A Qualitative Investigation Into Conceptual Understanding at Iranian Elementary Schools

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Abstract

This study attempts to root out some of the causes of absence of conceptual understanding in elementary level particularly in math subject and the factors that cause this deficiency. As a body of researchers, we use a quasi-form of methodology qualitatively designed by which we give a pre-test and post-test to our participants (randomly selected teachers and students), through some open-ended questions. Through open-ended questions, pupils will be led through processes like understanding the problem, how to fit new information into already existing networks of knowledge and - when thinking critically at the process of learning - the leaner will conceptualize and reorganize the thoughts in order to create presumably new knowledge. The data were collected through interviews (giving answers to post-test open ended questions) and observation and analyzed simultaneously just in order not to miss any information during the study. The conclusion of this study showed that there were various methods of teaching and every instructor would have his or her own style for conceptual learning. There is no universal "one-size-fits-all" teaching practice. Instead, depending on the goal and circumstances, it might be appropriate to combine various methods. For example, one might decide to embed cooperative group discussions into traditional lectures, or one could alternate between hands-on experiments and traditional lectures. The many possibilities then become a rich set of opportunities from which a teacher can construct a more meaningful learning instructional program.

Keywords: Conceptual Understanding, Cooperative Learning, Holistic Learning, Qualitative Inquiry.

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Introduction

There is no doubt that education cannot be defined on resting on a prescribed curriculum or a timetable, whereas, as Maria Montessori says, it must conform to the facts of human life, i.e. conceptual understanding. Some educators show their dissatisfaction with the traditional teacher-centered education in which the teacher gives speeches and the learners are only listeners. They are puzzled and ask: How far does it take one to hold a degree these days? Can one be sure of even earning a living? Who goes to a doctor who has only just graduated? Who turns the design of a factory into a young engineer, or engages a lawyer only just allowed to practice? And how do we explain this lack of confidence? The reason behind these is that these young men have spent years in listening to words, and listening does not make a man. Only practical work and experience will lead the young to maturity. Education is out of control, and one cannot change its inveterate habits. All it has done so far is to recognize in the growth of the individual different forms of development at various stages of life. The most important period of life is not the age of university studies, but the first one, the period from birth to the age of six, since that is the time man's intelligence, his greatest implement, is forming, not only his intelligence, but full totality of his psychic powers.

"Walking is an exercise complete in itself. Other muscular practices need not to be added to it. A man, who walks, breathes and digests better, enjoys all the benefits of health that we pursue in sports. It is a form of exercise which brings beauty to the body, and if, by the wayside, we find something of interest to collect and classify, a ditch to jump, wood to gather for the fire, these movements- of extending the arms and bending the body- make it the perfect gymnastics. Little by little, as man's knowledge increases, his intellectual interests widen and the activities of his body. The path of education should follow the path of evolution; to walk and to enjoy even wider horizons. In this way, the child's life becomes increasingly rich" (Montessori, 1969, p. 22).

To make this principle part of education is especially important these days, when people are walking less, and using all kinds of vehicles to carry them about. It is not a good thing to cut life in two,

using the limbs for games and the head for books. "Life should be a single whole, especially in the earliest years, when the child is forming himself in accordance with the laws of his growth" (P. 163).

This study tries to diagnose some of the causes of absence of conceptual understanding in elementary schools in Iran particularly in math subject and the factors that cause this to happen. The researchers try to explore the roots of this deficiency and the probable remedies that might help Iranian learners particularly at elementary level to overcome this problem. The researchers believe in holistic learning, in which soul, body, and mind are involved in the process of knowledge development, cooperating learning in the classroom, managing the classes in-group work learning, and activity based education and finally doing qualitative or self assessment for evaluation. As a body of researchers we use a quasi-form of methodology by which we give a pre-test to our participants (randomly selected teachers and students), through a questionnaire and some open-ended questions.

