TEACHING PRACTICES THROUGH A CHAT CURRICULUM IN THE EARLY GRADES

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Abstract: This research study is part of the @fise project which takes place in the University of Ioannina, Greece and focuses on the connection of Cultural Historical Activity Theory (CHAT) with Science Education. Within the CHAT frame, subjects collectively act in a community in the context of rules that the entire community follows. They become engaged in science activities and they use tools in order to deal with scientific concepts. In this frame, an Innovative Science Curriculum for the early grades was developed to introduce teaching scientific concepts by the use of cartoons. At the beginning, a popular cartoon, Spongebob Squarepants, was used in order to design floating and sinking activities. Then, elements from History of Science were incorporated in a narrative about light and colors. Finally, the narrative was turned to a 20 minute animation about light, colors and shadows in the program scratch. The Curriculum was implemented in autumn 2012 in 4 pre-primary school classrooms of 25 pupils each. Research data were collected before, during and after the classroom implementation by observations, field notes, video recordings, interviews and classroom materials. All collected data will be analyzed through the creation of different projects in the Nvivo9 research software Within the CHAT framework, the analysis and interpretation of data concerns pupils' selection and use of tools, the multiple mediations that take place within the classroom activity system and the way collaboration and contradictions affect the object and make visible the invisible changes within the activity system. Under the prism of CHAT pupils participate in meaningful cultural activities and receive scaffolding for improving of actions towards an inspiring object into the whole activity system.

Keywords: CHAT, Science Curriculum, cartoon

INTRODUCTION-THEORETICAL FRAMEWORK

This research study is part of the @fise project which takes place in the University of Ioannina, Greece and focuses on the connection of Cultural Historical Activity Theory (CHAT) with Science Education, especially in the early years, which is considered as a substantial paradigm in Science teaching. The ATFISE research project concentrates on transferring CHAT into the fields of science education. As it is combined with other relevant case studies, it finally aims to validate CHAT as an evaluation tool of scientific activities in different learning environments and institutions, such as in the university laboratory, in the school classroom, in a museum or science centre etc. Under the prism of CHAT learning involves a qualitative change of actions that may take place when people participate in meaningful cultural activities and receive scaffolding for improving of actions towards an inspiring object into the whole activity system.

The students' working in groups, the use of intermediary tools and the objects which are usually transformed into outcomes play an important role for creating new knowledge in the context of rules that the entire community sets and follows. The unit

of analysis is the activity. This makes moving from one activity to another flexible, getting advantage of prior knowledge. Thus, learning about scientific concepts becomes meaningful for the students' community who interact with one another as well as with meditative and analysing tools and means within the activity's context (Engeström, 1999) and within their cultural-historical background. In this sense, science education is not only focused on the scientific content but also on presenting science as a human activity (Nielsen & Thomsen, 1990) with social applications.

Within the CHAT frame, subjects collectively act in a community in the context of rules that the entire community follows. They become engaged in science activities and they use tools in order to deal with a scientific concept. Thus, the construction of knowledge becomes meaningful for students who interact with one another as well as with tools and means into the community of learners (Engeström, 2005).

An innovative method of introducing natural concepts in the early grades is using interdisciplinary means such as comics and cartoons-animations (Bongco, 2000). Gene Yang (2003),in his site Comics in Education presents the strengths of comics in education as motivating, visual, permanent, intermediary and popular. Keogh and Naylor (1999), support teaching and learning scientific concepts by using concept cartoons and offers an alternative method of science teaching which involves discussion, investigation and motivation for learners of all educational levels.

