# Learning Journey: Floating Boats

**Age:** 5-6 years old
**Learning activities**: Designing and planning investigations ; Gathering evidence; Explaining evidence
**Creative dispositions:** Curiosity; Ability to work together
**Synergies**: Assessment for learning; Reflection and reasoning; Motivation and affect
**Contextual factors***:* Group work

## Background Information

**School setting**: It is an urban kindergarten in Crete (Greece) with two classes.

**School policy for science**: We follow the official national curriculum.

**Curriculum links**:

- Children get to know and utilize scientific methods.
- Children learn to collect, compare data and draw conclusions.
- Children evaluate their thoughts and results of their actions.

## Setting the Scene

### Focus

The focus of this project is on children *designing and planning investigations*; becoming familiar with and practicing *gathering evidence* with precision; developing opportunities for *collecting data* in order to *develop explanations.* The difference I tried to do was to enrich the learning process with *assessment* activities, performed by the teacher and by the students. The purpose was to collect more evidence on children's creativity.

### Rationale

The children were familiar with working in groups, but did not knew how to *plan and organize an investigation*. Therefore *the motivation* for this new knowledge was intense and I needed to build on their *enthusiasm* for their *explorations* and subsequent *investigations*. I needed to encourage children *to reflect and evaluate* their actions not because I imposed this but because the inquiry procedure itself and its principles promoted it. I also believe that important factors are the value and use of *children's existing knowledge and experiences*. Consequently this framework was fertile for producing creative ideas and activities in all phases of the project.

### Implications for my planning and teaching

The implications for my planning and teaching were to strengthen children's *reflection and reasoning* through new experiential activities*. Observation and recording of data* were catalytic factors designed to give impetus for children's creative thoughts and actions. Children would have opportunities to *evaluate their*

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*actions* directly and spontaneously - prompted as a result of the active learning process.

*Group cooperation* would be fostered through encouraging direct exchange of ideas, sharing observations and interactive control of results. So knowledge and ideas would come naturally and would be unconstrained.

I also sought to enrich the way of the learning evaluation process to make it more effective. At the same time I gave more weight to the assessment made by the children, the way it is expressed and used by them. I tried discreetly to get involved, giving support as needed. My basic teaching tools were the questions and the audiovisual materials.

I preceded and reinforced learning activities that trigger the motivation and interest of children and were available. I sought the emotional engagement of children through setting clear targets. Children from the beginning knew the goals and worked to achieve them in a focused way. The variety of activities used also contributed to this.

## Outline of learning activities and resources

### Starting points

These first activities were designed to provoke children's interest and elicit their ideas in order to identify main issues and then to proceed to solving problems.

1. **What we know about water.** On the occasion of the visit of an alien in our class we list children's current knowledge about water.
2. **Children set their first goal**. They express their need to play with water and draw what they want to do.
3. **Free exploration with water.** The children play freely outdoors with water. I observe, ask questions and photograph their actions. Then, children draw what they really did.
4. **Children set the second goal.** After negotiation children decide to construct boats.

### Learning journey

Children, divided into small groups, start a series of exploratory activities to construct a floatable boat.

1. **Constructing boats:** Children construct boats they assume are floatable. They test them in water, make observations and draw conclusions.
2. **Evaluation:** After discussion and evaluation children decide on the most successful boat model.
3. **How much time should we wait for?** Children ascertain that time is a key variable in the flotation/sinking process of an object. Some objects float initially, but after a short or long time sink. Why?

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4. **How to run an inquiry?** Children express views on how to measure/control the time and after my prompting watch a relevant video animation.
5. **Inquiry design:** Children, after reflection, decide to try one by one some objects to see if they sink or float in water, by controlling the key variable of time. They notice that they also have to hold a kind of diary of their observations.
6. **Designing the diary:** Children, with my help design on the computer an observation sheet which takes into consideration the variables of time and kind of object.
7. **Inquiry procedure:** Children, always divided into teams, carry out a series of investigations, record and evaluate their observations. They plan their next moves based on their evaluations.
8. **Compare data and conclude:** Children present their results in plenary, compare them and express final conclusions. They also dramatize them.
9. **Boats construction:** Children based on the conclusions drawn from their inquiry processes, plan and construct floatable boats.

Enabling children's learning motivation was an important factor for me. Initially the role of the introducer of the topic was given to an 'alien' muppet. Children were each time unaware of the issue the muppet would focus on. The entailed conversation was concerned with summarizing the activities already done, creating new questions, or presenting the conclusions reached. The use of a variety of activities helped keep children motivated. Similarly, their active role in the planning and implementation of the following day's activities had an important motivating effect on them.

Generally the children were interested in the topic because they had several experiences with it. The difference was that the topic's teaching approach was mainly child-centered, that is through the prism of an investigation rather than frontal teaching. The motivation for learning supported by my many open questions such as : "how could you .....? why do you think .....? what did you do .....? how do you know.....? " Importantly, the children were also encouraged to be themselves the questioners. So their interest in learning and its deeper understanding was enhanced.

