TRAINING SESSION FOR AN INQUIRY BASED SCIENCE TEACHING IN PRIMARY SCHOOLS

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Abstract
The report presents the different stages of the workshop and assesses the result.
The aims of the workshop were: first to present a training session for primary school teachers, offering participants to be actors (participants playing the role of teacher trainers), to define a general frame to prepare such training sessions.
The simulation situation aims at integrating the inquiry based teaching method, in keeping with the "hands on" method.

Keywords: Inquiry based, training session for teachers

Introduction: background, purposes and guiding principles
The workshop included 8 participants from different professional backgrounds (primary or secondary school teachers, institutional decision-makers, university teachers, teacher trainers), with varied academic training (scientific or non-scientific), users or non-users of the “hands on” method.
The double purpose of the workshop was:
first, to introduce the inquiry based method to the participants who were to discover it.
Secondly, to define some general characteristics coming up when training non-scientific teachers, so as to work out a general frame which might enable them to set up new training sessions on their own.
A number of research studies have already shown that: "c'est en faisant vivre et analyser aux formés des situations semblables- au niveau des attitudes, des démarches, voire des contenus, - à celles qu'ils pourront faire connaître à leurs élèves, que le formateur aide durablement les formés à intégrer l'ensemble des procédures en jeu" [Astolfi, Develay, 1989] (in French).
This principle, recently referred to as “principe d'homomorphisme” (in French), is presently used by many teacher trainers.
The idea of a simulated training situation is derived from this guiding principle, in keeping with the "socio-contrustivist" (in French) paradigm.
The workshop was to include two different parts, corresponding to each of the purposes mentioned before.
   We could carry out only the first one, for lack of time.

**First part of the workshop: discovering and integrating the method**

The participants are invited to experience a training session for primary school teachers.
   During the session the participants are alternatively required to adopt three different positions.First the participants are in the position of the pupils (learners). They experience learning situations similar to real classroom lessons. This can only be achieved if the teachers agree to do so. This is usually no problem.
   Secondly, the participants are invited to analyse and think about their own experience and feelings during the learning situation.
   Thirdly, they are invited to think how they could transfer the learning situation in a class. Some recorded documents (audio, video or written) from actual “hands on” lessons concerning the activity they experienced previously are then analysed. This enables the teachers to use their new competence immediately. The comparison between their own experience and what came out of the activity in a real classroom situation often leads them to be fully convinced of the validity of the method.

We are now going to describe the different stages of the activity in chronological order.

**Coming up with a scientific questioning**

A challenge is proposed:
   “A child's toy balloon is inflated with a bicycle pump. The inflated balloon is closed with a knot. Is the inflated balloon heavier, as heavy as, or less heavy than the non-inflated balloon ?
   "Justify your answer".
   The participants are invited to give individual answers, in writing.
   All the answers are collected and written on a sheet which will be photocopied and later handed out to everyone.
   The answers collected were as follows:
1. Heavier because there is air into and air has weight.
2. The weight doesn't change, since the weight of the balloon is identical apart from the air in the balloon.
3. Heavier because it is inflated. There is some air into.
4. Heavier because air is weighty
5. Heavier, there is air.
6. Less heavier, because it takes a long time to it to fall.
7. In the balloon, there is some air, so it is heavier.
8. Heavier, it has mass.
(The answers have been translated into English from mother languages in Zlatibor)

We are surprised by the variety of answers. A debate follows, where members with non-scientific backgrounds have a priority. Everybody can give their arguments.

The fact that there were many different mother tongues, which had to be translated into several other languages, was an obstacle to a lively debate.

Two questions emerge from the debate, on which views are divided.
- Does the falling speed of an object depend on its mass?
- Is air has mass?

The participants are invited to leave the first position.

**Analysis of their own experience of the activity**

In this position the participants are supposed to analyse their own experience as pupils (learners).