Thus, science teaching with the use of cartoons is related to ideas learners already know or have directly experienced, which makes learning concepts meaningful (Mayer, 1996). Humor, exaggeration, symbols, emotions are all elements that provide learners with very interesting types of knowledge presented in a familiar context. The British Cartoon Archive (1973) encourages research about cartoons and supports groups of people who wish to exchange views about using cartoons in learning and teaching and also get ideas and inspiration. Furthermore, users have the opportunity to create web group of cartoons and use them teaching aid, create a research project, an online exhibition and share their ideas with others. Accordingly, in the webpage Educational Comics (2008) for kids individuals as well as institutions can become members and find educational comics on various topics such as reading, mathematics, learning to eat healthy or learning vocabulary. Furthermore, there is a variety of educational programming languages and multimedia tools that can be used to create projects that have an impact on pupils' education and can be a basis for teaching and learning as well as developing problem-solving strategies.

Rationale and Purpose

The rationale for this study was based on the fact that teachers in the early grades need cultural tools that can make learning scientific concepts meaningful. According to Roth learning is something that is strongly connected with the life of the learner and not something that just happens in a classroom. Thus, the object of learning can be achieved only when we proceed from the life of the individual to the collective life of society (Eijck& Roth, 2010a). Cartoons are cultural tools connected with pupils' interest that engage them in exploring a variety of scientific concepts, in experimenting, in creative thinking and providing solutions to problems.

Great importance is stressed on the socio-cultural aspect of teaching scientific concepts in the early grades as a means to reform science Education. The use of basic principles of CHAT to teach scientific concepts from the early grades provides motivation to develop innovative science activities for pupils. Thus, CHAT will

become a theoretical framework suitable for analysis and designing activities from the field of science education and will achieve meaningful learning and scientific literacy development. Using CHAT offers the opportunity to study in depth and analyze the interactions that occur within learning communities. In particular, the social identities of pupils and the subjective perceptions of their own activity and their role in it can be explored. In this sense, development of scientific knowledge is considered as a process of internalization from the society to the individual and production of scientific knowledge comes as a result of various factors. Initially, by using their senses, prior knowledge and cause-effect reasoning, pupils are led to making predictions about the behaviour of materials Then, they make hypotheses, test them through experimenting, draw their conclusions and finally gain new knowledge. Furthermore, it seems that scientific literacy of future citizens has to be considered as a concept that can occur 'in the wild, - that is- in the everyday world that we share with others as opposed to testing situations in classrooms and laboratories' (Eijck& Roth, 2010b).

The aims of this research study were set under a CHAT perspective in which scientific knowledge is a dynamic activity system and the participants, the institutions, the methods, the tools, the objects are connected in a cultural, historical and social process. In this frame, the study seeks to:

- Create the learning environment so that pupils can practice in science activities that are related to their socio cultural background.
- Use cartoons to help pupils gain experience about scientific concepts such as floating and sinking as well as properties of light.
- Provide early grade pupils the opportunity to obtain skills of the scientific method and life skills.

METHOD

The methodology used in this study is based on: the framework of analysis by the view of Yrjö Engeström (2005), the cultural- historical approach by Marilyn Fleer and Marianne Hedegaard (2008, 2010) about children's development in every day practices. More specifically it follows the third-generation of activity theory in order to develop conceptual tools to understand dialogue, multiple perspectives, and networks of interacting activity systems (Engeström, 2001).

Towards this direction an Innovative Sciences Curriculum for the early grades was developed in order to introduce teaching scientific concepts by using cartoons. In the first part of the curriculum, a popular cartoon, Spongebob Squarepants, was used to design floating and sinking activities. The didactical scenario of both parts was designed following certain techniques of drama in education in combination with science education techniques and was used to teach floating and sinking concepts in pre-primary school classrooms. As pupils during the implementation moved on from one stage to the other they exchanged roles in order to find the solution of problem concerning floating and sinking concepts. They defined the place and time and through role-playing, argumentation, conduct of experiments, evaluation they reached the conclusion. The didactical scenario included a series of classroom activities listed below.

The letter: Pupils receive an envelope which contains a two-page letter from Bob Sponge, a popular cartoon who lives in a city under the sea and faces unexpected problems of floating and sinking.

Teacher in role: Teacher in Bob Sponge role discusses the problem with pupils and provides information about the city and the situation described in the letter. Pupils ask questions and try to find a way to help Bob save his city.

