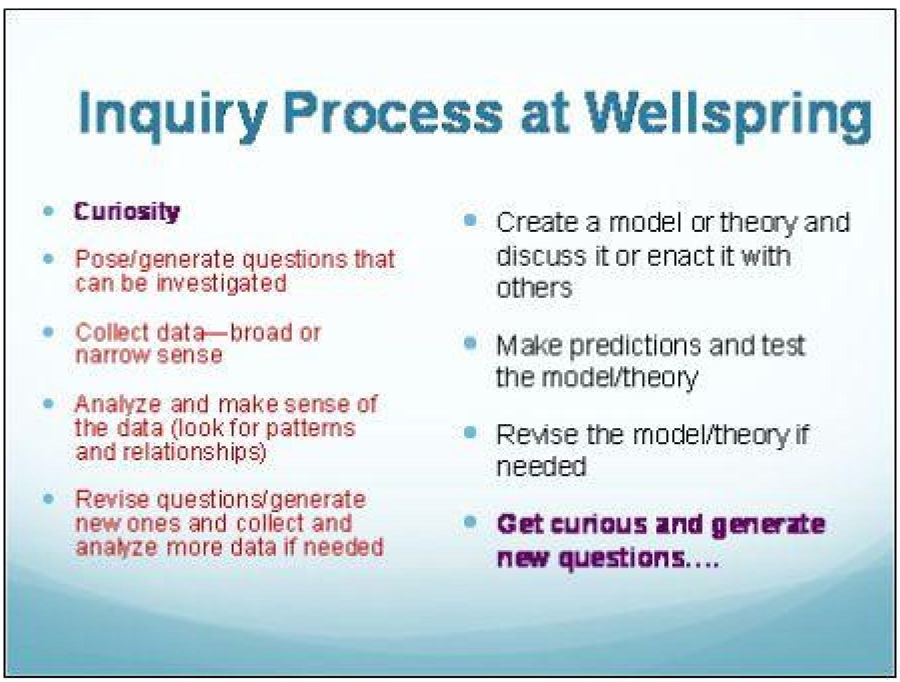


SLIDE 9

SLIDE 10

SLIDE 11

An emerging caveat, perhaps not well-articulated yet…

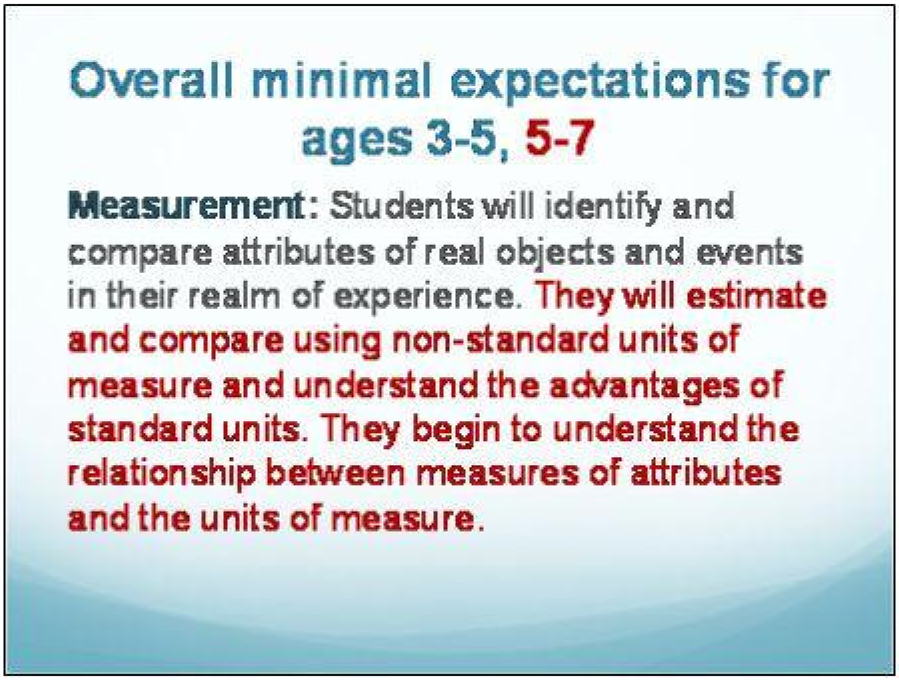
To inquire deeply and to see what is happening with children we have to move away from thinking about mathematical learning within the confines of a lesson with clearly defined *a priori* objectives as we traditionally think of it.

Instead we have to think about the role mathematical understanding has or can have as the child's natural inquiry processes play out and how mathematical insights and developing understanding can be afforded through the larger process of making sense of their experiences.