So as to increase the number of the answers from the group (only 8 participants in the workshop), we added 14 answers, which were given by young French teachers in their first-year of training. In this way we have a set of more varied answers, which enable us to see a pattern in the type of answers.

Eight types of answers (misconceptions) emerge:
- the inflated balloon is less heavy because it falls more slowly. (1)
- the inflated balloon is less heavy because the air decreases gravity. (1)
- the inflated balloon is less heavy because it rises in the air. (1)
- the balloon is as heavy as before because whether the air is inside or outside the balloon, nothing changes. (1)
- the inflated balloon is as heavy as before, because air has no mass. (1+6)
- the balloon is as heavy because air is not solid. (1)
- the balloon is as heavy because when we breathe in our weight does not change. (1)
- the inflated balloon is heavier because air has mass. (2+5)

We can imagine that in a debate with a larger group the arguments would be more varied.

For those who experience the method for the first time, they discover the idea of “misconceptions”. Some characteristics of these “misconceptions” are defined. We observe the benefits for teaching situation of hearing the misconceptions first. We also underline the attitudes of mutual respect and critical view developed in the debate.

**In the classroom?**

Transferring the activity to the classroom raises some questions. A video made in a class of 9 to 10 year old French pupils gives a few answers. The same activity as that experienced by the participants is proposed to the pupils. The debate is led by a young teacher, in the process of training. It is the first time that this type of activity is proposed to these pupils.
The debate in the class is analysed from the point of view of the teaching process itself, and also from the point of view of the role of the teacher in the debate. This analysis points at the similarities but also the differences between the activity with the pupils and the same activity with the adults; between the arguments put forward by children and those put forward by adults. The capacity of children to listen to each other, to ask themselves questions is surprising.

**Inquiry based scientific activity: devising an experimental process and putting it into practice**

The teacher trainer asks the participants to go back to the first position so as to solve the second problem mentioned at the beginning.

The task is phrased as follows:

“Does air have mass? Imagine a simple experimental process to solve this problem. Describe it through a drawing and list the equipment necessary to implement it”.

**Devising the experimental processes**

The participants are divided into four groups.

They imagine experimental processes and present them as a group (cf appendix)

Three groups propose to compare the mass of two child's toy balloons (one being empty and the other one inflated) by hanging them to both ends of a stick, at an equal distance from the point where the stick is itself hanging. A group suggests to take air out of a box by heating it.

A debate about the different experiments suggested, taking into account the necessary equipment, induces participants to alter their experiments.

In particular, the idea of taking air out of a box is encouraged by using a suction pump fitted to the top of a bottle.

**Implementing the experimental processes**

The experiments evolve as they try to implement the process.

Some are technically improved. For example, child's toy balloons are sometimes replaced with basket balls. The different types of scales used are tested.

**Presentation of the experimental processes and of their results to the group and debate**

The experimental processes selected for the presentation are the following:

− Comparison of the masses of two child's toy balloons (one being empty, the other being inflated) by hanging them from both ends of a stick;
− Comparison of the masses of two basket balls (one being fully inflated, the other being hardly inflated), each of them placed on each side of a Roberval's balance;
− Weighing successively an empty child's toy balloon and then the same inflated balloon, with kitchen scales;
Weighing successively the same closed box (first full of air, and then after taking out the air).

The results obtained by different groups vary.

One of them tends to prove that an empty basketball is heavier than an inflated ball, which is obviously puzzling.

Another one (the one using kitchen scales indicates a mass of 0 g for the empty balloon, which raises question of the quality of the scales.

A comparison of the different experiments leads to several types of questions:

- some are about the technique used and raises questions on the quality of the measure instruments: are the scales accurate? What is the smallest mass that each of the scales can measure?
- others concern the method used: what factors vary during the experiment? How can we manage to have only one variable factor?