## Developing the Learning Journey

Initially I explored the level of children's pre-existing experience and knowledge through a series of activities. I was sure that the general theme was interesting to the children and that they would have plenty of knowledge about it. But I thought that this knowledge would be general, empirical, nonspecific and would not have arisen as a product of reflection and awareness. Each activity was mainly based on children's questions and their desire for answers. Also each activity was based on the knowledge or skill that the majority of children had conquered in the previous one. We did not move to the next aim if the majority of children had not evaluated the previous phase. Thus, an activity was a natural result of the previous one. This

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assessment was made during plenary, through dialogue, looking and talking about pictures taken and drawing. As a scaffold, which children decide when to climb. I just increased or diminished the step, depending on the difficulties we met. I note that formative assessment, as a mental process not as teaching activity, was performed by children throughout all the activities, instantly and quietly. So I had to be good observant and listener.

## Starting points 1

**Activity: What we know about water**

An alien-muppet appears and spontaneously children ask him who he is. He says his name and asks them to help him understand what is this element he has landed in. He gives children some clues ("I could put my hands in it"; "It has no color", "It was near some sand") but not the name because he does not know it. Children figure out that he describes sea and its water. At once children start to tell him everything they know about it. We write them down.

**Rationale:** To activate children's **motivation and interest** about the subject of water**.**

**Children's responses**

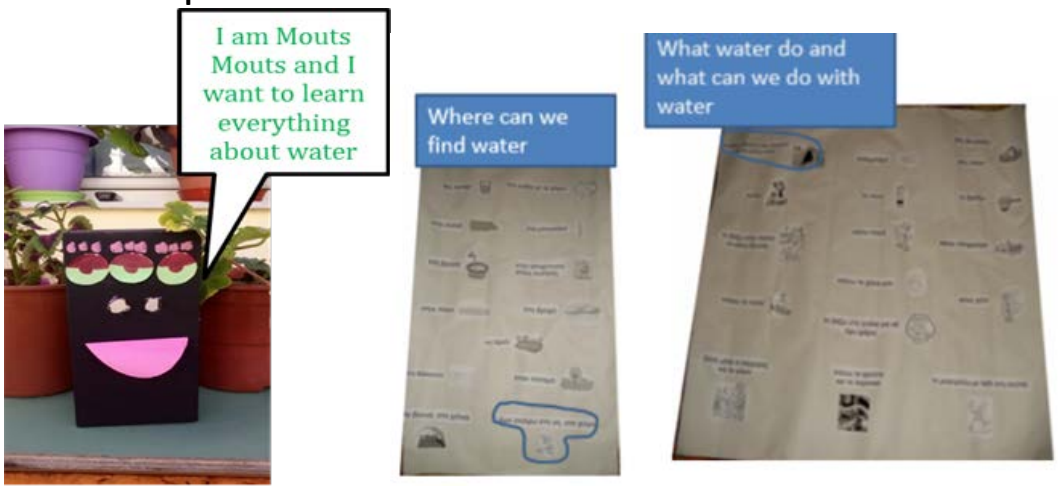


**Photo 1: Example of children's responses**

In the tap, in a bottle, in the sea, in ice, underground etc.
To drink, to wash, to cook, to swim, to make mud and build etc.

**Reflections and implications**

Children's emotional connection with the subject activates their learning **motivation.**

Children extend the discussion into activities they would like to do with water.

## Starting points 2

**Activities: Children set their first goal**

Children are talking about games they can do with water. We record their ideas and decide by vote which will be implemented first. Then they draw the game they will do.