Painting: Pupils draw the city of Bikini Bottom in a big piece of paper.

Role in the wall: Pupils express their thoughts and opinions and teacher takes notes of them in a piece of paper which depicts Bob Sponge's mind.

Conscience alley and Argumentation : Pupils are divided in two groups, the floating group and the sinking group. Each group has to discuss about the behavior of certain materials when put in water and present argumentation of why some of them sink and others float. A representative of each group announces estimations and provides reasons. They make predictions about the behavior of each material in water.

Prediction board: Pupils fill in their predictions in a three column board. Material: stone, nail, button, potato, orange….Sinks: YES ….NO….Floats: YES NO

Experiment: Pupils put the different materials one by one inside the water and observe what happens. They classify the materials in two categories according to their behavior inside the water. Finally they test their predictions, and discuss about the cognitive obstacles, the skills of scientific method used and they provide ideas for extra activities.

Telephone conversation: Pupils listen to one part of a telephone conversation. The teacher in the role of Bob receives a telephone call from Patrick, his best friend in Bikini Bottom. Bob writes down three key phrases that he hears from Patrick and tries to find out with the aid of pupils what they mean. Each phrase leads to an experiment which is performed in class.

Evaluation: Pupils draw in a sheet of paper divided in two horizontal parts the items that float on top and those that sink at the bottom.

Game: Pupils play games with a Bob Sponge puppet.

Still Images: Pupils present scenes of Bikini Bottom city using their body.

Discussion in circle: Teacher in role discusses with pupils about the knowledge they have obtained so far as well as the prospects of saving the city of Bikini Bottom.

In the second part, elements from History of Science were incorporated in a narrative about light and colors. Then, the narrative was turned to a 20 minute animation about light, colors and shadows in the educational programming language scratch and was used for the development of a didactical scenario about light, colors and shadows for the early grades. The animation 'Colour Visions from the Past' is divided into five parts. The story takes place in a town where colours are fading day by day because of the rain and almost everything is black and white. Phoebus and Iris, who live in this town, travel through time, in an unusual way, from uncle Albert's cottage to Newton's laboratory. There, they are caught while overhearing part of Newton's lecture to the scientific community and offer to work on light and colour experiments. When they manage to escape and travel back to the present, they bring invaluable information to uncle Albert's lab.

Pupils watch the cartoon in parts and discuss about it. They express their own ideas about light and colours and the way they are connected to the story and they participate in a series of activities about light, colours and shadows.

In the course of the activities, pupils play the roles of the characters of the cartoon and deal with scientific concepts in order to work like the scientists of the story. They organize the experiments in class; they set rules and use the materials in order to conduct the experiments. In certain cases they transform a part of the classroom to a class-laboratory, in which they experiment on colors. All in all, pupils participate in problem solving situations and interact with each other as well as with the teacher. Both parts of the Science Curriculum are connected with the Greek National Curriculum for the early grades which has recently been reformed. At this level scientific learning has been put on a cultural- historical and social basis. It is connected with inquiring in authentic environments, practicing skills of observation, classification, communication etc. and making sense of the relations and interactions that take place in the world around us. Furthermore the Science Curriculum is connected with the five frames of learning in the early grades (games, routines, everyday-life situations, explorations, organized learning activities) in which all early-grade pupils should equally participate (Greek National Curriculum for Early Childhood, 2011).
In the following cluster analysis of the first part of the Science Curriculum (figure 1) the activities have been grouped together because of the characteristics they have in common regarding their connection with the five frames of learning. This was done toward the beginning phases of the analysis to help see the connections between the classroom activities and the frames of learning of the National Curriculum for Early Childhood. Thus, the activities 01, 02, 04, 08, 09 are connected with explorations and everyday-life situations , the activities 05, 07,08 are organized learning activities while the activities 00, 03.12,13 involve routines that pupils usually do in their school life and the activities 10,11 are games.

