Perspectives In Analysing Classroom Interaction Data On Collaborative Computer-Based Mathematical Projects

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Abstract: In view of the potential of CSCL for educational innovation, this paper illuminates some aspects resisting the development of quality social interaction in pupil collaboration. A study is reported where pupils worked in small groups in computer-based classroom activity within the framework of a six year-old innovation program in a primary school. A combined ethnographic and discourse analytic model is used to describe group dynamics in four groups of pupils (aged 8-11) involved in tasks of exploratory learning. We analyzed the data taking three distinct perspectives, a personal or insiderís perspective, an interactionist perspective and a social norms perspective. The former revealed the pupil to be a person who seemed to perceive the society within which he/she was called upon to act, as a forum in which to claim and defend his/her social role. The interactionist perspective brought forward the issue of role negotiation and its overbearing presence in social exchange in the form of groupthink, role confusion and vagueness. Finally, the group and classroom social norms, which seemed to have emerged as functional within these societies, had a judgmental character.

Keywords: community setting, discourse analysis, project - based

Introduction

This paper discusses primary school pupilsí small-group interaction in computer-based classroom activity after six years' application of an innovation program in their school. In this study we sought to gain insight into what impedes the development of quality social interaction in collaborative pupil groups in a setting where a loosely controlled school innovation had had time to settle into school life. In analyzing observation data, we progressively became aware that restricting ourselves either to a cognitive - oriented individualistic approach, or a Vygotskian socio-cultural one regarding the interaction between individuals of non-equivalent maturity, would not provide us with the explanatory framework we were after. We thus applied alternative foci onto the individualís perspective, the interactions within the group, and the social norms in the classroom taking also into account the broader context of the Greek educational system which supports individualized learning and competitiveness between pupils. We discuss emergent perspectives as a means of approaching learning as a culturally based activity situated in context and in history.

Emergent perspectives

Prior to the research described here, we had focused on cognitive - oriented individual learning processes (Kynigos 1992) and on the problem of infusing open - ended pupil centered activity in schools within the context of the Greek educational system (Kontogiannopoulou - Polidorides and Kynigos, 1993, Kynigos, 1995). From these studies it became apparent that while at the background of our attention, pupils' social interaction within their working group and in the context of the classroom played an important role in individual understandings. It also raised new issues regarding the ways in which discourse and practices established through the evolution of the Greek educational paradigm influenced the social dynamics of the classrooms within which this activity took place. Thus in the attempt to explain the educational setting we have been observing we progressively found the need to approach the data with alternative perspectives. Yackel and Cobb (1996) have developed a similar methodology during a decade of research, calling it "emergent perspectives" in order to emphasize the methodologically evolutionary aspect of their research. In our attempt to describe this process we are finding it useful to address pupil interactions within their groups taking three distinct perspectives; looking inside the group, studying classroom norms and taking into account how groupwork is perceived in the wider picture of the educational system in which the study is taking place.

With respect to the first perspective, very little research has an explicit framework for collaborative learning processes, i.e. understanding the nature of learning in collaborative settings both at the individual and at the social level. Theoretical perspectives have been greatly influenced by attempts to draw from or to synthesize Piagetian views of individual learning and Vygotsky's socio-cultural paradigm (Light and Mevarech, 1992). Both Piaget and Vygotsky, however, do not focus on a theory for learning by doing *and* communicating with peers as a culturally based activity situated in context and in history.

With respect to the second perspective, a problem in encouraging collaboration is the need to take into account the dynamics of the school classroom. Classroom ground rules usually require pupils not to talk to their peers and to respond to teacherís questions quickly and correctly. To establish classroom norms (Cobb et al, 1992, Swartz and Herskowitz, 1997) that encourage and value a social mode of thinking (Mercer, 1996) is still a task and has only had positive results in experimental situations. The Spoken Language and New Technology Project is an example (Mercer, 1996), elaborating teachers' attempts to make explicit some ground rules such as, for instance, in negotiating the classification of animals into herbivores and carnivores, asking the pupils to decide between them which is which, to listen to the other person and ask them to give reasons for agreeing or disagreeing.