**Rationale: To encourage** children to crystallize their ideas and become more specific in their actions.

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**Children's responses**

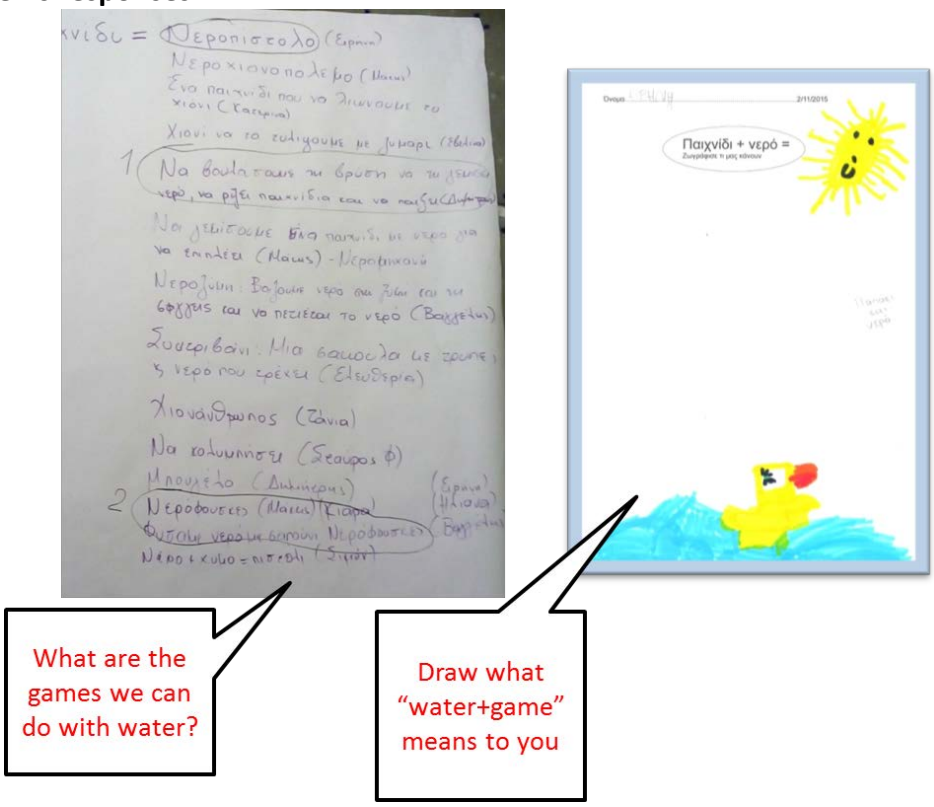


**Photo 2: Examples of children's responses and drawing**

Water pistol
Fill a bag with water, make holes to see water flow.
Close the bath tub, fill with water and play with toys.
To fill with water a toy to see if it can float
A game that melts snow
Snowman
Soapbubbles-bubbles

**Reflections**
Children begin to set goals and to shape the course of their activity.

I realize that when the object of learning has meaning and fun, then the children **express more creative ideas.**

**Implications**
Children have the **motivation** to design the next activity.

## Starting points 3

**Activities: Free exploration with water**
Children choose the materials and implement their chosen activity. I just observe, record and **ask for explanations** if something interesting happens. As an **assessment** they draw their activities

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**Rationale**

**Opportunity for** children **to play** with water. And for me to observe and record their actions to learn about their ideas and interests.

**Photo 3: Materials available**

**Children's responses**

Child 1: My paper roll does not make bubbles.
Child 2: This is because it has a big opening and the air goes out.

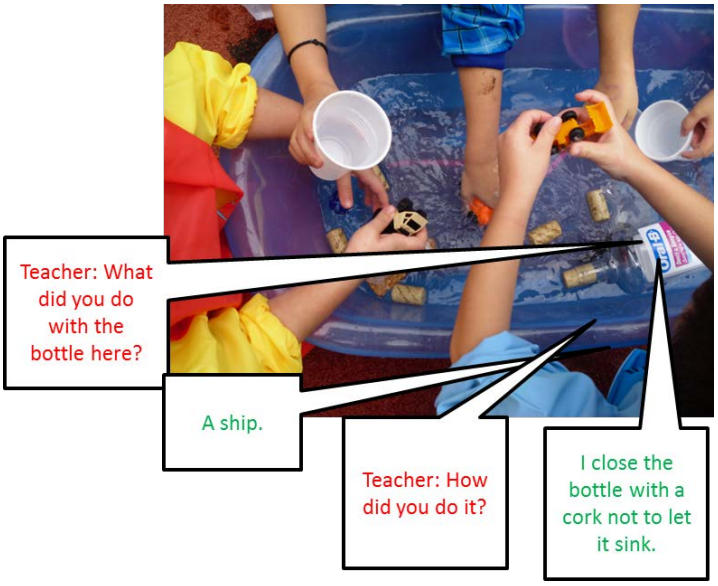


**Photo 4: Examples of children's responses**

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Teacher: Draw the game you did with water


**Photo 5: Example of child's drawing**

**Reflections**

Children's motivation and interest in hands-on activities strengthens. Because of this, they are able to express effortlessly prior knowledge and experiences.

**Implications**

Children refine the target of their next activity.

## Starting points 4

**Activities: Children set their second goal**

In the plenary children review the photos we took and **discuss and reflect** on their actions with water. After voting they decide to construct their most favourite play. They draw their ideas and expectations.

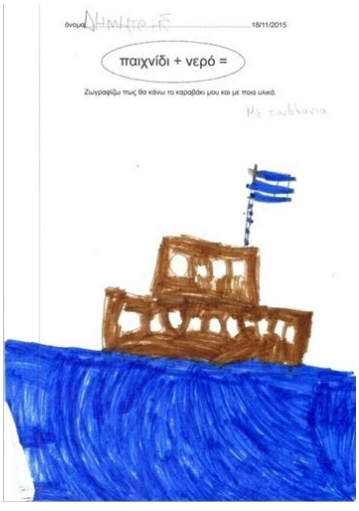
**Rationale**

Children design and organize an activity to create a floatable boat.

**Children's responses**

Teacher: Draw the boat as it will be, using the chosen materials

The child chose a paper roll, a box, blocks and paper)


The child draws his desired result

**Photo 6: Examples of children's drawings**



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**Reflections**
Children realize that their ideas can be implemented through a process of **hypothesis** and **design and planning**.