SLIDE 12

EXAMPLE: Emerging measurement

SLIDE 13



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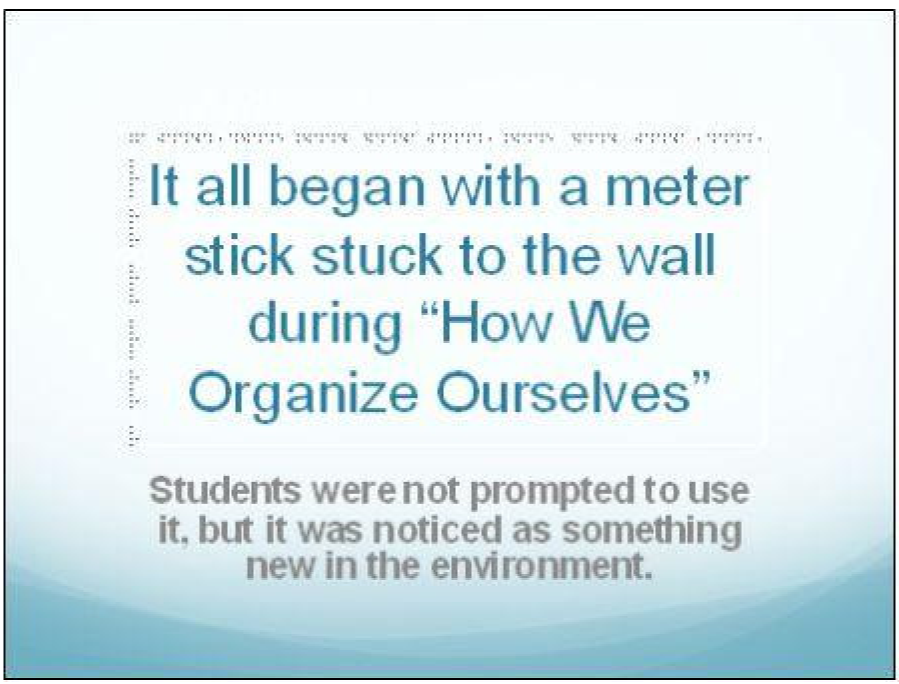

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Photos were shared with transcripts to illustrate a real classroom story (they have been removed from this presentation due to image use confidentiality agreements):

Teachers had placed a foam meter stick on the wall of the KG1 classroom (4-5 year olds). At some point students became interested in it and began "measuring" themselves and others with it. The interest in it snowballed among students. They became excited about measuring height with it. Students showed an awareness that the numbers on the meter stick had clear meaning and engaged in comparing one another in terms of height measure.

SLIDE 16

Where did this lead?

In the morning meeting the next day many students wanted to do more measuring. The teachers asked them if they could use other things to measure besides the meter stick on the wall since it was stuck there and could not be moved around. One student suggested, "We can use other long things that go this way (making vertical motion with the hand)". Teachers asked if they could find some objects in the classroom that could be used to find out how long or tall something is.

The students dispersed and came back with thin markers, a small measuring tape, snap cubes, glue sticks, and big paper clips. They the went around measuring things and recording their results.

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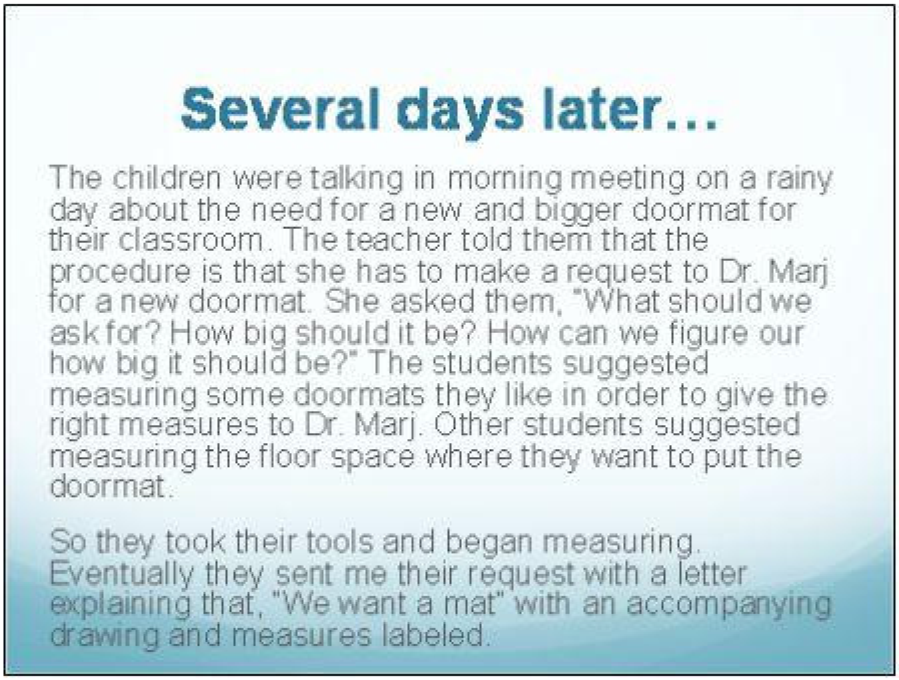

