

Report on teaching activities about light, mirrors, and images tested in Barcelona.

1. Introduction.

The proposed activities on “Light, mirrors and images” presented by the UB were adapted and used in the 1st course (6 years old), 3rd course (8 years old) and 6th course (11 years old) of the CEIP Lola Anglada of Tiana (Barcelona).

In the first course, activities on the “Shiny surfaces and mirrors” proposal and the first activities on “Mirrors and images” were tested. These activities were distributed into 4 modules:

- ? Shiny surfaces and mirrors
- ? Mirrors and images
- ? Projects with mirrors
- ? Presentation of the projects

In the third and sixth course the original proposal was adapted to be integrated in the curriculum of the area “Knowledge of the natural environment”, and therefore activities on technological education and activities dealing with scientific education are combined.

In the third course, activities dealing with “Mirrors and images” (with the exception of the activities on multiple images) were worked on, as well as some aspects on the reflection of light. The third-course activities were distributed into 4 modules:

- ? Luminous bodies and illuminated bodies.
- ? The reflection of light
- ? Mirrors and their uses
- ? The periscope

In sixth course the proposed activities dealing with “Mirrors and deflection of light” and some on “Mirrors and images” were used in the classroom. These activities are distributed into 3 modules:

- ? Characteristics of light
- ? The reflection of light and the periscope
- ? Multiple images

2. Shiny surfaces and mirrors (1st course)

In this module the proposal “Shiny surfaces and mirrors” was used in the classroom, following the guidelines indicated in the proposal and with the basic contents specified in it.

2.1. Timing and classroom organization

The module takes one hour, and the tutor works with the whole group. (The previous day the tutor had asked the children to bring shiny objects from home)

The total number of children of both groups that tested the activity was 20 and 21; in both, the number of girls was slightly greater than the number of boys.

2.2. Brief description of the activity

The teacher shows the objects that the children have brought in and asks them to observe and work with these objects in order to discover and talk about some aspects of their shininess in relation to their superficial qualities and how they are lighted by different sources of illumination.

2.3. Methodological considerations

The module is orientated as an exploration and discovery activity on the characteristics of shiny objects. The teacher asks questions about the displayed objects (like the ones indicated in the proposal “Shiny surfaces and mirrors”) to orientate the children’s observations and also to elicit explanations about what they think.

Sometimes the teacher opens up new fields of exploration, proposing hypotheses and asking for the children’s opinion children about these.

The children observe and work with the objects, venture hypotheses and explain them, and also ask questions and give explanations.

At the end of the session the agreed conclusions are collected and written down.

3. Mirrors and images (1st course)

In this module the first part, dealing with the “Mirrors and images” proposal was used in the classroom; specifically, they worked on the first four basic contents detailed in the proposal.

3.1. Timing and classroom organization

The module goes on for 25 minutes and is divided into two phases of 5 and 20 minutes respectively.

The children in the classroom are organized into groups of 4 that work in corners monitored by the teachers.

3.2. Brief description of the activity

In phase 1, the conclusions of the previous module are discussed. In phase 2, using the teacher’s suggestion, the children work with plastic mirrors, trying to discover which different kinds of mirrors and images can be formed.

3.3. Methodological considerations

In phase 1 of the activity, the teacher encourages the children to discuss the conclusions of the previous module about shining objects. Later she asks the children to work with plastic mirrors, to observe the images and the forms of the mirrors and to talk about what they observe. The teacher talks about some deformations and specific observations and helps the children to discuss what is observed, introducing new words such as, for example, concave and convex.

4. Projects with mirrors (1t course)

In this module the pupils design and put together an open technological project in which mirrors have to be used.

4.1. Timing and classroom organization

The module takes 2 h and 20 minutes and is divided into a phase of 20 minutes and two phases of 1 hour.

During phase 1, the teacher works with the whole group of children and during the other two the children are organized into groups of 4 that work under the monitoring and occasional support of the teachers.