**Implications**
Children's previous experiences with the boats in the water lead them to their new design.

## Developing the learning sequence

### 1 Start of investigation

**Activities: Boat construction**
Children, in small groups, construct their boats and **make predictions** about their floatability.

**Rationale**
Children **work together** to build a common structure, with a specific aim - but recognise that they cannot control their success – they are **testing their hypotheses.**

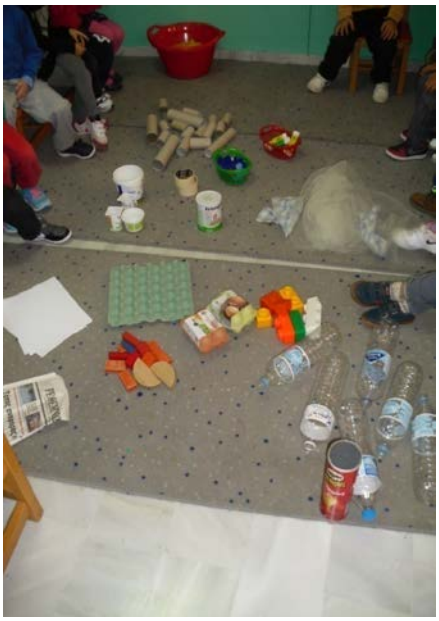

**Photo 7: Materials available**

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**Children's responses**

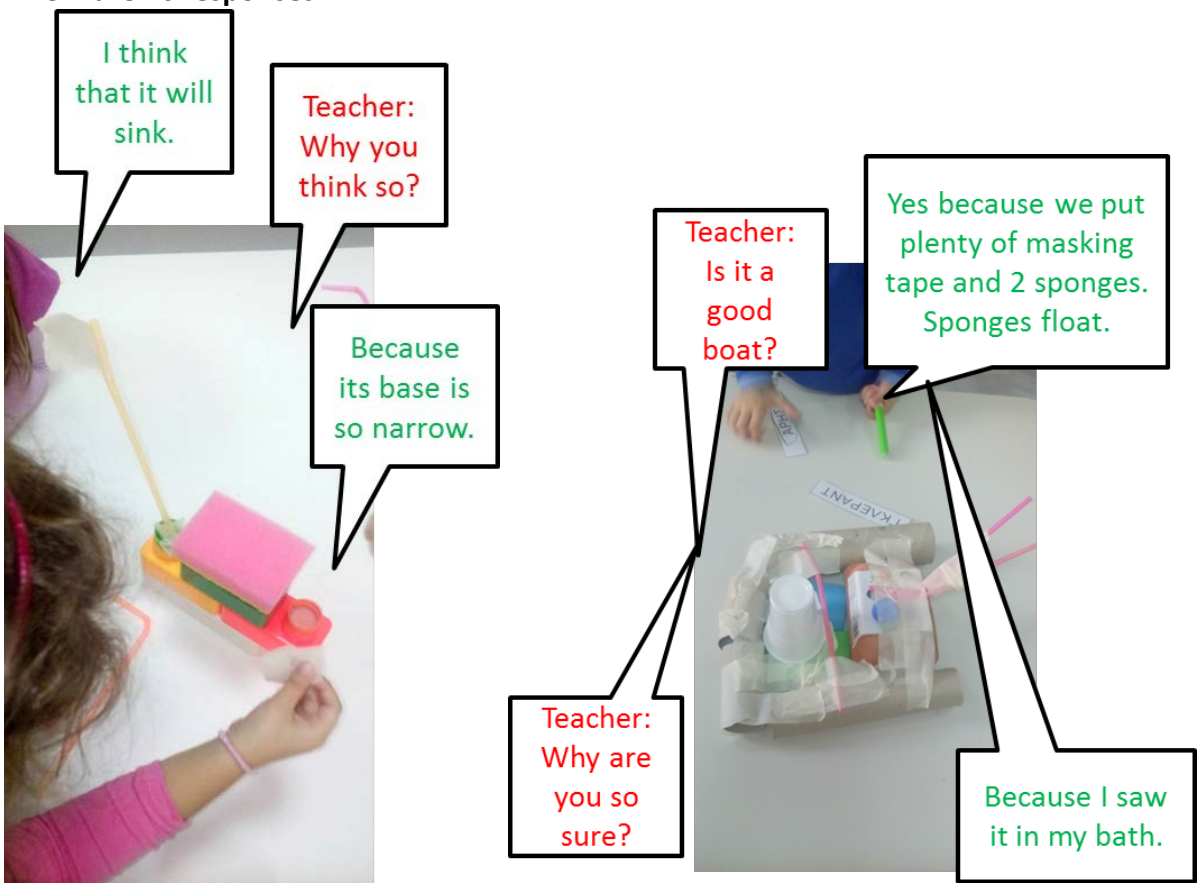


**Photo 8: Examples of children's reasoning**

**Reflections**

Children execute their ideas without forgetting their main aim. They give some satisfactory **explanations** about their choices based on their existing knowledge and experiences.