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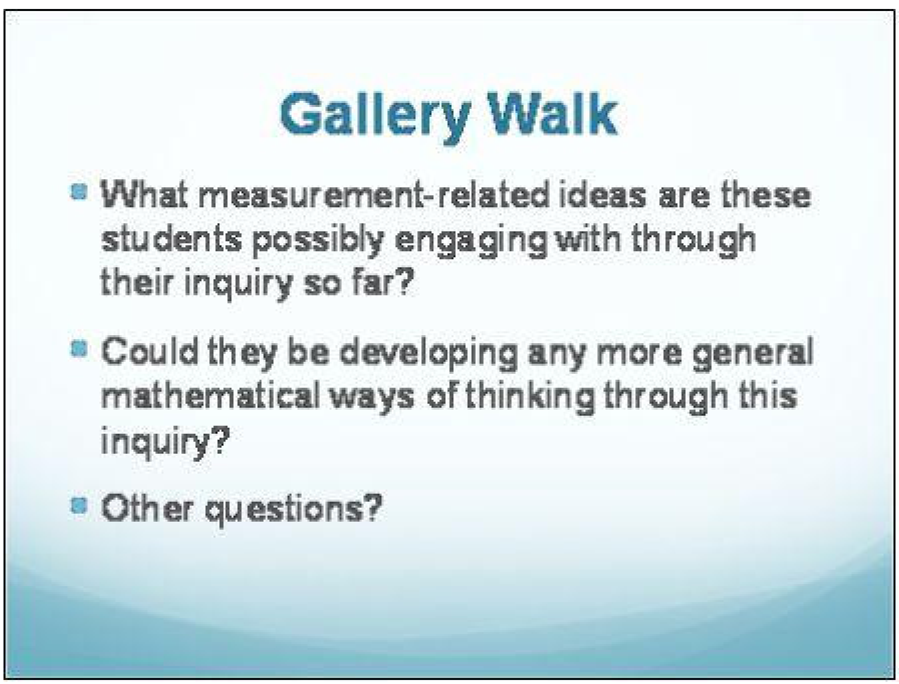

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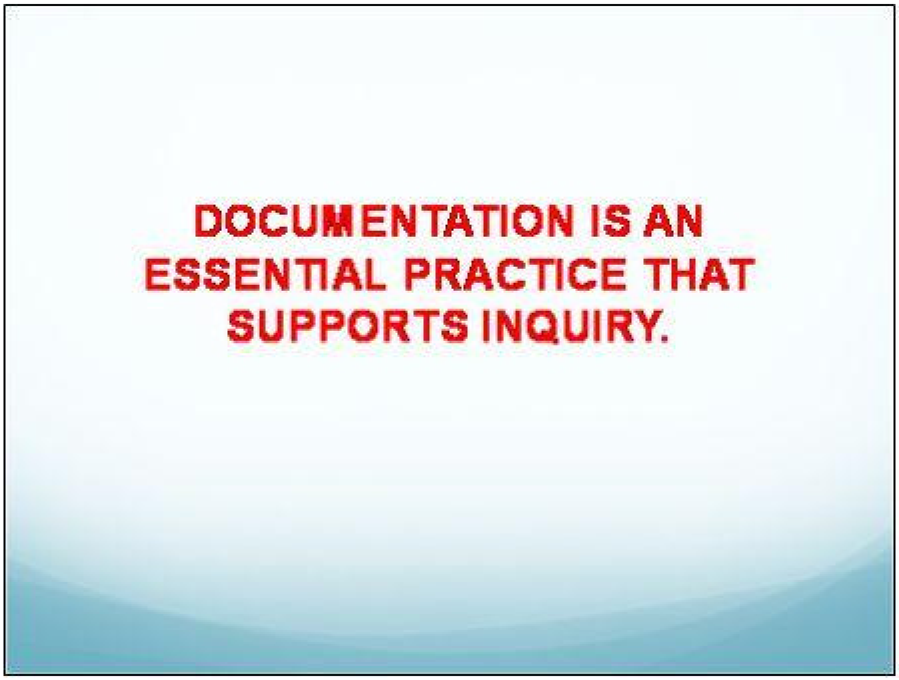

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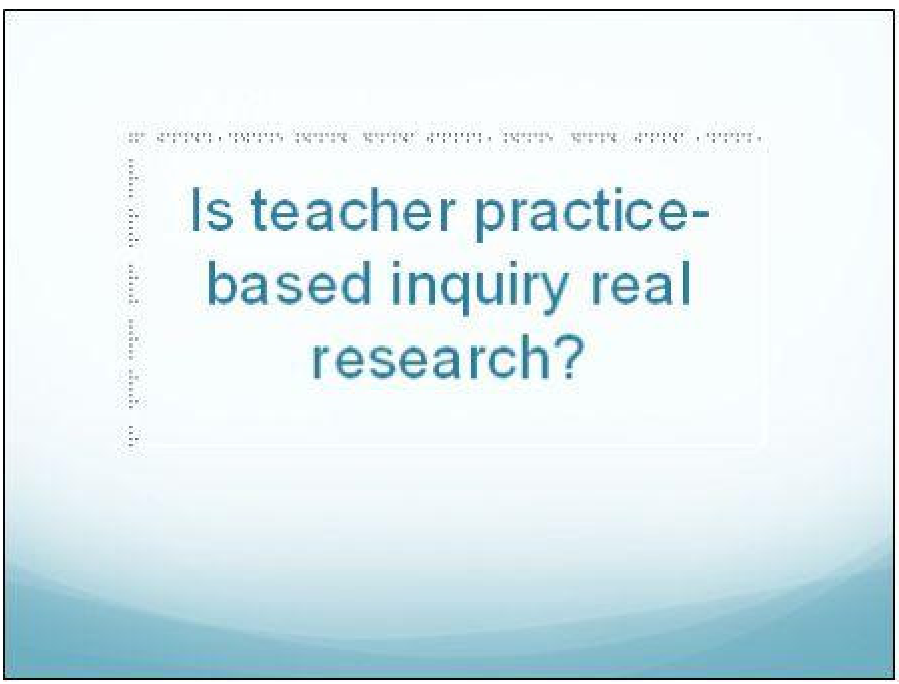