4.2. Brief description of the activity

During phase 1, the conclusions of the previous activity are summarized and written down, and the whole group discusses the applications of mirrors. In phase 2 the different groups choose and draw a device with mirrors that could be useful for anything; and then, in phase 3, they construct what they have designed.

4.3. Methodological considerations

In phase 1, the teacher asks the children questions to elicit their impressions of the last session and writes the conclusions in the blackboard. She also asks the children questions and makes observations about the applications mirrors have. The children intervene with answers and explanations and make a card/sheet with the summary the teacher writes on the board.

In phase 2, the children work in small groups to decide what project they will make, what materials they will use, and they draw it. In phase 3, the children build the designed project. In these two phases the teacher acts as observer and gives occasional support to the children when necessary.

5. Presentation of the projects (1t course)

In this module, the groups present and explain the technological project that they have created and its validity is evaluated.

The module takes 45 minutes, and each group spends between 8 and 10 minutes on their presentation. The children in each group present the device they have made and explain what it is for and how it works. The rest of the children and the teacher ask questions, test the invented devices, and say what they think about its functionality.



6. Luminous objects and illuminated objects (3d course)

The activities of this module have a perspective that is closer to scientific exploration than to technological training. The fundamental aim is to experiment with and make a model of the difference between a light source and an illuminated object and to discuss the characteristics of transparency of a body.

6.1. Timing and classroom organization

The module takes one hour and the tutor works with the whole group of children. The total number of children of both groups of the 3d course is 21 and 22 respectively (65 % boys, and 35 % girls).

6.2. Brief description of the activity

The teacher brings several objects and asks the children to observe and work with them to see if they are luminous or not and whether light passes through them.

6.3. Methodological considerations

On the one hand, the teacher claims that the children express their ideas and on other she proposes that they explore and model the phenomena. The teacher formulates questions and suggests observations and hypotheses to orientate the children's observations. Also, she asks for explanations and moderates the children's interventions. The children observe and work with the

objects, formulate hypotheses and explain them and also ask questions and give explanations.

At the end of the session the teacher summarizes the conclusions, putting up on the board a summary of the concepts and the scientific ideas that have arisen.

7. The reflection of light (3d course)

In this module the dominant perspective is also that of scientific exploration. The fundamental aim is to experiment with and model the behavior of light when it hits the surface of objects and, especially, to experiment with reflection on mirrors.

7.1. Timing and classroom organization

The module is one hour long and is divided into two phases of 15 and 45 minutes. The teacher works with the whole group of children.

7.2. Brief description of the activity

In the first 15 minutes the previous activity is discussed; then, the teacher guides the exploration of different situations regarding light reflection on mirrors and other objects.

7.3. Methodological considerations

In the first phase the teacher uses questions and answers to direct a revision of the experiences and contents worked on in the previous session. In the second phase, the teacher guides the activities of exploration and modelling of light reflection on different objects, ending by focusing on mirrors. To do this, s/he proposes experimental situations, asks questions and suggests hypotheses that orientate the observations and the pupils' hypotheses. As before, s/he also asks for explanations and moderates the children's discussions. The children observe and work with Mirrors and other objects, suggest new experimental situations, formulate questions, and propose hypotheses that serve as explanation to the others.

As before, the session finishes with a summary directed by the teacher, and at this time the children write their observations in their class notebooks.

8. Mirrors and their use (3r course)

The orientation of this module is both, technological and scientific education, and focuses on the kinds of mirrors and its applications and the study of the object-image symmetry.

8.1. Timing and classroom organization

The module takes an hour and thirty minutes and is divided into three phases of 15, 30, and 45 minutes, respectively. In the first and second phase, the teacher works with the class as a whole group. The third phase starts by working with the whole group of children; then, later, the children work individually.

8.2. Brief description of the activity

In the first 15 minutes the previous activity is discussed. Later, the teacher guides the exploration of the different types of mirrors and their uses and, finally, the pupils work individually with the symmetrical inversion of the images.