**Implications**

The next logical extension is to **test the boat** in water to confirm or not their **predictions.**

## 2 Test and evaluation

**Activities: Testing boats**

Children test their boats in the water. They observe and describe what happens. Finally they copy, in their opinion, the most successful model.

**Rationale**

Children **test their hypotheses** and **evaluate the results** of their actions.

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**Children's responses**

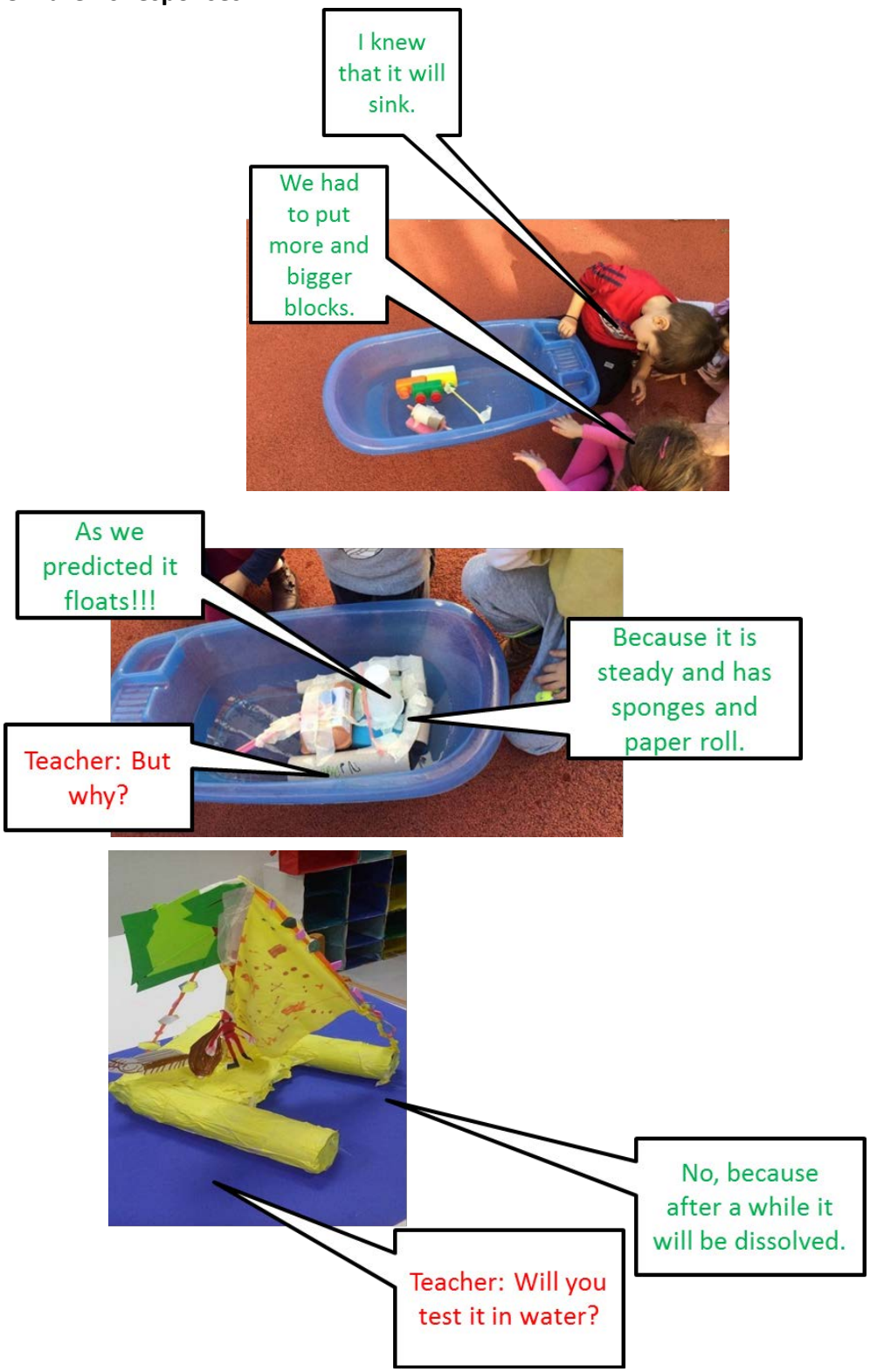


**Photo 9: Examples of children's responses**

**Reflections**

**Some predictions** of groups are semi-correct, but they still have not checked all the variables that lead to the construction of a floatable boat.

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**Implications**

We leave our boats a long time in water in order to watch what will happen to them.

## 3 and 4 Investigating Time

**Activities : How much time should be waiting?**

Children ascertain that time is a key variable in the flotation/sinking process of an object. Some objects float initially, but after a short or long time they sink. Why? I took advantage of this conversation and I asked them where we can find answers on how we can proceed. They are familiarized with internet searching so they propose to do so. We watch a relevant video.