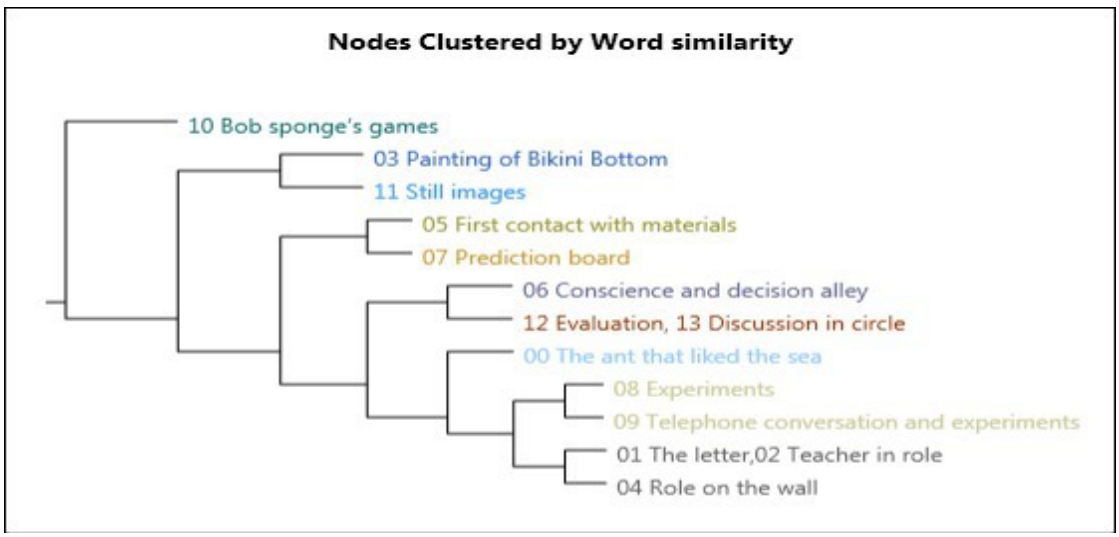

Figure 1. Cluster analysis of the activities considering floating and sinking concepts

The Innovative Science Curriculum was implemented in autumn 2012 in 4 pre-primary school classrooms of 25 pupils each. The researching methodology followed a qualitative design, and research data were collected by observations, field notes, video recordings and classroom materials. Teachers of the schools collaborated with

students on providing all the relevant information about their science program and the children's cultural and social background. All collected data are being analyzed through the creation of different projects in the Nvivo9 research software. The analysis and interpretation of the whole data have been developed by the realization of successively linked stages which were elaborated by the combination of theory and field research. The process of data analysis was inspired by action research studies as well as the qualitative research method proposed by Roth, 2005.

In the course of data analysis the focus has been on the way pupils express their opinion about scientific concepts, they practice skills of the scientific method and the way they develop their scientific thinking and vocabulary. Furthermore, the pupils' reaction towards the cartoon, their references of prior experience of scientific concepts and the connection with everyday life are being analysed.

RESULTS

Data analysis has shown so far that early grade pupils experience scientific concepts not as an individual, isolated phenomenon but as part of the historical and social background. Furthermore, pupils have developed interpersonal skills of communication as well as critical thinking, problem solving and argumentation skills. They made hypotheses and questions/suggestions that expanded beyond the scientific concepts of the specific activities to other fields such as language skills, expressing opinions, decision making, geography e. t. c.

Examples of pupils' questions/suggestions are provided below:

'- Where is the Pacific Ocean? – How are you able to breathe and talk at the sea bottom? – Why do jellyfish stick on you? –Certain people take sponges from the sea bottom and sell them in shops. – Where do scientists live? – I cannot see what is inside the box; let's make a hole in it! – There are big electricity generators that bring light to our home'.

Pupils used alternative vocabulary to refer to floating, sinking and light such as 'it swims, it goes up, it falls down the water, the sun and other luminous materials give us light', which was accepted because at such an early age children must be encouraged to describe scientific concepts the way they can. During the experiments, pupils saw their predictions come true or false, provided explanations for each case and came close to the scientific truth.