The Research Problem

Iranian pupils particularly at elementary level don't grasp their math education properly; this is due to absence of conceptual understanding in most state and even private schools in the country (Dadsetan, 1998; Kianmanesh, 2004; Hajforoosh, 1996). Different educators take this problem differently in different parts of the world. For example, Weil (2002) argues that meaningful learning fails when "education is changed into teaching". In fact, teaching is what the teacher plans to teach, fulfilling the goals of a prescribed curriculum which is implemented by teacher. In other words, learner is only the user and will never find the relation of what he/she learns with his/ her real needs in his/her actual life. Defeu (1994) states that conceptual understanding happens only when the pedagogy of having - a form of education that adds only to learner's information- is changed into pedagogy of being- the transformation of learner's representation of the experience and adaptation to his/her ever-changing environment. This transformation of experience cannot be achieved without putting into question learner's relationship with the learning of new knowledge and skills. It also has to deal with autonomy and creativity

that are mandatory to effectively put into question and improve learner's intellectual representations.

Freire (2000) also criticizes the traditional approaches to education and the present chore learning. He argues that the learner could not be defined as a depositor by the teacher to deposit some information into his/her mind. Fraire believes that education has to ignite a flame unto the mind of the learner and gives him/her independence in order to become able to care about him/her, society, and the nature. Langer (1997) is also one of the educators in North America who condemns the present rote memorization. Langer argues that conceptual understanding particularly in math education happens when creating a real situation in the learning settings including classrooms. Finally, Miller (2001; 2000) believes in holistic education in which the whole child must be present at the time of leaning. He argues that conceptual understating is interwoven with the involvement of all dimensions of learner including body, mind and soul when it comes to learning.

Furthermore holistic educators believe that lack of conceptual understanding is due to improper interaction between teacher and students and dichotomizing each discipline, ignoring its relation with other disciplines and its actual effect on the real life of the learner (Miller, 2000). It is not only this, but according to some evidence, methods of teaching also are not used properly in schools in Iran. That is, education in Iran is mainly teacher-centered, practice-based, and limited to only individuals or competitive learning rather than cooperative education in which students share their knowledge and use their own potential to solve their problems with proper interaction between teacher and their own peers.

In addition, teachers do not use an appropriate method of assessment in their classes. Self assessment in which students could use their own mind along with their attained knowledge and skill to deal with their problems in their real life has no room in most Iranian classes. In fact students are tested by some preplanned questions, which are given to them by the teacher on the exam days. Unfortunately most of these questions have no connection with the real life of the students; thus no evidence of conceptual understanding

is witnessed in Iranian students' learning. Many educators maintain that assessment constitutes part of learning. This means, as long as we do not use an appropriate approach towards assessment, we cannot make sure of happening of a real conceptual understanding or an appropriate mindful learning in education (Langer, 1997).

The Research Question

There are many factors that may play roles in happening of conceptual understanding or meaningful learning. Apparently, the topic leads us toward mind as the main source of grasping the knowledge and the related skills through a kind of analytical process but we believe in holistic approach to education and will look into all components of learning including philosophy, teacher, approaches to teaching and assessment and focusing on the leaner as the one who must grasp the content of the concepts meaningfully rather than memorizing and remembering them up to the time of exam. Thus, the research questions (in the questionnaire and the open-ended ones) will concentrate on issues like the interaction between students and the teachers and their peers, holistic approach to learning and teaching, learner-centered education, cooperative approach to teaching and activity based education as the methodology of teaching and learning, and self assessment as an alternative approach to evaluation. Looking for a real connection between the question and the learner's real life (individual, society, and the environment), and dealing with a real problem or question in part of the real life of the leaner, we could end with a question as follows: *How could we help conceptual understanding happen at Iranian elementary schools?*

In order to be able to answer the above question we should presumably find an answer to the following questions, involving theory and approaches to implementation and assessment.

- Could holistic theory to education help conceptual understanding happen in elementary classes in Iran?
- Does cooperative approach to teaching help pupils learn meaningfully in elementary level at Iranian schools?

- Does self-assessment as an alternative approach to evaluation help the leaner get a better conceptual understanding of math problems in elementary level in Iran?

Significance of Study

This study focuses on holistic approach to education in which all dimensions of the learner including feelings and spirit as well as the mind are involved in learning. Although the mind plays the most vital role in conceiving and perceiving the information but still the will of the learner carries the same importance (Capra, 1996). We believe conceptual understanding or even meaningful learning cannot happen without the involvement of all other dimensions of the leaner, whereas rote learning or the process of memorization happens mainly by using the mind.

