

The Mathematics Teacher's Judgment on 'non traditional' Lessons: The Results of an Investigation

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INTRODUCTION

Starting from the first half of the last century, with the fundamental contribution of the studies of Piaget, the conviction that the meaningful construction of knowledge can only come about with the active contribution of the learner was developed and largely shared. The educative process must be adequately ignited by the teacher, but the real protagonist of the entire process turns out to be the pupil; responsible in the first person for the construction of his own ideas.

The constructivist ideas of Piaget, taken up and developed with different emphases by numerous scholars (one thinks for example of the radical constructivism of V. Glasersfeld (1995) or of the social constructivism of P. Ernest (1995) or of the theory of didactic situations of G. Brousseau (1997)) are well known today, having been amply spread through articles on didactic research. Also, in the Italian programmes of 1990 for the upper secondary school, in the "General Didactic Directions" it says, for example, that "the re-evaluation of the rôle of the student as an active subject in the learning process" is necessary and it hopes for "a good methodology of management of the didactic action on the part of the teachers, so as to promote the sharing of the choices and the involvement of responsibility on the part of the students" ([1], pag. 56).

Everything that was said notwithstanding, the scholastic reality of our secondary school classes does not reflect at all, in most cases, and especially during mathematics lessons, the spirit which instead they should possess. Borasi (1996) also, after numerous observations of the U.S. reality, concludes that usually mathematics lessons were carried out in the following way: "First, answers were given for the previous day's assignment. The more difficult problems were worked on by the teacher or the students at the chalkboard. A brief explanation, sometimes none at all, was given of the new material, and the problems assigned for the next day... the most noticeable thing about math classes was the repetition of this routine." ([2], pag. 16).

The explanation, on the part of the teacher, as a central moment of the lesson, that is, the 'frontal lesson' continues, therefore, to be a didactic modality frequently adopted by teachers and it can be maintained that, not foreseeing active participation by the students, it ends with the excessive mortification of the initiative of most of the students. Very often, all this translates into a net refusal of the discipline and the consequent scholastic failure.

The contribution, which I intend to illustrate here, is connected to the didactic modality chosen for mathematics lessons by a group of upper secondary school teachers, in accordance with the results which emerged from an investigation performed during the Specialisation Course in Mathematics Teaching carried out at the University of Pavia in the academic year 97/98. In the form of a questionnaire, the teachers were asked to respond to several questions, among which was the following:

In your teaching experience, have you ever adopted modalities different from the 'frontal lesson'?

If your answer is yes:

- a) Explain briefly the modality used and the related context.
- b) Synthesize the advantages and disadvantages encountered.

If your answer is no, explain why you have never thought it opportune to make this choice.

The question had the objective of analysing if and in which context the participants to the test might have utilized lessons alternative to the traditional ones, as much as to say lessons which are not 'frontal'. It was intended therefore to monitor the various situations which exist today in some classes during the maths hour, but moreover we wanted to understand, by means of the responses to point b, what the facilitations are that can arise and the problems that can come forth with the choice of a 'non traditional' modality. Through the words of the teachers we wanted also to grasp how the teachers conceive their role in the educative process of mathematics.

Therefore, with such an account it can be said that we have "photographed" the reality which effectively lives in class during the mathematics lessons. It is obvious that, since the participants in the investigation were not chosen according to any criteria, that which emerged cannot be considered a completely meaningful statistic, anyway it remains an interesting occasion for understanding that which today happens in some Italian schools during the maths hour and for discovering some teachers convictions.

As regards the characteristics of the group of teachers who participated in the investigation we would like to clarify that they all hold degrees in mathematics, since the Specialization course is reserved for them.

Out of a total of 113 participants, 40 of the responses were disposed of because they affirmed that they had not had any teaching experience or had only been practicing their profession for a short time. It was decided, therefore, to select those who had more than one year's teaching experience, in such a way that the responses reflect an effective scholastic reality. Thus, the responses of 73 teachers were taken under examination, all from the upper secondary school: 21 from scientific high schools, 25 from technical institutes, 14 from professional institutes, 6 six from linguistic high schools, 3 from artistic high schools, 2 from classical high schools and 2 from teacher training schools.

