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Students in the Aegean islands learn to calculate the volume of a rain water container.

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Abstract

Since initially it was realised through evaluation that the students lacked the basic knowledge of volume, they tried to measure the volume of the container. Many of the containers were embedded in the Earth and we'll just for household needs on a waterless Dodecanese island.

The above activity took place in the framework of environmental education. The tools they used were part of the system they themselves designed for example a piece of string which be held at the mouth of the container and which reached to the bottom. If the containers were not embedded in the Earth they used the classical method of measuring the outside of the containers. Quite often the students became confused when reservoirs with the same volume (2 different houses) changed as regards one of the dimensions. The whole process was successful since finally after two months the student's ability to calculate volume had increased, and since their achievement levels were compared with schoolmates who all had been taught in the classical way.

Keyword: *Knowledge of volume, containers, environmental education, water container.*

1 Introduction.

In the present work students on a waterless island, using elements of volume, calculate the capacity of a reservoir or the capacity of the tank of water. Water tanks are mainly used on waterless islands in the Aegean in order to economise on our important quantity of drinking water and today a householder can use this water for all his needs except for drinking water.

2 Research questions.

If there is an increase in the mathematical ability of students in the calculation of elements of volume with the help of elements taken from their environment, compared to student use classical methods of teaching (for example with the help of the blackboard) if the students comprehend the changes in the elements of the rectangle of the Parallelepiped

3 Hypotheses

Teaching and evaluation of mathematical concepts from the natural environment increases the ability of students to be able to calculate..
Furthermore, students understand more easily the changes in volume when they study them with the help of elements from the day-to-day experience.

4 Theoretical framework

The theoretical framework is divided into two units.

A.The use of elements from the day-to-day experience of the students (for example from the students' natural environment) increases their ability to make various calculations.

B. In the alteration of the volume in the reservoir

A. The use of elements from the day-to-day experience of students can also be included in the framework of constructivist where the student composes the new knowledge through elements of his or her environment [2].

From a pedagogical perspective, inquiry-oriented teaching is often contrasted with more traditional expository methods and reflects the constructivist model of learning, often referred to as active learning, so strongly held among science educators today. According to constructivist models, learning is the result of ongoing changes in our mental frameworks as we attempt to make meaning out of our experiences [20].

This more interactive relationship between teacher and learner was given prominence by Vygotsky [30] who introduced the concept of the Zone of Proximal Development (ZPD). The ZPD refers to the gap between what the learner can do on his or her own and what he or she can do with the help of others. The process of support and guidance offered by the teacher to help the student perform at a higher level is known as 'scaffolding'. In this supportive role, the teacher has to discern the potential of the student to advance in learning, so that the activities presented, instead of being either too trivial or too demanding, fall within Vygotsky's ZPD ([30]) area of appropriate and productive challenges ([3]).

Teachers vary considerably in how they attempt to engage students in the active search for knowledge some advocate structured methods of guided inquiry ([15] while others advocate providing students with few instructions ([29]). Others promote the use of heuristic devices to aid skill development ([11,12]). A focus on inquiry always involves, though, collection and interpretation of information in response to wondering and exploring.

In contrast, alternative approaches emphasize deep learning strategies and favor assessment systems that place 'emphasis on understanding, transfer of learning to untaught problems or situations, and other thinking skills, evaluating the development of these skills through tasks that clearly must involve more than recognition or recall' ([4]).

It seems particularly important that inquiry-oriented teaching may be especially valuable for many underserved and underrepresented populations. In one study, language-minority students were found to acquire scientific ways of thinking, talking, and writing through inquiry-oriented teaching [21]. Caution must be used, however, in interpreting reported findings. There is evidence of interactions among investigative approaches to science teaching and teaching styles [16] (Lock, 1990), and the effects of directed inquiry on student performance may vary by level of cognitive development (Germann, 1989). There seems also a possible conflict of goals when attempting to balance the needs of underachieving gifted students to develop more positive self-concepts with the desire to develop skills of inquiry and problem solving ([32]).

It must also be emphasized that an emphasis on inquiry-oriented teaching does not necessarily preclude the use of textbooks or other instructional materials. Other materials accommodating an inquiry approach to teaching have been identified by Haury (1992). Several elementary school textbooks have been compared ([26,27]) and a content analysis scheme for identifying inquiry-friendly textbooks has been described ([8,27]) has described how textbooks can be used to support inquiry-oriented science teaching.

B.The topic of volume we have to add that after Piaget there was important research done by ([6,17,10]) and Donaldson attributes a large part of this inability to "a clear linguistic cause." He maintains that that a child takes language into consideration based on contextual elements. These contextual clues are considered irrelevant by adults ([17]).

This inability which students have is due to the fact that students think as they describe the phenomenon. So the student understands what he is seeing at the first glance, without going on to further analysis of process and change as an adult would do. Gelman maintains that children can be taught not to let their judgment be distracted only by what they see. If a student does not examine different parameters then he will give a wrong answer. Thus it would be good if students, before they express themselves verbally, could examine things which are the consequence of a change which, at first glance, they did not perceive as a total change ([10]).

McGarrigle did experiments with bodies of different volume. The reason for these experimental methods which he developed was the checking of children's different perceptions in the maintenance of volume ([17]).