Langer (1997) maintains that meaningful learning takes place with awareness of the context, and of the ever-changing nature of the information and the will of the learner, which encompasses her/her feelings and soul holistically. Learning without this awareness, as Langer says, severely harms the use (the actual nature of the concepts) but limits the leaner to the usage (some information about the concepts) (Dufeu, 1994). Most educators maintain that a mental power without concerning the role of the spiritual dimensions might enhance an insight in the learners with which they not only ruin themselves but the world around them.

Research Methodology

This study could presumably be best conducted by action research in a form of qualitative design. Students and teachers may constitute the participants of the study and they could be selected through the snowball model. In snowball model, in which each participant will suggest the next one, will do better for our study because in Iran those who know the subjects better normally are humble and reserved but usually respected by the other members of the peer group. One view of teaching and learning is that the teacher is the source of all knowledge, dealing out parcels of knowledge to the learners. The situation is much richer and more complex particularly when both

teachers and students are involved. Certainly children are there to learn, but the teachers are also learning every day.

As more is discovered about the many ways in which children learn, teachers need to reflect on and extend their teaching approaches. To best support each child's learning, the teacher needs to find out about individual children's thinking by observing, questioning, and listening. A school is in a very literal sense a community of learners. Learning is enhanced where this fact is appreciated, valued, and fostered.

A sample class is a true community of learners in which Ms Nafar, as an example, participates along with her students. She expects students to listen to one another, and she listens to them and clearly communicates that she respects what they have to say. Ms Nafar's role in the class is summed nicely up in the following excerpt from a discussion on the importance of listening:

Ms Nafar: Is it important for me to listen?

Students: Yes.

Ms Nafar: Why?

Mina: You're the teacher.

Ms Nafar: So?

Niki: You want to understand what we know.

Ms Nafar: Is it important for me to know what you already know?

Sarah: Yes, because if you don't know what we already know, you'll teach us the points that we already know.

Ms Nafar: Why else is it important for me to listen?

Sadaf: Because you might learn things that you don't know.

Ms Nafar: That's right. I learn a lot from kids.

That comment goes a long way toward explaining what makes Ms Nafar's classroom a place for learning with understanding both for her and for the students.

Educational Implications

As teachers, we need constantly to make opportunities to learn from our students. Learning should be a positive experience of growth. If we establish that atmosphere in the classroom, it will affect children's attitudes to learning. Everyone learns by making mistakes. In the

classroom that fosters a culture of learning, neither teacher nor child is afraid to take risks, make mistakes, or express his/her thinking.

In order to approach the problem of rote learning and have it to be replaced by conceptual learning, one might choose various strategies including a short term program of 15- to 20- hours during which the participants could be teachers from different parts of the country to become aware of the consequences of the problem of rote learning or lack of conceptual understanding. This program might be implemented through workshops designed and acted out by some experienced teachers or the researchers who are already involved.

Another alternative could be a Medium-Term Program, which could refer to 3- to 6- month schedule that might go more deeply into the contents of the short-term workshops. The third alternative could be a program of in-depth education which could be developed in one or two schools: one in a poor and another in a richer area in Iran for example one in Tehran as the most improved part of the country and another in Kerman as one of the underprivileged regions.

The researchers believe in a form of qualitative case study partly as an action research that could work as a viable method to do this study. As a body of researchers we used a quasi form of methodology by which we give a pre test to our participants (randomly selected teachers and students), through some real questions about his/her own life for giving the students something to measure, to calculate or some open-ended questions.

Steps of Problem Solving

First we gave a pre-test to the participants, which constitute students and teachers. This pre-test could be made of some open-ended questions like the following:

Do you like to learn math? Why do you want to learn math? What kind of role does math play in your life? How would you like the arrangement of your classroom, in rows or in a round form? Do you like to study individually or you would like to cooperate with your friends? How do you like to be evaluated? Self-assessment, teacher assessment, or be tested with a kind of pre-set test? How do you define self-assessment?
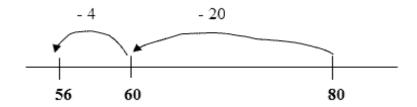
And questions for the teachers could be something like this:

Do you prefer to test your students through traditional approaches or you prefer to evaluate them through an alternative method? What kind of method that could be?

Why are you suggesting this? Do you believe that the method you are suggesting will help your students learn better? How? How do you define it?