Teacher: I think this video will help us.


**Photo 10: Screenshot of video used**

**Rationale**

To understand that knowledge must be checked and confirmed through investigations.

**Children's responses**

**Photo 11: Discussion in plenary**

Child: Our boat was ok. The paper roll sipped less water.
Teacher: Teacher: Why did your paper roll not sip more water?
Chid: Because the sponges held it up.

Child: I remember that the paper roll "crumpled" after a day.
Teacher: Is there another word for crumple?

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Child 1: Yes. It melted.
Child 2: Yes. It is dissolved.

Child 3: But the plastic bowl was ok no matter what.
Child 4: Not always. If the water comes in, it becomes heavy and sinks.

**Reflections**
For the first time the children express more scientific thoughts. They are talking about time and how this changes the state of an object.

**Implications**
The motivation for learning is reinforced by a video. They want now to try the scientific methods by themselves.

## 5 and 6 Design and plan the investigations

**Activities: Planning our investigation**
The video not only reinforces the motivation for further investigation but helps the planning of activity. With my help they design a worksheet on the computer to write down their observations. We decide how often we will check and record the results, we find a code for float and another for sink.

**Rationale**
To design and execute a series of investigations by **controlling all variables**.

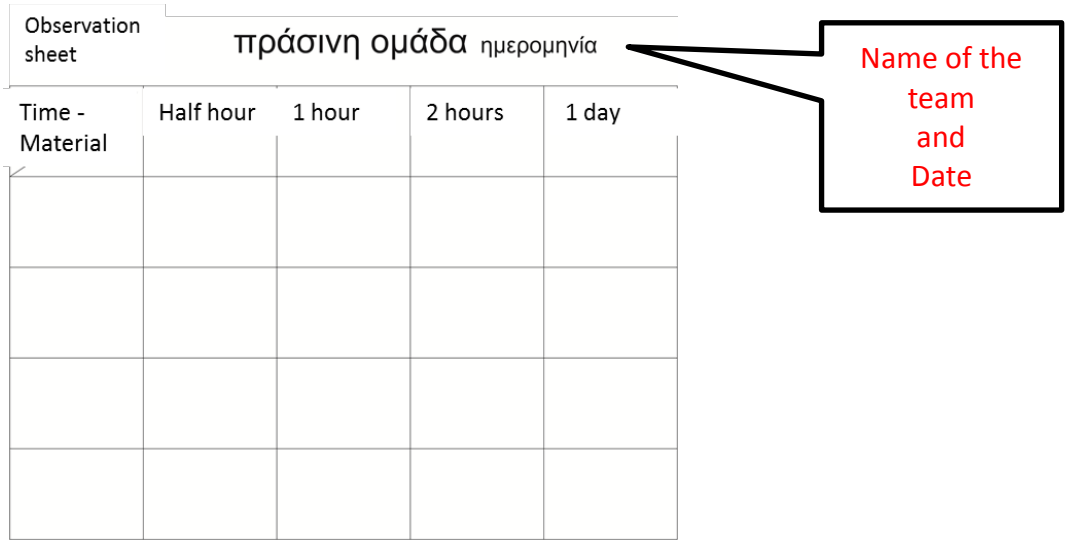


**Photo 12: Worksheet used to record the data**

**Children's responses**
Children mention the long duration of the procedure, the fact that they have to check one by one the materials and that they have to keep notes of their findings.

"We find out that finally our boats sank. We have to check all the materials one by one."


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**Reflections**

Children are able to **design an investigation** only when they've understood their aim. They **evaluate** results more critically when the investigation arises from their inspiration .

**Implications**

Carry out the investigation!

## 7 Carrying out the investigation

**Activities: Carrying out the investigations**

Children, always divided into teams, carry out a series of investigations, record and evaluate their observations. They plan their next moves based on this evaluation.

**Rationale**

To carry out investigations in a scientific way.

**Children's responses**

During investigation children in groups cooperate with each other to define which material they will use. During the conversation they evaluate their thoughts, reject or approve materials based on existed knowledge and experiences. Sometimes they repeat the same observation 2 times, changing some factors. They become more specific, observant and focus. They make more creative thought and comments.




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Child: One sponge sinks the other floats
Teacher: Why did this happen?
Child: Maybe because the first has more holes than the other. It's older.

Child 1: I keep pushing the bowl but goes up when I let it.
Teacher: Why do you think this happens?
Child 2: Because it is not "boring"
(in Greek boring and heavy have similar letters)
Teacher: When you put force, with which one you fight? The bowl or the water?
Child 1: I put force and the water lifts the bowl.

**Photo 13: Examples of children's exchanges**

**Reflections**

The scientific structure of the investigation helps children **check** more consciously some **variables**.

Children are more concentrated and observant.