Donaldson maintains that for all the attempts that took place to teach the students to deepen their thinking about what they can see, a significant number of children would continue to fail to prove that the volume of a liquid remains the same even if the container is changed. He compressed a ball of clay to make it greater in diameter and then posed the same question. Only older students understand that in the end the clay is the same. Similarly Smedslund compressed the clay and put it in water to check if the volume of the play changed. The students were able to observe if the level of water increased. Smedslund repeated the experiment taking away a piece of the clay before putting it in the water. He observed that only children above a certain age who had more developed reasoning could organize rationally and was justifications that the volume of the body in this phase was different. ([1, 7, 5])

5 The research section of the work.

Interests this research work students from the first-class high school in the academic year 2009 to 2010 The students measured a series of 20 reservoirs that were shaped like parallelograms. These measurements were to do with the periphery the container (a circular disc). At the same time they measured the diameter of certain trees and recorded these characteristics in a list.
If the reservoir was a parallelogram the students could again measure the length and the width of the area of the surface of the reservoir and then work out its volume.

-If they were unable to measure certain of the above characteristics the students received teaching in such a way as to take into consideration certain characteristics of the reservoirs etc. A similar process was carried out two month later again in the framework of environmental education. In both academic periods the students created graphic representations.

6 Participants .

The students who took part in the research work students in the first year of junior high school in the framework of environmental education. The process with the same students was repeated after two months when they were in the third class of junior high school (result this research).
Research took place in the academic year 2009-2010 and the second phase took place in the academic year 2010-2011 (with same research questions).
The school where the research took place was located in a large island city and 126 students took part in initially though because of transfer of students to other schools the final number of students who took part in the research in the two month was 106. There was also another group of students who took part in the research but they worked in the classical way. The students did not take measurements using instruments but worked on the same problems theoretically inside the classroom in the academic year 2010-2011. The number of students in the second group which was from another school building was 98.

7 Materials that were used.

Measuring tapes were used to measure every dimension of the reservoir usually its width and length. To get the reservoir's height they used a cord that was tied to stick or a bucket of water whose weight would take the cord down to the bottom of the reservoir since usually the reservoir or the water tank would have an opening in the top.

8 Procedure

The students measured a series of 20 reservoirs that were shaped like parallelograms. For this they used a measuring tape. Then each student tried to calculate the amount of water that there was in the reservoir, and also how much water the reservoir would hold. There were several reservoirs which had the same volume but were of different dimensions.
The reservoirs that were used were of two types – internal – underground (buried in the soil) usually underneath a room , but some were built outside. The first approach was to measure the capacity of the reservoir. In this case they placed a container type to earn string at the mouth of the reservoir letting it drop to the bottom using a stick to hold it. D then they measure the other two dimensions on the surface of the reservoir, subtracting from each the thickness of the walls etc.
If they wanted to measure the water contained in the reservoir then they measured the length of the wet cord.
If again the reservoir was outside (usually for the watering of fields) things were much easier since each dimension could be measured from the outside and then calculated subtracting the necessary length. Since its in a similar way comparisons were made with other reservoirs or with the same reservoirs which contained less water.

9 Result.

Students who worked in the classical way (as assessed by the teacher)			*The students who worked with water reservoirs*			
	M	*Sd*	**M**	*Sd*	*t*	*p*
Volume of the reservoir (also with by examining the same volume from different dimensions)	*5.42*	*2.15*	7.16	*2.11*	*0.7*	*0.02*
Volume of water-maintenance of water volume	*3.83*	*2.97*	5.9	*1.3*	*0.4*	*0.05*
Note 1: p<05, p<0.05**, p<001**** *Note 2: the assessment was carried out using a ten point scale.*						

Wishing to ascertain whether there was a differentiation between the abilities of the students who worked in the classical way in the environmental field.

There was statistically significant difference ‘contained in the reservoir’ between the pupils who worked with ‘contained in the reservoir’ (M=5.42 Sd= 2.15 and the pupils who worked in the classical way (M=7.16 Sd= 2.11), t=0.7 p=0.02<0.05 **$8.5** Similar statistically significant there was between students who worked in environmental field (of the water it contained and comparison between two identical or two different reservoirs) and pupils who worked in the classical way (pupils working in the classical way (M =3.83 SD=2.15) and the pupils who worked with environmental field M=5.9 SD=1.3 since t=0.4 p=0.05.

10 Discussion

In the present work an attempt was made to evaluate if there was any advantage to teaching the elements of volume to students working in the environmental field measuring the volume of water and reservoirs, compared to teaching students in the classical way in the classroom. It appears that the students involvement with the natural environment increases their ability in calculation.

For example clear evaluation criteria were used for each model [9].We answered to the instructions of Williams ([31]) who supported the notion of clear guidelines for marking as it makes the task more objective for students and thereby reduces any feeling they may have that criticism is personal. Consequently they evaluated work from pupils in different classes.

Any lack of clarity which existed could be explained to the students by helping to solve their question using elements from their environment.Such an approach agrees with the opinion of Orsmond, Merry and Reiling [19] and Falchikov [9] that because of the existence of ambiguity the positive results of the entire process were greatly reduced. Generally it appeared that there was a reduction in the things th students were not clear about and thus an increase was observed in their ability to calculate elements of volume if the students used elements from their natural environment even if the elements of there servoirs volume were altered.

So through this process the student develops an effective, coherent and lucid argument to support and/or substantiate the hypothesis or topic under discussion.

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