Zirbel (2004) suggests that to form new concepts or change old and inadequate ones, the student has to be led through several processes. First, s/he has to consciously notice and understand what the problem is; second, s/he has to assimilate more information and try to fit it into already existing neural networks; third, s/he has to critically think through all the argumentation in his/her own words and reorganize these thoughts; s/he has to accommodate the knowledge and evaluate against his or her prior beliefs; and finally, s/he has to work towards obtaining fluency in the newly acquired and understood concept so that this concept itself has then becomes a mere building block for future, more advanced concepts.

The claim here is that during the process of conceptual change what happens in the student's mind is a reorganization of his or her thoughts, the creation of new neural networks, and the rewiring of old ones. This process is difficult to provoke and requires the student to work hard. A good instructor can help with the process of conceptual change but cannot do it for the student. The researchers here explain how an instructor may help facilitate this process. As a piece of evidence Niki says that: 80-24 is 56. Asked to explain her thinking she draws a blank number line and shows that she took 20 from 80 leaving 60 and then took 4 from 60 leaving 56. Actually to do the following subtraction, Niki follows this algorithm:

This shows that Niki has a good understanding of the operation of subtraction and can even use place value with these numbers. She has an efficient mental strategy for subtraction. Her mental strategy is quite different from the typical formal written algorithm. As another piece of evidence, if I have forgotten 3 x 3, and recreate it by adding 3 + 3 + 3, that is reasonably efficient. But, if I have forgotten 8 x 8 and try to recreate it by adding 8 + 8 + 8… that is no longer efficient, because it takes too much time and is prone to error. However it would be efficient to recall 7 x 8 = 56 and then add 8. Another form of consolidation that is often misused is practicing a skill in a series of examples: for instance the traditional 'page of sums'. There are three observations worth making about this approach: Practice is counter-productive if the child is practicing something that is incorrect.

If conceptual understanding is built up effectively, then fewer practice examples are needed for consolidation. Practice is more stimulating if there is a point to the collection of problems. There are many effective ways of consolidating knowledge, and all of them should be used. They include: revisiting the idea from a different perspective or in a different setting, using the idea in practical settings, implanting the idea in games, practicing the skill in a series of examples memorizing.

True Examples
Children have been developing strategies for mentally subtracting two 2-digit numbers. The teacher gives the children the task of finding the difference between some 2-digit numbers and the numbers reversed (e.g. 64 - 46) and finding and explaining patterns in the answers. Children have been developing the meaning of fractions. Groups of

children are given a newspaper and asked to record and comment on the fraction of the paper devoted to different items, for example news or sport. Posttest activity will appear at the end of the term, program, or the study and another body of open ended questions will be asked from the participants through interviews and sometimes added with reviewing the available documents for making the study more valid.

Comments

Consolidation of learning should be built into the teaching program. Consolidation activities should not be used until children have a good conceptual understanding of the idea or skill. Children should never be asked to learn by rote something they do not understand or could not recreate if forgotten. Knowing that 'to add 50 and 30 I can take the zeros off add 5 and 3, and then put the zero back on' does not in itself show conceptual understanding. But if a child can explain, for example, 'it works because really I am adding 5 tens and 3 tens', this does show conceptual understanding. The explanation shows a connection between 'removing zeros' and 'adding tens'. Remembering that to find X% of a number I multiply it by X/100 does not constitute conceptual understanding of percent. For example if asked for 50% of 48, conceptual understanding would lead a student to halve 48, rather than calculate (48 x 50)/100. This would show the ability to make a useful connection between 50% and one half.

Analysis and Suggestions

1. Facilitating the process of learning:

It is fair to say that most instructors who teach science have the wish to teach comprehensively, provide the students with a deeper understanding of the world around them, and encourage these students to apply the newly acquired knowledge to other phenomena. Sometimes even we succeed, we may have the feeling that we have been successful, the lecture was well organized, very comprehensive and the students listened attentively. But later, when grading the tests, it becomes clear that a fair fraction of the students somehow did not get the main points. Reflecting back on the lecture, it can then seem rather puzzling to the instructor. Let's consider the ideal case: let's say

the student does follow our nicely presented arguments. Do we know what the student will do with those arguments? Accept them? Adopt them? Integrate them into their current knowledge database and apply them to new phenomena? The point is that we do not really know what happens in the student's mind; all we know is how we think and how we think the student thinks.