RESULTS OF THE INVESTIGATION

1. The choice of the type of lesson

Examining the responses to the test question, it was possible to verify that 66 participants in the investigation affirmed that they have used, at least once in their own classes, one or more kinds of didactical approaches alternative to the traditional lesson.

The other 7 teachers, who instead declared that they use exclusively the 'frontal' method, justified their choice not really by precise personal convictions as much as affirming rather that they were induced by a series of circumstances for the most part unfavourable to the utilisation of more innovative lesson modalities. According to the majority of those who undertake solely the traditional road, such a choice was declared necessary because of the scarce time at their disposition. As a matter of fact, they are convinced that, during the school year, the necessary time is lacking both for working on the vast programme planned by the Education Ministry and for the carrying out of the written and oral test used to evaluate the students. Thus, they declare that time is for the most part insufficient if the teacher avails herself of a teaching method which is held to be longer and more involved. They also add other factors which worsen the situation, for example: lack of discipline, or scarce interest on the part of the class, or the students' difficulty in accepting new methods, or their own difficulty, because they are not used to involving classes with large numbers of pupils. In one of the responses, for example, we read:

"...I have never adopted different modalities...because initially the time available was so short that the biggest worry was that of finishing or moving on with the programme; then, when the teaching period was lengthened, the classes...presented pupils with particular learning difficulties owing to the lack of a solid base, so attempting innovative lessons seemed to me to be inopportune."

Some teachers, on the other hand, were motivated to choose the traditional didactic approach by the fact of being "green" and therefore not having the base and the necessary ability to avail themselves of methods different from the standard one, acquired during their carrier as students. The following example is meaningful:

"A lesson different from the classic 'frontal' implies a certain teaching experience which I don't think I have yet. So, I preferred not to waste the time available."

2. The Modalities of 'non traditional' lessons

From the examination of the forms compiled by those teachers (66) who stated they had adopted teaching methods alternative to the 'frontal' one, the principal typologies of the lessons indicated were the following, in order of preference:- dialogue lesson (43) - work group (40) - problem solving (21) - rôle reversal pupil – teacher (5).

Now we will try to best characterize the various modalities, describing them synthetically by means of the formulations proposed by the teachers.

Dialogue lesson

The lesson indicated by most of the participants in the test is that of the dialogue kind. As a matter of fact, a good 43 teachers affirmed having given them wide use. This presupposes the introduction of a subject on the part of the teacher who, then following, initiates a discussion, possibly with all of the pupils. Stimulating questions but more over responses, the teacher aims at making the students participate actively in the lesson. One participant in the test, in this respect, expressed herself in this way:

"In this type of lesson contributions are requested from the pupils and participation also on the part of the more reluctant ones while the more interested ones can give their personal contribution."

Another teacher affirms:

"It was asked of the students to propose personal solutions on the basis of their knowledge, helping the discussion and utilizing the possible errors for a critical discussion, pointing out the choice of the most appropriate strategy".

Most of the teachers who utilize such a didactic practice maintain that it can help comprehension. One teacher, for example, affirms that "...one tries to solicit the interventions from the students so that they can acquire an awareness of the contents."

Some say that they use the dialogue lesson exclusively during revisions or for more deeply investigating a subject already treated using the 'frontal' method. One of these, as a matter of fact, affirms having used this kind of lesson "...in the phase of refinement and widening of the subject already partly noted or revising subjects which are preparatory for other parts of the programme."

Still other teachers avail themselves of this modality in the analysis of solutions, correct or incorrect, supplied by the students. Here is an example of two interventions:

"From the collective examination of the responses, possibly imprecise or incorrect, the exact formulation originates spontaneously (but guided!)."

"...one begins, in this way, a sort of educative dialogue between pupil and teacher which is less forceful than the imposition of an explanation without the possibility of reply."

Group work

This didactic modality was used by 40 teachers. After having subdivided the class into groups, more or less numerous and homogeneous, several tasks are assigned which the pupils must do as a group, that is, using the knowledge and the ability of each one. Among the teachers who said they used this work method, 9 use it widely especially during the hours dedicated to the informatics laboratory.

"I assign an exercise to groups of 3 (maximum 4) students. From the exercise, an analysis and the relative application of the language studied is requested."