The choice of relevant experiments is debate: the use of only one container (balloon, box or bottle) is necessary, it must keep the same volume throughout the experiment (box, rigid bottle or already inflated basket balloon can meet this requirement), the scales must be sensitive enough (digital kitchen scales are less sensitive than a Roberval's balance, which is often found surprising).

So, some of the experiments which have been presented are altered so as to become fully relevant. Then we can conclude that “air has mass”.

Analysis of their own experience of the activity

Besides the conclusion that “air has mass”, we emphasise the importance of mastering the method (having only one variable factor), and the technique (allowing for the tare and quality of the scales used). Mastering the method and technique must be considered as part of the teaching purposes.

Devising experimental processes as a team develops attitudes of collaboration, pooling individual ideas and know-how.

Transfer to the classroom

Extracts from a video made in a class are presented. The different stages of the inquiry-based method are identified.

For lack of time, we cannot identify the educational characteristics of each stage (different ways in which the teacher make up groups, role of the teacher). The last stage, which consists in ordering the things learnt and coming out with written material, is dealt with quickly.

Conclusion

To conclude, the principles of an inquiry-based method are listed [M.E.N. (France) 2002]
The principle of invariability:

– The pupils inquire about the real world, a phenomenon or an object, the realm of the living or of the non-living, natural or man-made;
– The inquiry leads to gaining knowledge, know-how, following an investigation carried out by the pupils and guided by the teacher.

The principle of diversity:

– Varied investigating activities leading to more knowledge: direct experiments on the real world, observing directly or through an instrument (to be chosen as often as possible), finding representations, finding information, surveys, visits.

The ensuing debate is mainly about transferring the method to a classroom situation.

Two potential obstacles are mentioned: the necessary time to put the method into practice (which is long) and the minimum equipment required.

For example, the lesson shown in the video took place over six sessions, ranging from 30 minutes to an hour each. On the other hand the session devoted to experiments was carried out with half a class, the pupils of the other half working on their own at the same time. This organisation requires less equipment and makes it easier for the teacher to manage the groups.

Concerning the equipment used in the workshop, in particular the suction pump, it is to be noted that it has been on sale in France only recently (people use it to preserve the quality of the wine in unfinished bottles!). It is easy to build a suction pump by reversing the piston of a bicycle pump, which is easy to get. It is necessary to add a stopper which can be found on an cycle tyre's inner tube.

Second Part

We didn't have time to carry out this episode.

Assessment of the workshops

In their written assessments the participants in the different workshops underline the fact that experiencing the learning situation was interesting. This makes them aware of what is involved in a learning situation as far as acquiring knowledge and know-how are concerned. They particularly enjoyed team work and found it beneficial. When considering how to generalise this method, the obstacles mentioned are: heavy school curricula, therefore a lack of time, and a lack of equipment, and above all exams which assess acquired knowledge only.

Many thanks to all the colleagues who took part in the workshop. The time needed to translate into different languages has made the pace of work a bit slow, as a consequence part of the session couldn't be carried out.

Many thanks to the interpreters who made it possible for me to communicate with non-French speakers.
References


Appendix 1
Appendix 2

- So oliges et sortez de place, comme avant.
- Soz chettres, putes, et vrai, de même.
- Soz ovets, pelouses mortes, et de même, et surtout, du même.
- Soz puce ouz empestas.
- Soz chétrez, empestas:

- Objectif: - Premiers les ovets, les morts, et autres.
- Matériel utilisé: - S bâcles, pelouses, et autres.
- - O bâcles, morts, et autres.
- - Chétrez.

- Mode de faire:
  1. Soz chétrez, inestables, croupent
  2. Soz ovets, pelouses mortes, et de même, et surtout, de même.
  3. Soz puce ouz empestas.
Appendix 3
Appendix 4

- коха
- 2 балона

протокол
- показвамо 2 балона
- надувамо, други не
- веземо балона на края на вага
- поставамо вагу када се уравновесян
Participants during a plenary session and a workshop