In other words, rather than focusing on our explanations and criticizing our teaching, it might be more effective to focus on the student and on how the student is learning. Not only is this approach much less intimidating, ultimately, it is also better aligned with our goal. After all, we would like the student to learn, to obtain a deeper understanding of the world for themselves, and maybe even apply the newly learned concepts to other situations (Eldridge, 1998). Only the students will be able to do this for themselves. But what we can do is to convince the students that they should do the learning for themselves and that it might be profitable. In other words, teaching, by itself, is not enough. What we need to do is to initiate the students to do real thinking and thus engage them in the process of learning. However this implies a very different way of teaching and a different way of thinking from our side. We need to shift the focus from "teacher centered teaching" to "student centered learning". While this might sound straightforward, it brings additional challenges. As instructors, we are no longer just responsible for delivering the material comprehensively; we are, in addition, responsible for initiating "the process of learning" in the student's mind. Although we cannot be responsible for what happens in the students' minds, we are nevertheless responsible for effectively facilitating the process of learning in the students' minds (Dewy, 1938).

2. Consolidating the learning of the learners (becoming part of the curriculum):

Learning does not just involve a series of one-off encounters with new ideas; a lesson on this, a lesson on that. An idea, concept or skill has to be revisited many times and in many ways in order to establish itself in the mind. Consolidation takes many forms: meeting the idea from different directions, using the idea in practical problems, practicing through games and other focused activities - and also

memorizing. Unfortunately consolidation and memorizing, which are important features of learning, have become confused with rote learning, which is something quite different. I may read and study a poem and because I enjoy it, I may deliberately memorize it. It means something to me and I wish to establish it in my mind. If we forget parts of the poem, we may be able to recreate the missing words because of the connections with the sense of the poem. That is memorizing. On the other hand someone may challenge us to learn by heart the first 20 places of decimals for pi. Those twenty numbers have no logic or pattern or meaning in themselves. We can only learn them by rote. If we forget some of the 20 figures, we cannot recreate them because they have no interconnections. We can only look them up again (Miller.2002).

We may make up our own idiosyncratic connections between the 20 numbers - but that is different. Those connections are manufactured and artificial and have no genuine intrinsic connections with picture. It is important to build consolidation activities into the teaching program (Dewy, 1938). But they must come in their proper place. This is after the idea or skill has been introduced, explored, and understood. That is, after connections have been made between it and previous knowledge, and between it and the world. Consolidation (which may include deliberate memorization) must follow understanding. Consider this as a touchstone: if a child is memorizing something, and forgets part of it, can s/he efficiently recreate the forgotten part through connections s/he already has? Consolidating is like building a well-constructed wall of interconnecting bricks. It is not like chucking a never-ending supply of bricks into the yawning pit of a child's mind.

3-Applying the Non-Traditional Teaching Methods:

There are many different philosophies about teaching and several strategies that have been tested in education so far. In fact, inquiry is used to describe a process of doing science. Inquiry is defined as a seeking of truth, information, or knowledge by questioning. It is a dynamic approach to learning that involves exploring the world, asking questions, making discoveries, and rigorously testing those discoveries in search of new understanding (Solvin, 2004). In addition, it is central to scientific learning itself. When engaging in

inquiry, students describe objects and events, ask questions, construct explanations, test those explanations against current scientific knowledge, and communicate their ideas to others. They identify their assumptions, use critical and logical thinking, and consider alternative explanations. In this way, students actively develop their understanding of science by combining scientific knowledge with reasoning and thinking skills.

Constructivism, a theory about knowledge and learning, attempts to describe how one "comes to know". This theory refers to the notion that knowledge results from mental processes when individual "schema" interact with the "environment". Cognitive structure thus organizes experiences by allowing the individual to "go beyond the information given" by connecting those experiences to "prior knowledge". Real learning occurs when the learner actively engages in his or her own knowledge construction, integrates the new information into already present schema, and associates and interprets this information in a meaningful way. Our objective, when it comes to teaching would then be to assure that the most fundamental concepts are well represented and connected in the students' minds and that the learners are provided with the necessary tools for constructing further knowledge upon those core concepts (Raskin, 2002; Solvin, 2004).