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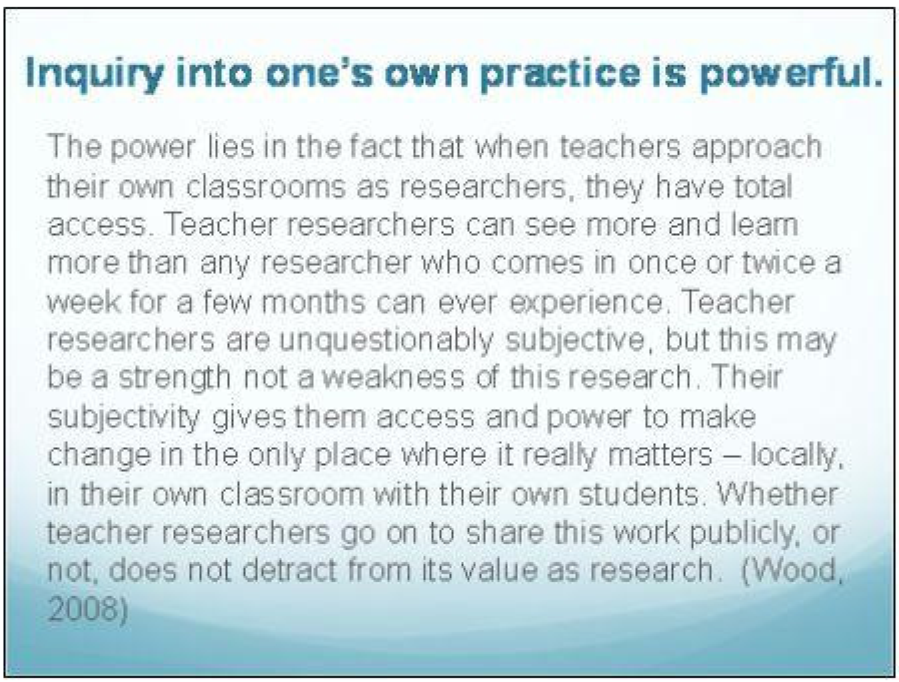

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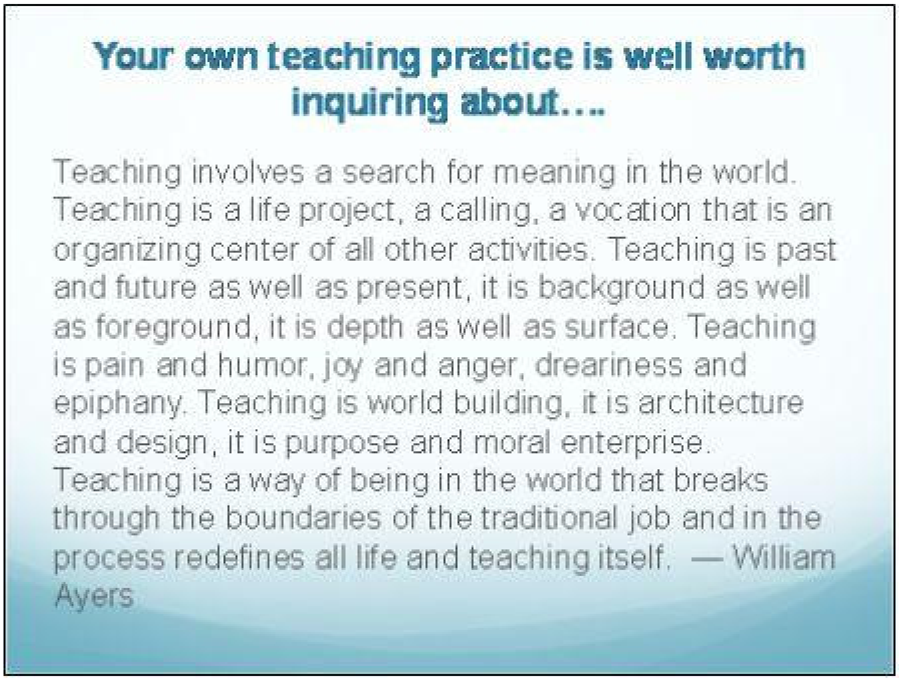

