WATCHING VIDEO-RECORDED SESSIONS AS A SUPPORT IN THE CONSTRUCTION OF A SHARED "CLASSROOM CULTURE"

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Résumé.

Dans cet étude nous considérons les difficultés des élèves quand on a des changes dans la leur situation d'apprentissage. Ça peut venir dans le passage d'un niveau scolaire au suivant ou dans l'approche à un different degré d'abstraction, de généralisation, comme dans le cas, par example, de l'introduction à la preuve. Entre les stratégies que nous avons envisagé pour surmonter ces difficultés nous considérons particulièrement efficace: - projeter des milieux d'apprentissage qui peuvent favoriser la continuité cogntive, - créer une ambiance dans la classe fondée sur la comunication des idées et des expériences.

Les moyens pour réaliser cettes stratégies que nous présentons ici sont la discussion en classe dans laquelle l'enseignant joue le rôle de modérateur et l'analyse de cettes discussions avec des vidéos. Cette analyse nous semble utile soit aux élèves pour les adresser à la métacognition soit aux enseignants pour refléchir sur leur action didactique.

INTRODUCTION

Students usually feel the transition between different sectors of education to be very difficult. There are a number of factors related to cognitive and environmental aspects, whatever the subject, which create differences in the learning contexts of these different sectors. The epistemological discontinuity that characterises some specific topics which are taught throughout all the school levels adds to this.

In Italy the transition from compulsory schooling (6-13 years old) to post-compulsory education (14 -18 years old) has always carried problems due to discontinuities. There are two main features. First, the shift from a child-centred didactic focus to a content-centred teaching that is focused on the learning of concepts and their applications. Secondly, the shift of focus from activities based on creativity and freedom of expression (e.g. brainstorming activities) to the assessment of the acquisition of very definite contents.

We believe that a smooth transition from the one sector to the other can be achieved by:

- Paying attention to affective aspects of students' behaviour, even in secondary school.
- Planning learning environments that can support a cognitive continuity so that the epistemological discontinuity of some subjects can be managed without too many troubles.
- Providing a "classroom culture" by means of sharing students' experiences and knowledge.

This paper discusses some crucial aspects concerning the second and third point. In particular we intend to investigate two objectives.

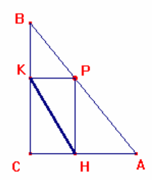
First, we present an example of a classroom activity that supports the production and validation of conjectures; it is based on an open geometric problem to be solved by small groups of students in the classroom. This activity relates to the research project we have been working on for some years now, which is aimed at identifying and planning learning environments that can support a kind of cognitive continuity in the transition from argumentation to proof, so making the epistemological discontinuity manageable by students [2, 3, 4]. Our claim is that a cognitive continuity in the transition from argumentation to proof can be constructed through the activity of producing and validating conjectures.

Secondly, we intend to make clear the need for identifying means and techniques that foster the construction of a shared "classroom culture". This should be one of the objectives of any teaching and learning process. Students should always be able to share experiences and knowledge, both when they undertake the passage from one school sector to another, and whilst in the same school sector. As a matter of fact, it often happens that experiences that are relevant for teachers and for some students are not so much important for the rest of the class; this situation does not allow the creation of a common classroom experience and culture, upon which knowledge can progress. Therefore, whenever teachers refer to an episode taken from the past life of the class, it is likely not to have the expected and wanted effect, as the students may have forgotten everything about it.

THE "PROBLEM BY ARSAC"

A problem was given to a classroom of 16 years old students in the Liceo Scientifico "Issel" in Finale Ligure (Italy), in which one of the authors is a teacher. This problem is well known and it has been analysed from the didactical point of view by Arsac [1, p.48].

> You are given a right-angled triangle ABC, AB being the hypotenuse. Take a point P on AB. Draw the parallel lines to AC and BC through P. Name H and K the points of intersection with AC and BC respectively. For which position of P does the line HK have minimum length?



The problem was chosen because of the variety of solution strategies it offers, allowing students to exploit knowledge and techniques previously acquired (e.g. synthetic and analytic geometry).

The classroom activity was divided in two parts. First, students were divided in groups (three students per group) and were given one hour to try and solve the problem. Then a student from each group presented the group solution in front of the whole class; a classroom discussion orchestrated by the teacher allowed the students to compare all the strategies.

During the first part of the session, the teacher intervened only if students required his help, making sure to foster discussion among students and not to close the debate.

The whole session was video-recorded and watched during the following class.

The groups were chosen according to the following criteria.

- avoiding the presence of very extrovert and very introvert students in the same group, in order to foster group discussion;
- putting in the same group students who are happy to work together and used to do it, in order to provide a friendly atmosphere;
- providing the same level of students' achievement within a group, in order to avoid very good students providing the solution too quickly and to let everyone take part in the process.

We observed a variety of solution strategies and means of working co-operatively in groups.

In the following section we present a description and analysis of students' group work done by the three authors on the basis of the video and fieldnotes taken during the session.

AN ANALYSIS OF STUDENTS' GROUP WORK

Group 1: Camillo, Silvia, Ivan.

The three students sit together but work on separate papers. They feel the need of working on their own first, and they communicate only in case they need help. They do not believe in the richness of group work compared to individual work.

Regarding the solution to the problem, Camillo, Silvia and Ivan exploit many different strategies. They use ruler and measures; they work a lot with the equivalence of areas. They do not use analytical geometry at all. They are not able to provide a solution by the end of the group session.