What all of the non-traditional teaching methods have in common is that they involve the student to participate actively in the classroom. The following steps are recommended to facilitate conceptual understanding:

Step 1: The educator has to assure that the particular idea does get noticed efficiently. In other words, the new idea has to be dressed up enough so that it gets noticed in order that the student is initially intrigued by it enough to become interested to know more.

Step 2: The material needs to be presented in such a simplified fashion that the student can follow every part of the arguments clearly. The student should at least have the feeling that something makes sense. Meaningful associations are particularly useful, because they might help the student make meaningful connections. Suggesting to the student how to chunk the information might be another way a good instructor might be able to help.

Step 3: A good instructor will confront the student with why his or her prior beliefs no longer work. What is important here is that the student thinks aloud and articulates the problem in his or her own words. The instructor can guide the student by challenging the student with the right questions.

Step 4: A good instructor can now provide meaningful examples that go beyond regurgitating the problem, examples that involve applying the new knowledge and testing it. Also suggesting how to transfer the newly acquired concepts to other areas might also help. Clearly, the very last step of making original discoveries is in the hands of the student himself. All a good instructor can do is to challenge the student to go beyond his or her limits. Always, there should be a connection between the learner's need and the material he/she is learning holistically. We should always make connections between what children are learning and what they already know. Wherever possible, we should relate what children are learning to situations that are meaningful to them. In fact we should consolidate learning by using it to solve real life problems.

If students are to have ownership of their mathematics learning, they need to have conceptual understanding of the ideas they meet. This implies that knowledge of the idea, and how it relates to already acquired ideas. It also requires an understanding of the contexts within which the idea is applicable, as well as its limitations. In other words, conceptual understanding enables a person to apply and adapt an idea flexibly to new situations. It is much more than just following learned procedures in familiar situations.

4. Dealing with the Students' Misconceptions:

It is not only the instructor who needs to do some major readjusting, the students themselves will also have to get used to this new approach to teaching and need to be willing to share some of their rather personal views. They will be challenged to think through all their arguments. This will be a particular challenge when dealing with somewhat counterintuitive situations or situations where the students have some prior beliefs. Letting go of deeply engrained beliefs is a major challenge, and the students will have to be walked through all the steps of the conceptual change model. They will have to realize

that there is another theory that does an even better job at explaining the problem at hand. And they will not only have to accept the new theory, but also follow it and understand it deeply. Often the students will then try to re-accommodate their prior belief and this process will continue until they are confronted with the fact that there are major problems with their prior belief systems. In other words, their prior belief will be challenged and this will inevitably lead to some moments of misconception.

Students do not like to be confused. In fact, being confused is an uncomfortable feeling for all of us and it is something we all like to avoid whenever possible. The only problem is that those moments of confusion in the lectures are unavoidable. They are part of a natural process that happens when changing minds. Thinking takes a major effort and thinking in a new fashion is especially challenging. This is something that does not come naturally or automatically. The student will have to struggle in order to accommodate the new theories into his or her prior belief systems. He will have to re-evaluate the situation and test his or her own ideas. This is a process that does not only take time, but also one that feels rather uncomfortable and sometimes even disturbing. In other words, they need to experience that an initial confusion can lead to a clearer or more logical understanding of the material. Furthermore, they need to experience that resolving the confusion and deeply understanding the problem at hand is truly rewarding. They have to learn that an initial confusion is an integral part of learning.

Again, the students need to be told explicitly that confusion is unavoidable and that this is part of the process of leaning new material. If they are not told, so they will feel frustrated, and blame the teacher for that feeling. Most students will tend to associate any feeling of confusion with the lecturer's inability to explain the material clearly. Students like to hear clear and logical explanations, and being challenged requires extra work. It is not uncommon for the teacher to get unflattering evaluations from the students. After all, anybody who challenges student's prior belief systems is going to be evaluated more critically (i.e., unfortunately more negatively) than anybody who lets the students retain their prior beliefs. One method of

making yourself popular again is by explicitly encouraging the student to go through the process of conceptual change and by making appropriate compliments after the students do understand that particular concept.