Another teacher who uses group work in the laboratory writes:

“The work must be carefully prepared by the teacher and never improvised. To avoid useless wastes of time I prepare the cards which the students must complete by answering questions about the work to be carried out with some software (for example Cabri or Derive).”

For some teachers group work is also efficient in the practice phase and for consolidation and recovery of subjects already proposed.

Problem solving There are 21 teachers who declared having proposed lessons using the problem solving method, that is, by means of problems whose solution should prepare the students comprehension of new themes or show better the utility of mathematic. Most of them, who affirm utilising this method sometimes do not specify how they interpret it or apply it in class. Instead, some teachers clarify that by presenting, to the students, a concrete problem tied to their every day reality, they want to try to make the subject, which they have to introduce, more tangible and less abstract. For example, one teacher says: “I propose, if possible, a concrete problem which regards everyday life, where the concept to be treated is necessary for its solution..in this way..the pupil approaches mathematics in a more natural way.”

Contemporaneously, some teachers hope, using this method, to bring the students to be more directly stimulated and therefore to offer personal solutions and to utilise errors for critical reflection. In regards to this, one teacher writes: “Once-in-a-while I begin with concrete problematic situations or ones that originate in the same mathematical environment and I ask the students to supply personal solutions... utilising the error... and underlining the choice of the best strategies.”. One teacher says she uses the problematic lesson since “...the students need to see the practical side of mathematics.”

Rôle reversal pupil - teacher

Five teachers sometimes adopt rôle reversal between the pupil and the teacher. To actualise this modality, the teacher chooses a pupil who, with the more or less consistent help of the teacher, must prepare and teach a lesson and sometimes also examine his classmates on the subject, assuming completely the typical duties of the teacher. One teacher affirms proposing this activity in the following way: “Sometimes in class we play the ‘teacher game’. At the end of a series of lessons, when the pupils should have understood the concepts, one of them is invited to take my place and thus become the teacher (he explains, examines, maintains discipline, proposes exercises...)”.

3. The advantages of ‘non traditional’ lessons Almost all of the teachers agreed in confirming that, independently of the modality chosen, using ‘non traditional’ lessons means obtaining, in class, greater attention and, as a consequence, more intense involvement by the students. One teacher writes, for example:

“Just the transmission of ideas, as clear as they may be (in the teacher’s opinion) does not assure comprehension on the part of the students, often does not stimulate their attention and rarely creates interest and the will to know and overcome an obstacle.”. Another teacher adds: “It is absolutely necessary to “create” some situations during in the pupil feels himself to be the protagonist, has the courage to try a solution strategy for a problem, not be afraid to ask and overall not feel unable.”.

In reference to the dialogue lesson, many affirm that it develops the ability to communicate between the student and the teacher, but also between the students themselves. The pupil, moreover, approaches the discipline more easily, as appears from the following two interventions: “...the child approaches mathematics as a reality to discover and construct, step by step, with his own reasoning and his own intuition.”. “The pupil can feel himself to be the protagonist... overcome the fear of committing an error... The collective overcoming of an obstacle, moreover, makes the reasoning, which made it possible, more evident.”.

One teacher says that the dialogue lesson develops in the pupils “...a research process and autonomous reasoning” and another adds that “it helps to develop in the student the capacity to connect, to analyse the problem, also stimulating the ability of intuition and his critical ability.”.

The dialogue lesson is not only efficient for the children, who develop critical abilities and autonomous reasoning, but also for the teachers, who manage better to comprehend the students’ difficulties, thus being able to adequately programme interventions.

This didactic modality, moreover, encourages the memorisation of the results obtained and it is sometimes useful, as stated one teacher, to help them understand the necessity of “...creating a common language which is precise and understandable to all.”.

The group work has numerous points in common with the dialogue lesson, first among all of them is that it encourages more active participation. One teacher writes: “The group work gets the students used to participating more actively in the lessons and greatly stimulates their logical abilities helping them to overcome their unnatural fear in confronting the material.”.

The group work permits the students to socialise and to collaborate among equals, thus learning to take on the work as a group, to share the objectives and compare them. With regards to this, one teacher states:

“...the group work stimulates the ability of a constructive agreement among the students to never take anything for granted and it gets them used to verifying (and therefore placing them in crisis) their own mathematical convictions.”.