8.3. Methodological considerations

The first phase is for revising and placing the children in the suitable context, as in the previous session. In the second phase, the teacher suggests observation of experimental situations in the classroom or to revises situations from everyday life to thoroughly discuss the different types of mirrors, what applications they may have, and the places where they are used. The children intervene basically with explanations and new offers of their own. This phase finishes with a summary directed by the teacher.

The teacher begins the third phase proposing that the children observe and explain how their image looks in a flat mirror in relation to themselves (all the children have a flat plastic mirror). Later, she moderates the offers of experiences and the pupils' explanations for modelling the symmetry of the images related to the objects. The children describe and explain the relation between them and their image and make observations and suggest hypotheses. Finally, the teacher asks the children about their observation on the mirrored image of a written text and its reproduction with a drawing; then asks them to write texts that could be seen correctly in a mirror. The children write texts, look at them in the mirrors and draw what they see.

9. The periscope (3d course)

This module has a clear technological orientation and is realized by using the didactic periscope presented in paragraph 3.5 of the proposal "Light, mirrors and images".

9.1. Timing and classroom organization

The first phase of the module takes 15 minutes and the tutor works with the whole group of children. The second phase goes on for two weeks, in periods of an hour in which two children have the didactic periscope to experiment with freely.

9.2. Brief description of the activity

In the first 15 minutes, the teacher presents the didactic periscope and how it works. In the second phase, the children practise in pairs, using the didactic periscope: one of them places an object and the obstacles that prevent the viewer from seeing it and the other one must arrange the periscope so as to be able to see the object.

9.3. Methodological considerations

During the first phase, the teacher presents and explains what the didactic periscope is and how it can be used, encouraging the children to look at it and try to create some assembly. The children observe, work with the material and ask questions. In the second phase, every pair of pupils works freely, proposing situations and finding solutions. The children draw some of the assemblies that they create. The teacher acts only as observer, giving support if it is required.

10. Characteristics of light (6t course)

This module is to revise the experiences and contents on light that had been taught in the previous course. The orientation of the session is basically that of scientific education.

10.1. Timing and classroom organization

The activity takes one hour and the tutor works with the whole group of children. The total number of pupils of 6 t course is 31 (15 boys and 16 girls) distributed into two similar groups.

10.2. Brief description of the activity

The basic contents on light sources, the characteristics and behavior of light, and of illuminated bodies are discussed, looking for illustrative examples.

10.3. Methodological considerations

The teacher acts as leader (raising questions and asking for examples from the classroom or from everyday life), and moderates the pupils' interventions, (summarizing and commenting on their answers and asking for explanations). The teacher writes on the board a summary of the concepts and scientific ideas that come up. The children intervene with answers, examples, explanations (some of which need manipulations of objects the classroom) and also with some questions. They write in their notebook the summary that the teacher writes on the board.

11. The reflection of light and the periscope (6t course)

In this module the reflection of light in mirrors and the technological applications of such phenomena is discussed from the scientific point of view, and the children practise assemblies with the didactic periscope.

11.1. Timing and classroom organization

This module is distributed into three phases. The first and the second have a length of 30 minutes each, and the tutor works with the whole group of children. In the third phase the children are distributed into groups of 4 that work with the didactical periscope for 45 minutes. This phase is done over the course of two weeks.

11.2. Brief description of the activity.

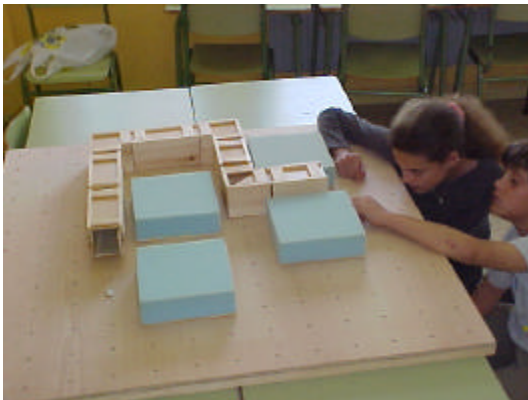
At first, the contents on light propagation and reflection are revised (the kind of mirrors and the images that they give, and the applications that they have). Later, the didactical periscope is presented and the children practice in groups of four.