The figure below (figure 2) is illustrating the skills of the scientific method that pupils practiced during the implementation of the science curriculum. We notice that although pupils practise a variety of skills, communication is the most prevalent. Communication is an essential skill for early-grade pupils as they use drawing and other symbols to describe an action, object or event. During the implementation of the curriculum communication took many forms and was present at every moment of action. Given its collaborative nature it was combined with almost every other skill. Pupils communicate in order to share their observations or predictions and try to make themselves clear and effective if the other person is to understand their point of view. Furthermore, dealing with scientific concepts with the aid of cartoon characters and role-playing involved forms of communication which contributed to better understanding of science, connecting with prior knowledge and building a strong interactive network in order to achieve meaningful learning of the scientific content.

Following the CHAT theoretical framework, collaboration and interaction within the activity systems entailed communication regarding the use and effectiveness of mediating tools. Problem solving was a result of group work in which both verbal and non-verbal communication were used in order to reach the solution.

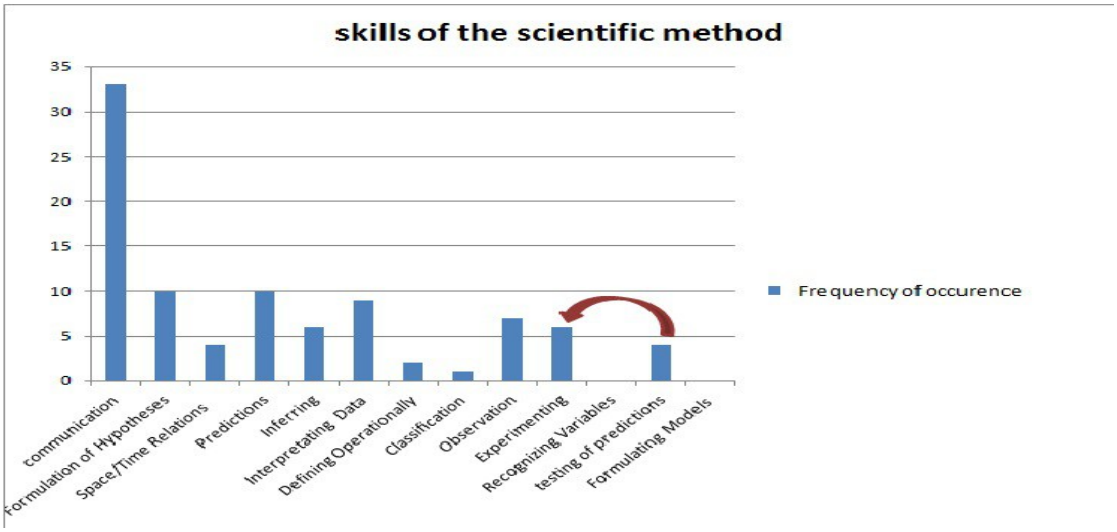

Figure 2. Skills of the scientific method

Within the CHAT framework, the analysis and interpretation of data concerns pupils' selection and use of tools, the multiple mediations that take place within the classroom activity system and the way collaboration and contradictions affect the object and make visible the invisible changes within the activity systems.

The tools used in the activity systems shown below, (cartoon, computer, language, thought e.t.c.), mediate with the subjects (pupils, teacher-researcher), so as pupils to become able to reach the object (understanding scientific concepts, practice skills of the scientific method, achieve meaningful learning). The learning community (school-classroom), sets and modifies rules to the members of the community and to the groups (student-student, student-teacher, group-group, group-teacher, teacher-group), forms flexible groups and divides the labor. The object/outcome of the activity is reached literacy within the boundaries of the socio-cultural frame of learners. In this regard, learning procedure is based on the multiple interactions that take place in the community and supports the development of tools such as drama, cartoons and role playing all of which help early-grade pupils learn combining their personal experience and knowledge with the interactions of the group.