And another teacher adds: “...it encourages socialisation, habituates the sharing of objectives and makes the pupils aware.”.

Often the group work makes it happen that the better pupils help those in difficulty and that makes the first aware and the second are brought to a net improvement. One teacher states:

"...in particular the students with greater learning difficulties manage to overcome some fears, to discuss with their classmates, thus learning to see problems from others' points of view."

Another teacher declares having put into practice this modality "...so that the better students could help the weaker ones since I noticed that sometimes the students manage to learn a concept more quickly and more easily when explained by a classmate rather than by a teacher."

Therefore, group work also turns out to be useful for the students with more difficulties which, as one teacher affirms "...they discover that they are able to follow a particular reasoning or to obtain some positive results."

Those who use the problem solving method maintain that it principally develops the capacity to organise thoughts in a logical-mathematical way and encourages the emergence of alternative solutions. Moreover, with this modality interesting proposals can be initiated on the part of the students who are in a certain sense "constrained" to reason with only the help of their own means.

Beyond that, according to one teacher, beginning with a problematic situation encourages generalisation:

"...the students better manage to follow a particular reasoning when it is not completely abstract, and then they have fewer problems generalising."

Also the rôle reversal between the teacher and the student helps one obtain more participation, attention, more involvement and curiosity on the part of the pupils. Such a method, according to several teachers, leads to less passive learning, makes the students, involved in the first person, more responsible and also those who they assist are drawn in advantageously, improving their ability to comprehend. As one participant in the test affirms "...they feel important and therefore they express themselves better, they are more precise and they are in much more tranquil psychological conditions with respect to a normal interrogation."

4. The disadvantages of 'non traditional' lessons

Almost all of the teachers agree that, whatever lesson modality different from the traditional kind was used, it brought with it an excessive waste of time, slowing down the didactic activity and reducing the consequent carrying out of the programme. With regards to this, one teacher states that "...the lack of time available impedes the realisation of tasks of this type" and another adds that each one of these modalities "...slows down the carrying out of the programme (a nightmare for us teachers)".

The dialogue lesson and the work group are considered difficult to put into practice because if the class is not disciplined there is the risk of creating disorder and confusion compromising also the concentration of many pupils. One teacher for example fears that utilising the dialogue lesson "...could create a confusing and distracting climate." This kind of obstacle is encountered if the students are too numerous and lively and overall if, for the same reason, the teacher cannot manage to control them. As a matter of fact, one teacher admits: "If the class is numerous and/or particularly vivacious it can make the lesson difficult to manage."

The fact of not being able to manage the class reality, according to one teacher, should be attributed non as much to the teacher herself as "... to the ever increasing immaturity of the pupils and consequently to their inability to confront a group work." One teacher admits: "The greatest difficulty that I have encountered is relative to the maintenance of perfect discipline." The risk of this situation, as one teacher specified, is that the lesson "...degenerates into a non-productive operation."

Several teachers are worried both about the organisation required by the work groups outside of the class and for the necessary in class commitment: "...the group works must be prepared and followed carefully to avoid the students getting lost and not concentrating on the desired subject."

Moreover, several maintain that, putting group works into practice, only the abilities of the most capable students emerge: "... often, only the most motivated members truly obtain results from this work."

In this case many students risk becoming passive spectators in facing the knowledge in play, benefiting exclusively from the work of the group-heads: "...the disadvantage can appear when, in a non-homogeneous group, one student monopolises the work and the others follow slavishly."

From these words, another problem encountered by the teachers emerges: that is, the effective organisation of the groups. Forming "right" and homogeneous groups that can work in a productive manner is complicated.

The dialogue lesson also is not seen in a completely positive way in that it can be rather wasteful and can attract the attention of only the most motivated students. For example, one teacher writes that "...sometimes few manage to stay with you, to accept the stimuli, to answer the questions."

During the dialogue lesson it can, in fact, easily happen that not everyone manages to follow and above all participate actively, expressing their ideas on the questions proposed, perhaps for shyness or for lack of a solid mathematical base. For this reason, some pupils slow down, benefiting from the fact that anyway the better ones, with their interventions, keep the dialogue alive. For example, one teacher states: "...some more intuitive and able leaders have arisen while others "imprison themselves" in the passive role of one who never has a good idea".