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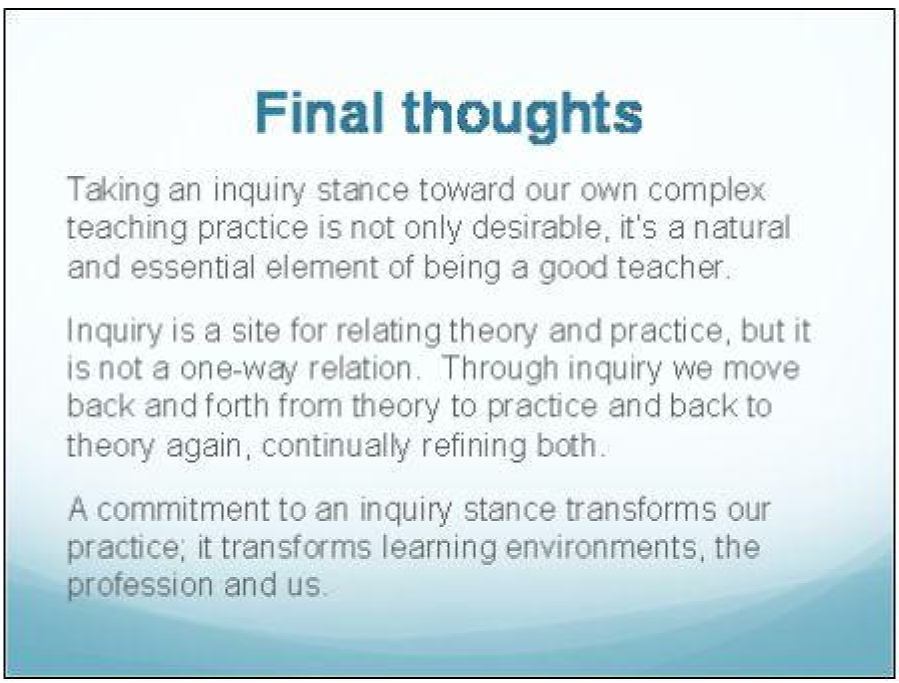

SLIDE 25

Accreditation Process
Jaimy Kajaji

SLIDE 1

SLIDE 2

Why Get Accredited?

The main aim of this evaluation program is to provide an opportunity to improve the quality of the education offered at the school through a rigorous process of self-examination followed by an objective external appraisal by a team of peers.

SLIDE 3

Benchmarks of Evaluation

Each school is evaluated against two basic benchmarks, these being:

1. The School's own Philosophy and Objectives and how successful the school is in meeting its own stated purposes.
2. The Standards for Accreditation which are designed to reflect the characteristics of a high quality educational experience.

The guiding principles of the accreditation program are that a school will be evaluated against The Standards for Accreditation but in terms of its own Philosophy and Objectives.

SLIDE 4

The Initial Evaluation

The Head of a school wishing to enter the accreditation process for the first time should meet with key members of the school and together assess whether the school meets the prerequisites for the initial application or not. This evaluation should be made by discussing the school's:

1. Philosophy and Objectives
2. Curriculum
3. Governance and Management
4. Staff
5. Student Support Services
6. Resources
7. Student and Community Life

and assessing to what extent these school sections meet with the Standards for Accreditation set by the accreditation organization.

SLIDE 5

The Initial Evaluation

Also to be considered are:

1. The school community time and effort commitment.
2. The Board of Trustees financial commitment.

If the head and key members of the school consider that the school is eligible to enter the accreditation process, then the school proceeds to the Initial Application.

SLIDE 6

The Initial Application

The Head of a school receives a request to submit a brief amount of prior information to the accreditation organization. This information includes:

1. Name and address of the school
2. History of the school
3. Mission statement (including philosophy, motto, objectives)
4. Curriculum
5. Governance
6. Finance

SLIDE 7

Preparation for the Preliminary Visit

The head of a school is advised to involve a small number of key members of the school community (e.g. heads of sections, heads of departments, etc…) in the task of producing suitable information and comments for this form.

As a preparation for the preliminary visit, the school is required to:

1. Submit various pieces of information, including:
   - general school information
   - student enrollment statistics by class, gender and nationality

SLIDE 8

Preparation for the Preliminary Visit

2. Submit some documents

- **SECTION A: PHILOSOPHY & OBJECTIVES**
  - Doc-A (i) A copy of the school's current philosophy & objectives (may be entitled " Mission & Aims", "School Charter", etc.).
  - Doc-A (ii) A copy of the school's admission policy and enrollment procedure, including details of screening processes.
  - Doc-A (iii) A short description of the main characteristics of the community served by the school.
- **SECTION B: CURRICULUM**
  - Doc-B (i) A short descriptive summary of the school's main curriculum, covering design, delivery, student assessment and review.

SLIDE 9

Preparation for the Preliminary Visit

- **SECTION C: GOVERNANCE & MANAGEMENT**
  - Doc-C (i) A list of the members of the governing body showing names and occupations
  - Doc-C (ii) A document such as by-laws showing how the board is organized and how it operates
  - Doc-C (iii) names of persons responsible and titles + organizational chart
- **SECTION D: STAFF**
  - Doc-D (i) A list or chart showing how staff is organized into departments, divisions, etc.
  - Doc-D (ii) A copy of employment contract(s) in use, and any other school documents regulating employer/employee relations.
  - Doc-D (iii) A copy of the salary structure.

SLIDE 10

Preparation for the Preliminary Visit

- Doc-D (iv) A list of other benefits offered to personnel (housing, travel allowance, medical insurance, etc.).
- Doc-D (v) Full list and details of all academic and academic support staff (including current role in school, number of years of experience, and post-secondary qualifications and institutions).
- **SECTION E: STUDENT SUPPORT SERVICES**
  - Doc-E (i) List of names and summary roles of staff that make major contributions to the school's health services.
  - A description of support services (special needs, English as a second language, counseling, and health care.