11.3. Methodological considerations

The first phase is similar to the previous activity, but focused on light propagation and reflection in mirrors, as well as on examples of the applications they have in everyday life. Also, as before, the teacher conducts a summary and writes it on the blackboard and the children write this down in their notebooks

In the second phase, the teacher presents and explains what the didactical periscope is and how it is used, then shows the children how light travels inside the periscope. The teacher also invites the children to observe how the object and its image are related by means of the periscope. The children observe, use, ask questions about, and suggest explanations and object/image relations.

During the third phase, the children practice with the periscope, making assemblies like the ones done by the children of the third course. The children take the cover off the periscope and experiment with how light travels. And after that, they draw their ideas of how they think light travels inside the periscope. The teacher observes them and occasionally asks questions about the relationship between an object and its image.



Nom:

C.M. Natural

Data: 13/5/04

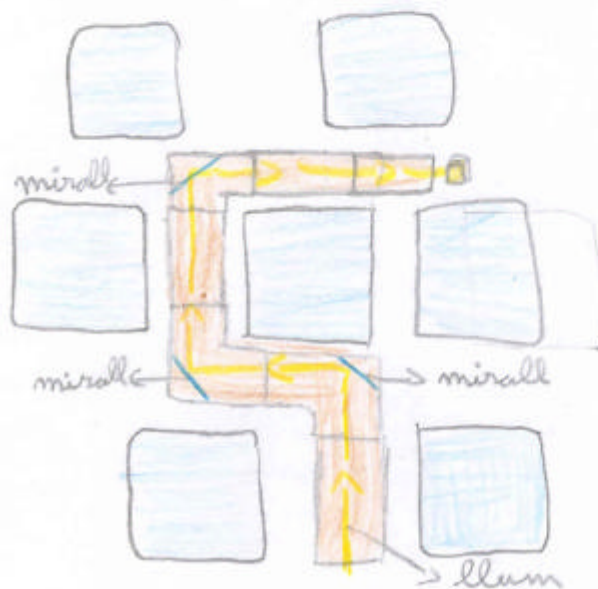
LA LLUM. Activitats

1. Veure un objecte amb el periscopi.

Material: base de muntatge, peces angulars, tubs allargadors, 1 objecte, llanterna.

a) Situeu l'objecte sobre la base de muntatge, poseu-vos d'acord sobre el punt d'observació i feu el muntatge que cal per poder veure l'objecte.

Em posat s'ir obstacle i una maquineta amagada de radera un obstacle. Després em fet un recorregut amb allargadors i angulars fins arribar a veure la maquineta. Quan ho hem mirat semblava que el circuit era recte perquè els miralls reflectaven l'imatge



Nom:

C.M. Natural

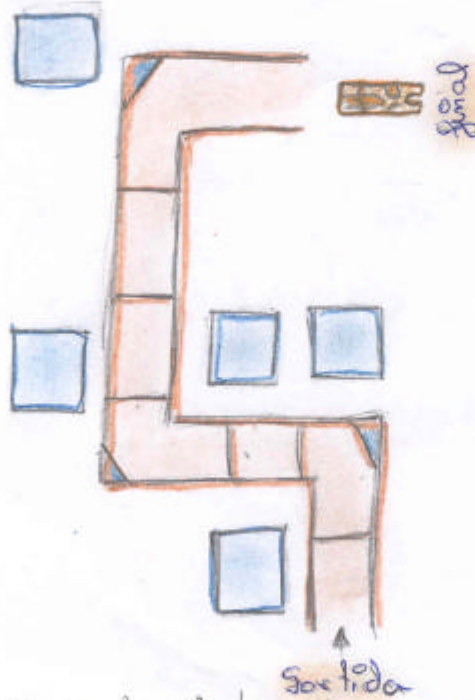
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LA LLUM. Activitats

1. Veure un objecte amb el periscopi.

Material: base de muntatge, peces angulars, tubs allargadors, 1 objecte, llanterna.

a) Situeu l'objecte sobre la base de muntatge, poseu-vos d'acord sobre el punt d'observació i feu el muntatge que cal per poder veure l'objecte.