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**Implications**

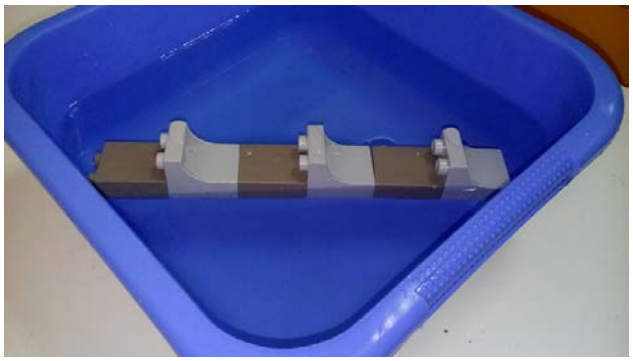
Children are concerned about the weight of each piece of construction. They want to make new combinations.

**Children's responses**

Child: Blocks are floating because they are made of plastic.

*(After half an hour)*
Child: But now it half-sinks.
Teacher: Why does it not float as before, after half an hour?
Child: Because the light gray brick is heavier than the dark one and sinks from this side.

Child 1: We put one more light grey to become the same heavy on both sides.
Child 2: Can we do a pattern?
Teacher: And how will you do it?



Teacher: Why are the bricks floating now?
Child: Because there is a pattern and it is the same heavy everywhere.

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**Photo 14: Example of children making new combinations of materials**

**Reflections**

The integration of past experience and knowledge enhances children's abilities to evaluate their actions.

**Implications**

Effortlessly children reach the end of their learning journey and they feel satisfied. Now they want to review their diary.

## 8 Finalising investigations

**Activities: Compare data and reach conclusions.**

Children present their results in a plenary, compare them and discuss final conclusions. They also dramatize them with sound accompaniment. We find a sound for float and one for sink.

**Rationale:**

Engage children in **comparing data**, and argumentation leading **to conclusions and explanations based on evidence.**

**Children's responses**


**Photo 15: Examples of children's completed worksheets**

Children use tick and crosses to record whether the material floated or sunk.

Child: Plastic bowl with wide base is better material to construct a boat.
Teacher: But why?

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Child: Because it does not turn over to fill with water.

**Reflections**

Children could **evaluate and reason** about their findings. They developed **dialogue** and complemented each other's **explanations**.

**Children's responses**

Child: I am a plastic bowl and I am floating
Teacher: Why are you moving?
Child: Because the water moves.

Teacher: What is happening to you?
Child: I am in the bottom. I sank and I am starting to soften.

**Photo 16: Examples of children's dramatizations of their conclusions**

**Reflections**

Children's representations seem simple. But when we ask for further explanations the amount of knowledge gained is highlighted.

**Implications**

Naturally they proceed to the boat's construction.

## 9 How to construct a floatable boat

**Activities: Boat construction.**

Children construct their boats based on the conclusions gained from the planned investigation experimental processes. They construct floatable boats.

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**Rationale**

To **express** their acquired knowledge and experience through hands-on activity.

**Children's responses**

Child 1: We can put a Playmobil in it.
Teacher: You can do that if you want.
Child 2: No! We do not want it to be heavy.


**Photo 17: Examples of children's floating boats**

Examples of exchanges between children:

- "How big must the sail be in order not to be wet?"
- "Let's measure it."

- "How can we glue the sail?"
- "We can use playdoh and glue."

- "Let's colour the water to look like sea"
- "We can spill blue tempera.

- "How can we colour our plastic boats?"
- "We can try tempera too."
- "No because it will be washed away by water."
- "Let try crayon."

**Reflections**

Even during the construction of the boat children **continue to argue, to infer, to investigate**. They address new obstacles but they try to **give explanations and solutions.**

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## Overview of teaching and learning approaches

This project lasted almost 4 months. The following factors were taken into account to facilitate learning and encourage children to creative thinking and hands-on activities:

- collaborative learning and the exchange of ideas;
- sufficient time;
- exposure of children to open-ended questions and counter-questions - *when children asked something I provoked them with another question instead of an answer*;
- step by step sequence of investigations - *as the children decide to go ahead and not as I decided*.

Approaches to assessment

- self-assessment during the activity;
- team assessment after discussion;
- evaluation of data in plenary discussion.

Types of evidence for assessment. The assessment took place through

- dialogue;
- drawing;
- dramatization;
- recording.

## Reviewing learning across the project

- The facilitation and control of the learning was done through **discussion, open questions** on my part as the teacher, and children's experiential activities.
- Children's **design and implementation of their investigations** spur their **creative thinking** and, as much as they can, **scientific justification**.
- Finally the children had the necessary **time** to implement and finalize their planning.
- **Evaluation and assessment** was carried out by the students themselves naturally and effortlessly during the investigation and its completion.
- The **motivation for learning** is maintained throughout the investigation because there is rotation and variety of activities, several experiential activities, quick and substantial discussion with audiovisual support.
- There is **not enough variety of materials** but the important thing is that they are familiar to children. So they focus to find their new usage rather than to explore them.