SLIDE 11

Preparation for the Preliminary Visit

- **SECTION F: RESOURCES**
  - Doc-F (i) A brief description of school transport, food, residence, safety and security and cleaning services (and any other auxiliary services if applicable)
  - Doc-F (ii) A simple annotated plan of the school facilities
  - Doc-F (iii) A brief description of the ICT services (for teaching /learning and administration) available at the school.
  - Doc-F (iv) a brief description of the library/media center and its services
- **SECTION G: STUDENT & COMMUNITY LIFE**
  - Doc-G (i) A list of the co-curricular activities on offer , with an indication of the approximate number of students participating

SLIDE 12

Preparation for the Preliminary Visit

- Doc-G (ii) A copy of the regulations applying to student conduct, and the procedure to be followed in the case of breach of rules
- Doc-G (iii) A list of methods by which information is shared between parents, students, and the school
- Doc-G (iv) A list of methods by which the school seeks opinions from parents and students
- Doc-G (v) A short description of any form of student government or representative council
- Doc-G (vi) A short description of any community service activities undertaken by students
- Doc-G (vii) A list of the practical ways in which the school promotes intercultural and international awareness among students.

SLIDE 13

Preparation for the Preliminary Visit

3. Submit frank comments on the school's current position with respect to each and every standard for accreditation. A rating and a concise comment is required against each standard. Possible ratings are E (exceeds), M (meets) or D (does not meet).

- **SECTION A: PHILOSOPHY & OBJECTIVES**

  Section A: STANDARD ONE

  The school shall have a clear and effective written statement of its philosophy and objectives, appropriate for the students it serves.

  School Rating and Concise Comment: …

SLIDE 14

Preparation for the Preliminary Visit

Section A: STANDARD TWO
The school's philosophy and objectives shall be generally known, understood and accepted by the governing body, school management, staff, parents, and students.
School Rating and Concise Comment: …

- **SECTION B: CURRICULUM**

Section B: STANDARD ONE
The curriculum, in its content design, implementation, assessment and review, shall reflect the school's philosophy, objectives and policies.
School Rating and Concise Comment: …
Section B: STANDARD TWO
The curriculum shall be comprehensively documented.
School Rating and Concise Comment: …

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Preparation for the Preliminary Visit

- **SECTION D: STAFF**

Section D: STANDARD ONE
The school shall have management, teaching and support staff, sufficient in numbers and with the qualifications and competencies to carry out satisfactorily the school's programs, services, and activities.
School Rating and Concise Comment: …
Section D: STANDARD TWO
The school head shall ensure that there is a co-operative working relationship with all staff to facilitate proper utilization of their abilities
School Rating and Concise Comment: …

SLIDE 16

Preparation for the Preliminary Visit

- **SECTION E: STUDENT SUPPORT SERVICES**

  Section E: STANDARD ONE

  There shall be effective procedures for identifying the learning needs of students, both at admission and thereafter.

  School Rating and Concise Comment: …

  Section E: STANDARD TWO

  If children with learning or other disabilities or remedial needs are admitted, the school shall provide specific curricula and programs to meet those needs.

  School Rating and Concise Comment: …

SLIDE 17

Preparation for the Preliminary Visit

- **SECTION F: RESOURCES**

  Section F: STANDARD ONE

  The school shall provide or arrange for such services as are required in support of its program offerings, and shall ensure that these services with respect to food, security, transportation, cleaning, and others meet acceptable standards of safety and comfort.

  School Rating and Concise Comment: …

  Section F: STANDARD TWO

  Personnel employed to provide student services shall be adequate in number, have appropriate qualifications, and receive sufficient training to perform their functions effectively.

  School Rating and Concise Comment: …

SLIDE 18

Preparation for the Preliminary Visit

Collection of the required information, comments and documents will:

- help orient the school towards the accreditation process.
- assist the preliminary visitors in planning the visit and assessing the readiness of the school for the next stages of the process.
- be very useful later as a foundation for the full self-study.

SLIDE 19

The Preliminary Visit

The preliminary visit is of extreme importance to the whole of the accreditation process as the two experienced evaluators/visitors clarify the various aspects of the accreditation process and ascertain the school's readiness to undertake the self-study.

The visitors should contact the head of school well beforehand to agree on a schedule for the visit.

SLIDE 20

The Preliminary Visit

During the preliminary visit, the team will:

1. Hold a training workshop for the school to have a group of people who understands the expectations of the accreditation process.
2. Meet with representatives of school community (administration, teachers, students, parents, workers, etc…) to gather information about the school's operation and the extent to which it meets the standards for accreditation.

SLIDE 21

The Preliminary Visit

3. Produce a report which will include:
    - reference to the current position of the school with regards to the standards for accreditation,
    - proposal of a schedule of dates for the Self-Study and Team Visit,
    - suggestions as to the size and general composition of the of the visiting team, and
    - general concluding remarks and a recommendation (areas of concern) with regard to candidate status.

After the report is reviewed by the accreditation organization, it is sent with a letter which informs the school whether or not it may proceed with the next step in the process.

SLIDE 22

Preparation for the First Visit

Before entering the self-study phase, many schools endeavor to have one or more key staff members trained and selected for a visiting team to another school.

This evaluation experience can provide valuable insights into the purposes and procedures of the accreditation process which can be shared with the school staff.

SLIDE 23

The Self-Study Process

The self-study is the most important stage of the entire accreditation process and will normally take more than one academic year to complete.

The school should begin the self-study by administering the opinion surveys of its community: the governing body, staff, students, parents, and alumni (optional).