Hem posat una màquina darrera d'un obstacle. D'espanya
= després hem anan posan allargadors i angulars per arribar
a la màquina. Quan hem arribat em mirat, i es veia el
reflexe recte de la màquina. Hi la forma per arribar a la
màquina es fent curves.

Em fet servir 4 allargadors i 3 angulars.

12. Multiple images (6th course)

This is a practical module of scientific-technical exploration and modelling, in which the children carry out the activities of multiple images proposed in point 3.3 of “Lights, mirrors and images”.

12.1. Timing and classroom organization

The children are distributed into the same groups as in phase 3 of the previous module when practising with the periscope. As in the previous module, this activity is done over the course of two weeks.

12.2. Brief description of the activity.

The children are given two flat mirrors and a small object. They have to explore to see how they can obtain multiple images of the object. Also, they have to relate the number of images with the angle determined by the two mirrors.

12.3. Methodological considerations

In this activity the children work freely with mirrors and have to explain and draw the arrangement of mirrors built and the images they have obtained in each case. The tutor observes and intervenes to encourage activity.

13. Valuation of the activity.

Once the activity had been used in class, an evaluation session was carried out among the teachers. In this session several aspects were evaluated regarding the didactical approach, the children’s answers/response, the teachers’ task(s), and the educational/training value of the activity in relation to technological education.

13.1. Methodological and organisational aspects

The teachers evaluate positively the proposed activities and the materials of “Light, mirrors and images”. The variety and the open orientation of the suggested activities of this proposal have permitted its adaptation to the curriculum previously planned.

The adaptation was a little difficult, especially in 6th course because there were not enough materials in the classroom and because at this time of the year the course is very tightly planned.

Despite the difficulties, the teachers think that the introduction of these activities and materials stimulated both teachers and pupils and represented an improvement in the curriculum in terms of the topic of light. In this sense, the teachers find the basic contents indicated in the proposal “Light, mirrors and images” very interesting, because they aren’t the usual sort found in the

majority of scientific education proposals. They think that this presentation of contents permits a change in point of view about the topic of light.

Also, they found interesting the suggestion of questions, because this helps the teacher to have an orientation in regard to what is important, what is necessary to observe and what is necessary to explain. On the other hand, the fact of making the questions clear stresses the role of the teacher as stimulator of the children learning and reduces the weight of his/her role as someone who answers their questions.

The organization of activities according to small groups, alternating with activities of thinking, discussion and summarizing together in the whole group of children, seems to the teachers very correct. It is the kind of organization they currently use.

Regarding the activities that were carried out in small groups with the periscope, the teachers think that the groups would have to be of 2 children, but because not enough material was available and because they had little time, they were forced to distribute the children into groups of four.

As to the length of the sessions, they think that it was correct. The longest sessions were balanced by combining several kinds of activities and thus did not tax the children.

13.2. Attitude and response of the children.

The teachers evaluate positively the children's interest, especially regarding the activities with the periscope and the mirrors. They consider that there are two reasons for the special interest shown here by the children, on the one hand, this is the kind of activity that is free and easy to handle, and on the other hand, they were surprised about this application of mirrors. For example, to discover that with the periscope, an object that is in a place can be seen looking at another place is very surprising for the children. It is an experience that is very different from the one they currently experience with mirrors: a child in the 3^d course said that the mirrors brought from home were not like the ones in the periscope, they were different because it is only possible to see one's own reflection in them, and this idea provoked a good deal of very interesting discussion among the children.