CONCLUDING OBSERVATIONS

Above all, we can observe that from the words of almost all the teachers it isn't possible to have a completely positive impression of lesson modalities which are alternative to the 'frontal' kind, even from those who have stated that they have used them.

a) The ‘non traditional’ lesson for the first time is accused of “taking away” too much time from the programming. It would be useful to understand what the objectives are that the teachers themselves should propose: rigorously complete the course without any kind of stop, not worry about the effective needs of the pupils, or perhaps lose a bit of that so precious time, using more involved methods, but which are surely more efficacious for learning? If it is difficult to adopt alternative methodologies to manage all the subjects, one could at least try to use them in some situations, with the aim of making some subjects more accessible, of promoting participation in the class and therefore of favouring learning processes.

b) It comes out that numerous teachers, who have been doing their profession for a short time, do not feel able to put into practice a ‘non traditional’ didactic modality since they maintain that they do not possess the means necessary to do so. In their opinion, the lack of experience blocks the use of lessons which are different from the traditional ones. Nevertheless, it does not seem that teachers with many years of experience have less difficulty in adopting ‘non traditional’ lessons and manage to obtain more satisfying results. It can be held instead that the ability to avail oneself of such didactic modalities depends on the awareness and on the professional preparation of the teacher.

c) Many of the teachers complained of the fact of often being prevented from utilising the ‘non traditional’ lesson since this requires students who are: disciplined, favourably disposed to learning, without difficulties and with a solid cognitive base. Unfortunately, such prerogatives, in most cases, are difficult to come across.

It is necessary at this point to reflect on why the students very frequently present notable gaps in their basic preparation. Very often this is the result of a long scholastic period characterised, for such students, by mental laziness, indifference and disinterest. We should not forget, however, that it is the same teachers who are responsible, in large measure, for this situation. In reference, then, to the problem of discipline, it seems to us that some teachers have set aside, if not forgotten, their rôle as educators; as important and necessary as that of teachers. It is the same teachers who should be able to obtain appropriate behaviour on the part of the students, making them responsible for their rôle as learners and thus developing favourable conditions for the process of teaching – learning. From what is read in the protocols of the teachers, it does not come out at all that they feel responsible for the disinterest of their students.

If, therefore, the teachers find themselves in such a situation, in front of students who are little motivated or with difficulties, they should not renounce alternative strategies, because perhaps exactly in this way they can help their pupils both re-ignite their interest by means of active involvement and take another look at the disciplinary contents by means of a continuous class confrontation.

d) It has also been noted from the responses given by the teachers that the complete carrying out of the programmes is a real and present nightmare. The fact that many teachers maintain that the ‘non traditional’ lesson slows down the process of the programme makes it clear the conviction that on the other hand the traditional lesson does not slow it down at all. Surely, it would be more convenient to explain the subjects on the board in a rapid manner, without interruptions on the part of the students, obviously attentive, discipline and motivated, transferring to them all the pre-planned notions without getting in the way of the professor’s work.

What then is the task of the teacher, the duty which the teachers hold as priority? From what emerged in the test, it has to do with the development (at the board) of the entire programme, certainly not with the construction of an environment in which each pupil in the class is cognitively involved. Therefore, the idea of teaching as conveyance of knowledge, of the pupil as a “clean slate” and of the teacher as transmitter of culture is still extremely rooted in many teachers even if they try different approaches when they recognise the need to improve.

In conclusion, we can maintain that the teachers who participated in the investigation are still, for the most part, very insecure in the use of new didactic modalities. The main reason could be in their professional training, too tied to traditional ways of conceiving of teaching as a transmitted knowledge model. Until this model has been placed in crisis in its entirety, it will be difficult for the scholastic situation to evolve toward a greater acceptance of responsibility by the pupils and toward a teaching – learning process more productive and more satisfying. Fortunately, that is what is happening in Italy, even if only recently (1999), with the activation of a law (passed in 1990) which foresees, for teachers of all pre-university schools, a two-year plan of specific pedagogical, psychological and didactic courses, beyond the usual disciplinary preparation. In this way, it can be maintained that the constructivist ideas shared in the research can truly translate themselves concretely in the daily practice of the mathematics lesson.

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