Teachers should aim to monitor their students' conceptual understanding. Answers may be correct for the right reasons. But answers may be incorrect even though the basic reasoning or strategy is correct. It is important to ask children to explain their incorrect answers. This can give the teacher a window into their thinking, and a springboard from which to work on misconceptions. It is equally important to ask children to explain their correct answers. This helps children to make explicit and consolidate their thinking. It also signals that reasons are important. Children can produce right answers for the wrong reasons - and it is equally important that these are uncovered.

5. Communicating with the Students

Communicating includes describing what you are doing, what you have done and what you have found so that your listener can share your actions and discoveries. This involves explaining your thinking and the reasons for your actions, decisions, and conclusions; justifying the reasons: why you thought, acted, said, wrote, and concluded as you did; forming hypotheses, and attempting to convince others through reason, not through emotion or physical intimidation, that your hypotheses and conclusions are right. And in the arena of mathematics it is a form of describing, explaining, justifying, convincing, hypothesizing and proving mathematical processes or mathematical actions. Communicating has many connections and implications beyond mathematics.

Mathematics is a very good arena for experiencing, practicing and developing these skills. In fact, this may prove to be one of the most important contributions of mathematics education to many children's overall education. It starts with oral communication, developing speaking and listening skills. It should extend to include pictorial representation and graphs, tables, and forms of written communication. It may extend further to the use of spreadsheets, computer graphics, video and other technology. Communication is a means of making children's thinking explicit and consolidating their

learning. For teachers it provides a valuable insight into children's thinking. This forms a springboard from which teachers can correct misconceptions and build on what children know and can do.

A True Example

Mina, a 7-year-old girl, has six objects and is asked to give one third of them to the teacher. At first she says that she can't. Then she hands over 3 objects and offers them to the teacher. Asked to explain her thinking, she arranges the 6 objects in two groups of 3. She points to one group and says that this is one third, and this group together with the other group is two thirds. Her explanation makes clear that she has confused 'thirds' with 'groups of three'. The teacher finds out that Mina is still too young to understand the problem. Then the teacher divides the objects into 3 groups of 2s and asks Mina to give her one of the groups. In this way Mina understands the meaning of one third.

Teaching is much more effective if it has an inner consistency and a consistency across grades. To achieve this, coordination within and between classes (and schools) is needed. Is teaching being driven by a clear understanding of the desired learning outcomes for students? Are assessment practices reflecting the full range of these learning outcomes? Such things as conceptual understanding, the ability to apply knowledge and skills, the ability to combine several skills in a more protracted investigation, the ability to communicate what one has done and found, the ability to pose problems for oneself.

In order to enhance the math knowledge of the children at schools, McIntosh & Dole (2001) believe that students' numeracy is enhanced if:

-Teachers encourage students 'communicating math's means, including discussing, reasoning, explaining, justifying, hypothesizing, and explanations of solution strategies for both correct and incorrect answers.

-Teachers place a major emphasis on the development of students' mental computation ability and if they approach this through the development of flexible mental computation strategies.

- Teachers pay attention to the significance of children's attitudes to and feelings towards mathematics, the classroom and the school.

-Teachers develop the meta-cognitive skills of students, particularly those students at risk, by making explicit learning strategies and the student's role in his/her learning.

-Teachers assign an appropriate role to conceptual development.

-Teachers constantly relate abstract mathematical ideas to real life through making connections with situations familiar in students' experiences and through embedding mathematical ideas and challenges in real-life situations familiar to the student.

-Teachers approach the content of the curriculum where possible and appropriate in an investigative and problem-solving manner, using open-ended problems, and with a balance between student exploration and teacher-directed modeling of solution strategies.

-Teachers' planning and classroom practice are informed and directed by a range of assessment tools that accurately reveal individual students' conceptual understanding and needs.

-Teachers provide students with concrete objects which aid understanding and which lead to useful mental images.

-Teachers provide very clear instructions and also ensure that they and students are clear about the significant objectives of any lesson and how it relates to previous learning.

-New technologies are explored and employed effectively, including student access to calculators for use both as instructional aids and computational tools.

-Students' time on task is maximized, that is, the critical discernment is not the number of minutes per week devoted to mathematics, but the number of minutes the individual student is on task.

-Teachers provide opportunities and support for the involvement of parents and the community in students' learning.