## Developing inquiry skills and creative dispositions

There are several examples where children's investigating skills and creativity were expressed. But I will focus on those that gave impetus to the project. More specifically,

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- Once the kids realize that time is a parameter which affects the materials' floatation.
- During the experiments there were many moments of creativity. Eg when they began to make correlations between the size of an object's base and its floatation. If it is large or small and what happens in each case.
- When they made links between the change in an object's weight with its ability to float.
- When a child explained that when he forces the bowl down, the water raises it up.
- When they combined their knowledge of pattern with the balance of the object that floats and made a number of combinations of bricks.
- When they began to relate the structure of the material and floatation.
- When they discovered that an object may be in an intermediate state of floating and sinking.

Children's creativity can be associated with all synergies but in this project can be attributed more to "Dialogue and collaboration", "Reflection and reasoning", "Teacher scaffolding and involvement", "Assessment for learning".

I fostered children's creativity by

- ✓ listening to them constantly;
- ✓ asking for more explanations;
- ✓ involving all members of a group in observation and inference;
- ✓ seeing through their actions all possible courses of activity - so when something important was going to happen I highlighted this to the whole group;
- ✓ allowing them to complete their actions - to have as much time as they needed;
- ✓ not insisting to deal with the matter if the whole group did not agree;
- ✓ following democratic procedures;
- ✓ spending time in the planning of the next activity with the children the previous day - so they would be psychologically prepared;
- ✓ including other activities which children enjoyed, e.g. watching a relevant video with "Peppa pig" without intervening, just listening to their discussions.

All activities were a chain. Conclusions or new questions of previous activities were forming the following ones. The needs of children defined continuity. Reaching the set objectives led to the definition of new objectives.

## Overall Reflections

### Children's progress

**Child 1:** "I want to see if the cork softens in water, as the roll paper does."



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**Photo 18: Child 1 exploring the properties of cork**

**Child 2:** "Our boat floats because it has a large base."

**Photo 19: Child 2's boat**

**Child 3**

Children notice that one sponge floats and the other sinks. So Child 3 says "We must put both sponges dry in water at the same time to see which floats."

**Photo 20: Child 3 exploring the properties of sponges**

## Review of children's progress

- ✓ They had a strong **motivation** for learning and emotionally engaged, because the **reflection** was purely their own inspiration.

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- ✓ They learned and applied **scientific procedures**, such as observation and data recording.
- ✓ Their **evaluations and explanations** were as a direct consequence of their thoughts and actions.

Also, children improved their ability to collaborate; to set common goals and work for them. Children were more concentrated and better able to distinguish the items they were interested in working with. They improved the way they shared their ideas. They understood that by sharing an idea they would improve it. They began to think more scientifically, looking at both 'why' and 'how'. They no longer considered their knowledge for granted but tried to verify it.

**Unexpected outcomes**

- ✓ Fertile **incorporation of children's prior knowledge and experiences** in this learning process and its evaluation.

I did not expect that they could observe and reason for some phenomena and that they would find so many floatation factors, e.g. connections between the pattern and the balance of an object, or when they were talking about the structure of the paper: that the paper has small holes that allow water to pass, while the plastic does not.

**What did children say about their learning?**

- ✓ That they learned to **work as team** having a certain role, sharing their tasks.
- ✓ They recognised the **value of identifying and sharing ideas**. "I have an idea."
- ✓ They realized that **knowledge is built through hands-on activities**, repetition and because of their personal interest. "We see…..we try…….we did it before……..we want……."

They learned how to **design, plan and carry out an investigation**

## Teacher role

1. **Assessment** carried out was more often **formative**. It was **taking place during the activities** and mainly emanated from the children. Firstly I focused on how children drew what they knew or inferred, but later I realized that this was an incomplete way of assessment. So I tried, at first to ask them to remember, to explain and discuss what they think or figure out, both in groups and in plenary. Secondly, I provoked them to read their "notes", their drawings and to observe the photos we took. I realized that these tactics improved our effort to evaluate and assess.
2. As a conclusion, **through questioning and recording**, I managed to realize the essence of children's actions and to promote the **genesis and expression of creative dispositions**.
3. Additionally I found that these assessment approaches promoted children's own **reflection and reasoning** in relation to their actions and acquired knowledge. They better understood the whole learning process and recognized the stages of activity and ultimately the processes of scientific thought.

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4. Finally I realized that their **motivation and affect** were enhanced because they recognized the importance of their own role and action in planning the activities. I choose to give children this role following the principles of child-centered and social-cultural theory.

### Classroom environment

All dimensions of the *spider diagram* are important factors for the exploration and development of children's creativity. Their balanced development is important. However I would emphasise: **the role of the teacher, grouping, time, aims and objectives and content**.

## Reflection questions for the reader

- Is the teacher's detailed design of an activity an obstacle to children's creativity?
- Does assessment affect creativity?
- Do democratic classroom processes enhance or suppress individual creative expression?



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