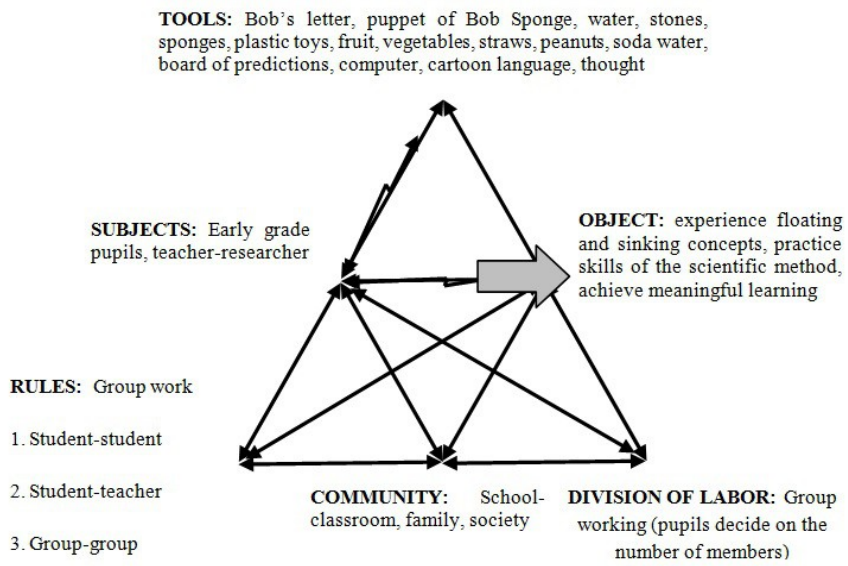

Figure 3. The Activity System Model (Engeström, 1987)

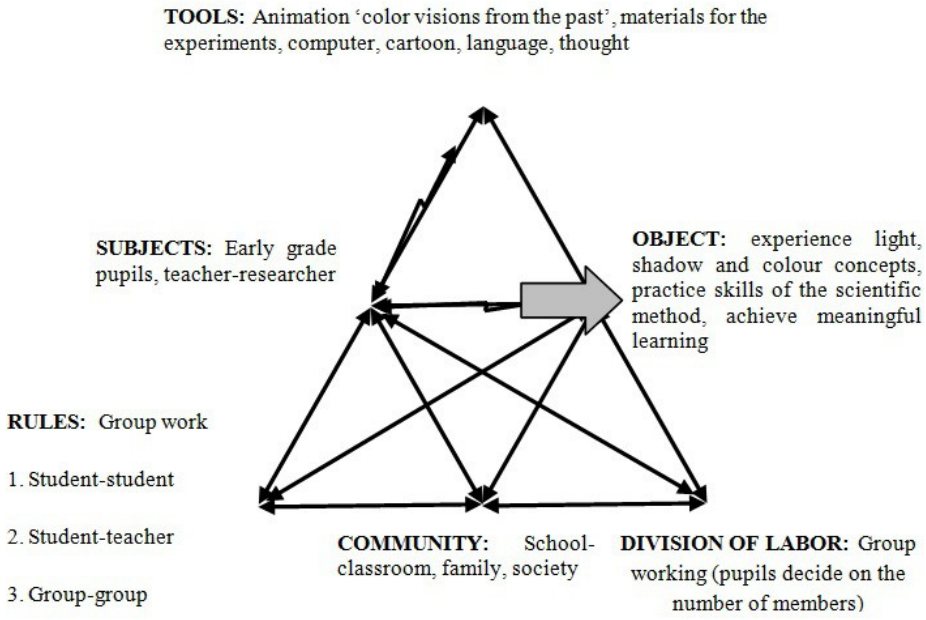

Figure 4. The Activity System Model (Engeström, 1987)