Group 2: Marta, Tatiana, Elisa

This group shows a totally different modality of working. Marta, Tatiana and Elisa tackle the problem together. They write on one sheet of paper, they all speak in turns, paying attention to what the others say. This group can be considered a co-operative one [5]: the students are aware of the fact that everyone can and should contribute to the solution of the problem, and that sharing and comparing strategies and ideas is much more productive than working alone.

Elisa, Marta and Tatiana start with considerations in synthetic geometry: Elisa draws the diagonal PC of the rectangle CKPH. However this path is abandoned in favour of other ideas, mainly exploiting analytical geometry. Only at the end, they go back to the initial idea; the solution the group provides consists of realising that HK equals PC, because diagonals of the same rectangle, and using the fact that the distance of a point from a line is the length of the segment joining the point to the line and having minimum length.

In this case we might think that such a strong co-operation caused a delay in the final solution, due to the very soon abandonment of Elisa's idea. Perhaps, in a competitive group Elisa would have pursued her strategy and solved the problem more quickly.

<u>Group 3: Mauro, Luca, Claudio</u>

Mauro, Luca and Claudio find co-operation extremely difficult. Luca and Mauro work on their own and come to two different solutions. Eventually, Claudio, who seems to suggest a sort of collaboration, shows the equivalence of the two solutions. This is a typical pseudo-learning group [5]: the students work together but they are not interested in doing it, they are very competitive, they hide useful information and they do not trust their colleagues. Such a group might be of no help at all to students; it could even diminish the potentiality of individuals.

In solving the problem the students begin by considering particular cases and using measures in a dynamic way. Luca uses the ruler and moves it in order to show how the length of the segments varies. Mauro suggests the final solution they come up with. He considers a pencil of circles centred in C and going through P. The circle whose radius is minimum is the circle tangent to the segment AB; therefore HK has minimum length when P is the point of contact (point of tangency) between AB and the circle centred in C. This idea came from applying Pythagora's theorem to the triangle PHK, in a system of Cartesian axes centred in C, which produced the formula $\sqrt{x^2 + y^2} = d$.

<u>Group 4: Vittorio, Greta, Alessia</u>

This group shows co-operative work. Our observations reveal the great potentialities of the discussion in small groups: for example Alessia uses her hands a lot, in order to tell the others what she is thinking. Individual problem solving wouldn't allow such an activity, therefore many communication and listening strategies, which play an important role in this phase of the solution process, would be lost.

As far as the solution is concerned, the students begin with synthetic geometry first, and then they switch to analytical geometry and explore extreme cases. They perform dynamic explorations, especially Alessia, who moves her hands on the figure in order to show what happens when the point P moves on AB. In our opinion, these dynamic explorations might be favoured by the work in small groups. At the end they provide the same solution as group 2.

<u>Group 5: Claudia, Monica, Michela.</u>

The students seem to co-operate. However a deeper analysis of their work suggests it is a traditional learning group [5], that is students agree to work together, but they are not organised in the division of tasks; they know they will be assessed as individuals and they are not interested in a learning exchange with their colleagues. Their way of dealing with the problem would probably be the same if they were working on their own.

Claudia, Monica and Michela are not deeply engaged with the new kind of work they are required to do (conjecturing). Their desk is covered with traditional learning tools, e.g. books, notebooks, ruler, compass, calculator. These students seem to rely on these tools in order to find a solution. They spend a lot of time in browsing books in order to find any useful information related to the given task. At some point, Michela says "do you remember that time we studied…", referring to a topic studied the previous year. They do not follow a precise strategy and they can't come up with a final solution by the end of the session.

WATCHING VIDEO RECORDED SESSIONS IN THE CLASSROOM: SOME REMARKS.

First of all, we believe that video-recording sessions and therefore analysing a lesson or some parts of it, as we did in the previous paragraph, can be a powerful instrument: it is a means of metacognitive analysis from both students and teacher; watching the video in the classroom allows a detached and critical analysis of behaviours.

Another important issue concerns the possibility of creating an 'echo' of the most significant voices that emerge during the classroom discussion orchestrated by the teacher. This potentiality of the videos provides the construction of a common classroom experience. When the teacher refers to a situation (teacher's explanation, a student's intervention, an exercise,…) which has been not only experienced, but also watched, analysed and criticised by the students themselves, the impact on students can be very different from reminding them a situation which has to be reconstructed only through memory. In the first case the situation provides a basis for the construction of a shared "classroom culture", upon which building knowledge.

In the classroom activity we described in the paper, two significant episodes in the discussion, were pointed out by the teacher when analysing the video in the classroom with the students: the relationship drawing/figure in geometry and the dialectic synthetic/analytic geometry. During the discussion, one of the students says: "*By using Euclidean geometry we can draw a figure, while using analytic geometry we can determine the position of the point P […] with analytic geometry we are able to find the exact position of P, while Euclidean geometry would require the use of measures".* Camillo goes on *"Euclidean geometry comes first, then analytic geometry. Analytic geometry wouldn't exists without the Euclidean one, because a triangle can be thought of as a figure, and not as co-ordinates, formula, equations".* The two interventions gave raise to a debate, which continued in the following sessions and is still open. This debate is still alive in students' mind as a research question aimed at defining the terms synthetic/analytic geometry and drawing/figure in geometry precisely.

In our opinion, watching and analysing video-recorded sessions, pointing out the most significant episodes, contributes to keep alive that sort of mathematical debate, which plays a fundamental role in the mathematics class.

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