It is important that a school creates or reviews its statement of philosophy and objectives which conveys the school's fundamental beliefs about education, and what it seeks to accomplish for its students.

SLIDE 24

The Steering Committee

A steering committee should be appointed well before the self-study to develop an overall plan and schedule of work. The head of the school should select someone other than himself to be chair of the SSSC. The chair would best be a person from a middle management position who communicates well across all school sections.

The head, with the help of the SSSC chair, should build a self-study steering committee. Members should be drawn from various parts of the school and be good communicators and motivators.

SLIDE 25

The Steering Committee

The composition of the steering committee follows a basic structure: steering committee chair, a secretary, and a representative from each of the sections of the self-study, i.e.

- Section A-Philosophy and Objectives
- Section B-Curriculum, including
  - Sub-sections reflecting the school's identifiable divisions (i.e. horizontal)
  - Sub-sections reflecting the school's subject strands (vertical)
- Section C-Governance and Management
- Section D-Staff
- Section E-Student Support Services
- Section F-Resources
- Section G-Student and Community Life.

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The Steering Committee

The SSSC does not itself "do the self-study" but it does have to ensure that the self-study gets done.

The SSSC should choose chairs for the self-study committees (facilitators) for part one and part two-A to G.

SLIDE 27

The Sections' Committees

A successful self-study will depend in large measure on the broad involvement of the school community in the self-study process.

Teachers, support staff, board members, students and parents should sit on committees preparing section(s) of the self-study.

SLIDE 28

The Sections' Committees

Some typical examples might be:

a- nurse on committee E-student support services.

b- student representatives on committee A-philosophy and objectives and committee G-student and community life.

c- board members on committee A-philosophy and objectives and committee C-governance and management.

Throughout the self-study process, it is vital for the school to encourage a climate of "constructive criticism". Individuals should be given the opportunity to praise what they consider to be the positive features of the school but also to point out (with proposed solutions) where they feel the school needs to improve.

SLIDE 29

Part One of the Self-Study

Part one of the self-study is the initial stage and should be completed early in the self-study process, before commencing part two. All self-study committees, and later all visiting team members, will need to use this material in their work. It is imperative, therefore, that this part is updated just prior to the team visit.

Duly completed part one documents in their entirety should be made available to all self-study committees carrying out the procedures described in part two of this guide. All part one documents must also be sent to all visiting team members six weeks in advance of their arrival on site.

SLIDE 30

Part One of the Self-Study

The part one committee should assemble materials requested for the following sections:

1. School staff
2. Students currently on roll
3. Student nationalities
4. Graduates/school leavers
5. Student movement pattern-enrollment
6. Student movement pattern-withdrawal
7. Student achievements
8. The opinion survey (students, faculty/staff, governing body members and parents (options: alumni/ex-students)

SLIDE 31

Part One of the Self-Study

Furthermore, part one committee must add one to two typed page document for each survey explaining:

a. The most significant findings of the survey

b. The implications

c. The actions taken or planned by the school as a consequence of the findings

SLIDE 32

Part Two of the Self-Study

Section A committee (philosophy and objectives) should present an interim report to be made available to the other committees, in a similar way to the part one report.

Self-Study committees shall use these general guidelines to complete the self-study sections A-G:

Step 1: Collect and Review the Information

- The committees should collect or prepare the materials called for in each section of the guides.
- The number of section B reports should be equal to the number of the school's identifiable divisions (horizontal: e.g. preschool, elementary, middle and high schools) and subject strands (vertical: e.g. math, science, etc.)

SLIDE 33

Part Two of the Self-Study

- Some examples are:
  1. Written curriculum guides for the school division or subject area
  2. A listing of teachers in the division or subject area including their grade level or subject assignment and qualifications (this information should be extracted from the whole staff list assembled in part one of the self-study).

Step 2: Write the Descriptive Profile

- The committees should provide a clear, accurate and complete descriptive profile, presenting only factual data.
- The committees shall review the school program with respect to the relevant sections to ensure consistency with the school's statement of philosophy and objectives.

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Part Two of the Self-Study

SUBJECT AREA FACT SHEET

Complete the sections of this document that are relevant to the grade level structure of the school.

Name of Subject Area	Elementary	Middle	Secondary	Elementary	Middle	Secondary
				No. of Teachers (by division)		

Elementary	Middle	Secondary	Elementary	Middle	Secondary	Elementary	Middle	Secondary
Frequency of Class Meetings per or Week (by Division)			Average Length of Classes in Minutes (by level)			Date of Most Recent Update Curriculum Documents		

Elementary	Middle	Secondary
TYPICAL INSTRUCTIONAL PRACTICES List typical teaching strategies and include information about leveling or grouping practices.		

Elementary	Middle	Secondary
CORE INSTRUCTIONAL RESOURCES List core texts, kits, or other resources by grade or course.		

Elementary	Middle	Secondary
ASSESSMENT METHODS List, by grade or course, any standardized testing or departmental tests as well as examples of types of typical teacher prepared assessments.		

Elementary	Middle	Secondary
ASSESSMENT USE List examples of ways in which the results of assessment are analyzed and used.		