Table 1

Interpretation of the impact of cartoons on teaching scientific concepts

Impact of Cartoon in Science Teaching	*Moments of change in the Activity Systems*	*Transcript*
1. Pupils receive an envelope which contains a	Pupils connect the fact that they have received a letter	- we receive letters at home from the tax service

two-page letter from Bob Sponge. The letter is a tool that gradually defines the course of action of pupils as they follow the basic points of it to move from one stage to the other.	with an ordinary activity that takes place within their socio-cultural background. Their parents receive letters at home so the letter becomes a tool to motivate pupils to act as a group dealing with a situation.	- we receive letters that are electricity bills - we pay bills at the bank using types of letter - I have never received a letter from a cartoon - If someone wants to send a letter he puts it in an envelope fills in the addresses and takes it to the post office
2. Teacher plays two different roles using a Bob Sponge puppet. She becomes Bob Sponge when she puts the puppet on and she becomes the teacher again when she takes it off. When she is in Bob Sponge role, she discusses the problem with pupils and provides information about the city and the situation described in the letter. Pupils ask questions and try to find a way to help Bob save his city.	Pupils try to define the rules in order to respond to the two different roles each time. The interactions within the group and with the teacher in the two roles lead them to divide the labour in two groups. The first group will talk to the teacher and the second to the teacher in Bob Sponge role. Thus, pupils transform the rules and their actions according to teacher in role.	-this is fun, I like this puppet -let's take turns to ask questions -No, I want to speak to Bob -You will when she (the teacher) takes the puppet of off -Why don't we change groups? -What do you mean? -One group will speak for Bob and one for teacher -Then we can change groups.
3. Pupils are divided in two groups, the floating group and the sinking group. Each group has to discuss about the behavior of certain materials when put in water and present argumentation of why some of them sink and others float.	The cartoon is used by pupils as a tool in order to make predictions about the materials when put in water. Learning is connected with real-life situations and becomes meaningful. As a result, critical thinking of pupils develops and at the same time motivation to gain new information rises.	- we could give Bob only items that sink so they can stay at the sea bottom. - we could tie the items that go on the surface with rope. - the stone sinks because it very hard and thick -this piece of wood sinks because it is heavy and if it is in the sea, it is impossible to go up. - no, I am certain wood floats because I have seen pieces of pine-trees float in

		the river. They were big pieces but they were on the surface of the water.
4. Pupils listen to one part of a telephone conversation. They hear three key phrases and try to find out what they mean. Each phrase leads to an experiment which is performed in class.	Pupils organize the experiments in class, they interact within the group and with the teacher (in Bob Sponge role), they set rules and use new tools in order to conduct the experiments.	-peanuts in water and carbon dioxide -we need peanuts and something to put the water in -let's look in this bag -there are plastic glasses in here -there is soda water as well…
5. Pupils organise experiments about light and colors and try to follow the way Newton presented his discoveries to the scientific society. The role of university students is that of a mediator and a facilitator.	Pupils become familiar with some episodes in the history of science and use elements from these to organise their own scientific work and progress.	-hold the piece of glass like this -the man Phoebus and Iris met (Newton) was in a very dark room -let's go near the door, there is not much light there.
6. Pupils participate in a problem solving situations and interact with other pupils and teacher-researcher in order to reach the desired outcome, to learn about light and its properties.	Pupils describe scientific concepts providing examples of their logical thinking and their everyday life.	- there is light in the sun -there is light in the electricity poles that bring light to our homes -my dad teaches physics and he told me that there are generators that produce electricity.

CONCLUSIONS

The initial results of using CHAT in Science Education seem promising. This research study contributes to a growing interest of CHAT-based education research. Great importance is stressed on the socio-cultural aspect of teaching sciences in the early grades. All in all, by using basic principles of CHAT the development of scientific knowledge will be considered as a process of internalization from the society to the individual. Taking this into account, teaching scientific concepts is considered as an interdisciplinary procedure with strong connections to society. Learning is an on-going process which is affected by societal conditions while aims and goals can be modified according to current circumstances and pupils' interest. Under the prism of CHAT pupils participate in meaningful cultural activities and

receive scaffolding for improving of actions towards an inspiring object into the whole activity system.

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