In brief after collecting the evidence and the responses of the participants in order to understand how conceptual understanding happens we will look into:

-An appropriate base for education: (Holistic and Participatory Education), looking for a connection between the leaner and what s/he learns,

-An appropriate method of teaching (Cooperative Learning), Activity-based Education), all based on inductive or experienced-based approach to education, and,

-An appropriate method of class management (group learning, arrangement of the classroom or the learning setting).

Conclusion

Reviewing what was discussed in this paper, we conclude that there are many different methods of teaching for achieving conceptual understanding and meaningful learning including doing math, and that every instructor will have his or her own style (Sigler, and Saam, 2006). The approaches normally differ based on the context, the level of education, subject matter, and the gender of the leaner. Asking which teaching technique is best is analogous to asking which tool is best-a hammer, a screwdriver, a knife, or pliers. In teaching, as in carpentry, the selection of tools depends on the task at hand and the materials one is working with.

Books and lectures can be wonderfully efficient modes of transmitting new information for learning, exciting the imagination, and honing students' critical faculties, but one would choose other kinds of activities to elicit from students their preconceptions and level of understanding, or to help them see the power of using meta-cognitive strategies to monitor their learning. Hands-on experiments can be a powerful way to ground emergent knowledge, but they do not alone evoke the underlying conceptual understandings that aid generalization.

There is no universal "onesizefitsall" teaching practice. Instead, depending on the goal and circumstances, it might be appropriate to combine various methods. For example, one might decide to embed cooperative group discussions into traditional lectures, or one could alternate between hands-on experiments and traditional lectures. The many possibilities then become a rich set of opportunities from which a teacher can construct an instructional program.

However, there are a few guidelines. Setting a goal of what you want the students to accomplish and get out of this course is a good start. Also integrating effective assessment techniques into the lecture

is another. It is important to constantly ask the students what they think and help them construct the arguments in their own way (Raskin, 2002) as opposed to telling them a nicely laid out logical explanation. In other words, how you, as the instructor, think is almost irrelevant – the student will have to build up his or her own model that makes sense to him or her. The instructor thus has a rather different purpose in this type of classroom-instead of giving straight lectures (and these might be appropriate at times!), he stops and asks the students to do the thinking and watches out that the students do not just regurgitate the arguments but phrase them in their own words. The instructor thus "facilitates" the process of learning.

In a large classroom setting, the next best alternative to listening to individual students might be to initiate group discussions where the students are asked to explain the concepts to each other, or where the students are asked to use that particular concept to get a deeper understanding of the bigger picture. There are a few tricks of how to deal with those types of discussions – one would be to write all the answers by all groups on the blackboard (there is generally a limit to the possible answers) and then go through individual points jointly, evaluating each of the arguments. This way, some student misconceptions can surface-and the latter need to be discussed in quite some detail and it might need to be shown that those ways of thinking really do not solve the problem at hand. There is no shortcut of dealing with misconceptions-the students need to be walked through all the steps of the conceptual change theory.

This paper deals with how to teach in general to provoke a deep understanding of the subject matter. A deep understanding consists of logically and meaningfully interconnected concepts that form an even larger web of concepts. Deep thinking then involves being able to make further connections between the webs of concepts. Deep thinking involves the construction of new concepts and is almost always based on what the student already knows. Thus it is also very important to assure that the most basic concepts are profoundly understood and well connected. Constructing successive arguments on somewhat shaky knowledge results in not-so-well connected further concepts. Thus, a thorough understanding of the most basic concepts

is of utter importance. Therefore, to guarantee conceptual understanding according to what could be perceived from Earl, et al. (2000), the teachers should:

-"Apply the strategies that influence the learners' motivation and capacity as well as the situation in which they work" (p.4). For improving the numeracy capabilities (math), these strategies are intended to bring about altered practices at schools and classrooms that will result in improved learning for students,

-Create a home-like situation in the classroom and bring the whole learner into the learning setting,

-Get rid of all factors of distractions, and create a real situation for transformative learning that is characterized by acknowledging "the wholeness of the child in which the curriculum and the child are no longer seen as separate but connected" (Miller, 2001, p.7).

-Get learning and the learner at the focus of education. Learning is something what has to happen. It is not something the teacher decides upon but it is based on the learner's needs and request.

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