Elementary	Middle	Secondary
SUBJECT-RELATED, CO-CURRICULAR, OR EXTRA-CURRICULAR OPPORTUNITIES List any clubs, competitions/contests, teams, etc. Include activities that utilize the diversity of the staff and students and the culture of the host country.		

Elementary	Middle	Secondary
UNIQUE LEARNING AREA FEATURES Note any subject-specific aspects of the program such as specialized facilities, labs, equipment etc.		

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Part Two of the Self-Study

Step 3: Rate the School Against Indicators and Standards for Accreditation

- The committees shall evaluate the school's practices in terms of each indicator.
- Some examples are:

	Section B: INDICATORS RELATED TO STANDARD ONE	Rating W, P or N
1a	Curriculum design and delivery are consistent with the school's philosophy, objectives, and policies.	
1b	The curriculum reflects school policies on: i. admissions and placement ii. student assessment iii. student records iv. reports on student achievement	

Section B: STANDARD ONE	Rating E, M or D
The curriculum, in its content, design, implementation, assessment and review, shall reflect the school's philosophy, objectives and policies.	

	Section B: INDICATORS RELATED TO STANDARD TWO	Rating W, P or N
2a	Written curriculum materials indicate the scope and sequence for each course/grade.	
2b	Written curriculum materials specify expected learning outcomes in terms of what students should know, understand and be able to do.	
2c	Written curriculum materials include references to the methodologies that are used.	
2d	Written curriculum materials include information about teaching materials and resources.	
2e	Written curriculum materials indicate assessments to be used to measure student progress.	
2f	Written curriculum materials include references to links within and across disciplines.	

Section B: STANDARD TWO	Rating E, M or D
The curriculum shall be comprehensively documented.	

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Part Two of the Self-Study

Step 4: Write the Statement of Conclusions

The committees should briefly summarize their main conclusions with respect to:

a. principal strengths in the area
b. principal factors needing attention
c. draft plans or proposals for improvement

Step 5: Assemble, Sign and Submit the Self-Study Report to the Steering Committee

Each member of the self-study committee must sign their name and position to testify to their involvement in the committee's ratings and conclusions. No person may be solely responsible for any aspect of the committee's work.

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Part Three of the Self-Study

Part three is the final stage of the self-study process, where the steering committee reviews the work of the other self-study committees and present a summary of their findings and their detailed strategic plans of improvement, focusing on the quality of students' learning and/or well-being.

SLIDE 38

Scheduling the Team Visit

The accreditation organization normally schedule team visits either in March/April or October/November to avoid opening or closing school activities.

The school must bear in mind that the entire self study document must be in the possession of the accreditation organization , the visiting team chair and the co-chair at least eight weeks before the visit.

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The Accreditation Team Final Visit

Following the completion of the self-study, the school is visited by a Team of qualified administrators and teachers drawn from other schools.

The visit extends through a week of on-site observation and discussion, with team members spending time observing classes, examining teaching/learning materials, inspecting the facilities and talking with staff, board members, students and other representatives of the school community.

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The Accreditation Team Final Visit

By the end of its visit, the visiting team must make an overall judgment as to how well the school is doing in terms of its own philosophy and objectives as well as the accreditation organization standards for accreditation.

The visiting team should reach a consensus with regard to the school's accreditation status. this overall recommendation, along with the visiting team report, will be sent directly to the accreditation organization (and NOT to the school) within a week of the conclusion of the team visit.

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The Accreditation Team Final Visit

The visiting team report will cover:

- all aspects of the school's operations
- a set of commendations which will highlight for the school and the accreditation organization any principal strengths that significantly enhance the school's operations
- a set of recommendations which will highlight for the school and the accreditation organization any principal factors in need of strengthening.

SLIDE 42

Decision of Accreditation

The accreditation organization advisors analyze the visiting team report and send their recommendations to the accreditation organization board of trustees.

The accreditation organization board of trustees carefully considers the advisors' recommendations as well as the recommendations from the visiting team.

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Decision of Accreditation

Once the accreditation organization board has taken the required time (generally one to two months) necessary to consider the team report and its overall recommendation in depth, the board takes the decision with regard to the school's accreditation status.

The school will be encouraged to share the contents of the visiting team report in its entirety with the school community after it has been reviewed by the accreditation organization, as well as any recommendations made in letters from the accreditation organization as the accrediting agency.

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Subsequent Procedures

Once the school merits accreditation, it should be continually working for self-improvement. Thus, a series of steps have to be taken following the team visit, including:

1. studying the visiting team report.
2. addressing all the visiting team recommendations (as well as those in its own self-study report), develop plans for improvement, and initiate concrete steps towards their realization.

SLIDE 45

Subsequent Procedures

These form the basis for the first progress report to be submitted about one year after receipt of the accreditation decision.

The school will again be required to report on progress and submit future plans at the five year stage, after which it will host a five year visit by one or two members from the accreditation organization representatives.

SLIDE 46

References

"NEASC/CIS School Improvement Through Accreditation," Version 7.01, September 2003
"NEASC Request for Prior Information Form," Version 7.01, June 2003
"NEASC The Preliminary/Preparatory Visit," Compatible with 7.02, September 2006
"NEASC The Self-Study", Compatible with Edition 7.02, September 2006
"NEASC/CIS The Team Visit," Version 7.02, September 2006
"NEASC/CAISA Guide for Evaluators"