The consideration of application and the aspects of utility motivate the children very much too. Therefore, the contribution of their personal experiences was very ample and rich. For instance, a girl from the 6th group commented that in some clothing shops there are mirrors that make people slim and so easier convince the customers.

Like the pre-school pupils, in the first level a couple of boys that have difficulties with reading or mathematics were very outstanding in developing the technological project.

Neither the 3rd nor 6th level children had any problem in finding adequate assemblies for the activity about periscopes during pairwork and they always worked in a collaborative way. But the teachers think that all proposals are very similar, the only difference is the number of mirrors that they use. Therefore, there aren't many opportunities for creativity.

As examples of initiative we can point up that a group of third made a vertical assembly of a periscope in order to see what was passing outside the classroom. There was also a sixth-level group that, in a spontaneous way, arranged the mirrors in parallel to obtain multiple images.

Regarding the differences of interest or involvement of boys and girls, the teachers appreciated no difference in either the 1st or 3rd levels. But, in 6th, the teacher thinks that in one of the groups, the boys were a little more active than the girls.

13.3. About the teachers' task.

Teachers had no special difficulties in leading the activities, because the methodologies are similar to the ones they currently use. The only problem was the introduction of these activities into an already previously chosen curriculum.

Regarding the teachers' intervention, the teachers think that it was correct: in the activities with the whole group of children they led and moderated the process, but in the small group activities they left the children to work freely and only observed, circulating and intervening when the children asked for their help.

13.4. About the technical education value of the activities.

The teachers of 3rd and 6th, who worked with the periscope, think that with the activities of the proposal "Light, mirrors and images", certain aspects of technological education were added to a topic that was basically one of scientific education. With the activities made by the pupils, the children discovered materials and their uses, although the proposals would have to be followed with open proposals of application. For example, it would be fine for the children to build their own periscope.

The teachers of the first course think that for the children to develop a technological project that were properly adapted to reality, that it were really of utility was not easier to plan. Some groups didn't try their project before presenting it to the whole group of children and discovered during their presentation that it did not work very well. The teachers think that would it have been positive for the children to have worked with the periscope previously and seen several of its applications (we need to remember that the children of the 1st course had never worked with the didactical periscope at all). Perhaps improved guidance in the project would be necessary by following the steps of the Method of Projects in greater detail and in a more complete way, including practical checking of the constructed object.

2. Obtenció d'imatges.

Material: 1 objecte i 2 miralls.

. Com ho pots fer per tenir dues imatges?

Col·locar els miralls en forma d'angle recte. L'objecte em posat a meitat entre els dos miralls. En obtenir més imatges.

. I per tenir més imatges?

I després en comprovar, que com més petit és l'angle que separa els 2 miralls, més vegades es reflecteix la imatge.

① Dues imatges.



② Més imatges



Vist des de dalt

2. **Obtenció d'imatges.**

Material: 1 objecte i 2 miralls.

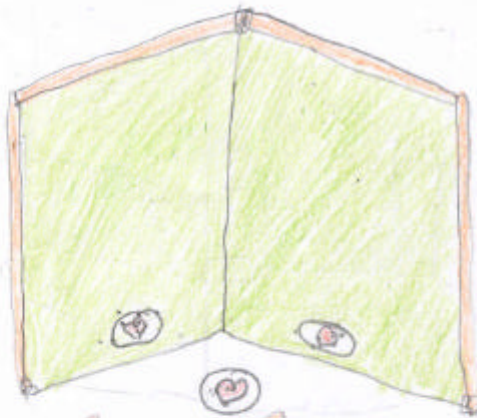
1. Com ho pots fer per tenir dues imatges?

Es pot obtenir dues imatges iguals si com els miralls amb el mateix angle.

2. I per tenir més imatges?

Ficant els miralls mirant-se cara a cara

1..



2..