These above issues could well be a symptom of the third problem in achieving effective educational outcomes from groupwork situations; seen through the lens of a systemic approach, groupwork is not something which can easily fit in schooling since competition, individual achievement, lack of opportunity for reflection and negotiation and emphasis on information reproduction are central facets of school systems

(Scardamalia and Bereiter, 1994). New perceptions of schooling thus need to be cultivated allowing for conditions where groupwork is accepted valued and evaluated (Hoyles, 1993a, Roschelle, 1994). Before this process is underway in large scales, educational achievements will only involve tightly controlled and small-scale situations.

The Research Setting

In 1986, a project began in a Greek primary school involving the use of computer technology for a weekly "investigations" hour from year 3 to 6. The researcher played the role of teacher educator and consistently held seminars at the beginning and the end of the school year and meetings of a varying frequency during the year. The project set off explicitly focused on the idea of providing pupils with the opportunity to collaborate in small groups, gain some autonomy from the teacher and become more active in their thinking, constructing and problem solving (Kynigos, 1992). This was socially mediated and agreed upon by the school's direction and staff and all teachers took part with their own class. They used Logo as a means of expressing mathematical ideas, constructing and experimenting and later on used a word processor and a drawing application for composing reports on their projects (previously they had written the reports on paper).

This type of innovation and experimentation at school level is not at all typical within the highly centralized Greek Educational system. All schools follow the national curriculum laid out in one book for each topic produced by the Pedagogical Institute. It is useful to perceive the project as happening within the Greek educational paradigm (Kontogianopoulou - Polidorides, 1996), part of the central European paradigm that has been characterized as encyclopedic. Kontogianopoulou - Polidorides suggests that the notion of Educational Paradigm is useful in supporting the interpretation of educational practice and juxtaposes the central European one to the U.K. based essentialist and the USA based pragmatist one.

Research Questions and Method

Within the above context, we aimed to analyze the dynamics of classroom collaborative activity in a system, which primarily supports individualized learning and competition at school (Kontogiannopoulou-Polydorides & Kynigos, 1993). The significance of the study stems from the fact that it integrates a personal or insider's approach to study the pupils' own perspective of collaboration and groupwork in the computer based learning environment, with an interactionist and a socio-cultural perspective.

A randomized sample of 12 pupils (6 boys, 6 girls) of the third (aged 8-9) and the fifth (aged 10-11) grades of the school was selected for this study. These pupils were observed during their normal activity in the classroom and detailed visual and audio data of the computer screen, their actions and their talk was collected. By following a time series analysis protocol, we analyzed the work of the 4 groups of pupils comprising the sample (2 in each grade, 3 pupils of the same gender in each group) for approximately a month and a half. Pupils of the two grades had had prior experience with the computational environment within the school program for 5 months and 2.5 years for the third and the

fifth grade respectively. Each group was videotaped for a period of one investigation (5 to 6 meetings of 1 working class hour each) and their verbal interaction was transcribed.

The study aimed to investigate the following research questions:

- How do members of the group perceive the role of themselves and of their peers during their collaborative activity?
- How do members of the group perceive their social interaction and collaboration in the context of the computer based environment?
- What is the nature of the classroom and group social norms regarding collaboration and criteria for positive and negative social behavior?

A combined model of ethnographic (Hammersley & Attkinson, 1995) and discourse analytic work -as applied in social psychology (Potter & Wetherell, 1989)- was used for analysis of the data in this study. The ultimate purpose of the above combined model was to understand how members of the groups feel and communicate their experience at the level of language behavior. The following section is structured so that the three levels of analysis in our emergent perspective are portrayed, i.e. a personal perspective of the view of the self and the interaction of the self with the group, a perspective of the social interaction within groups and a search for the social norms developed within groups and in the classroom. Transcript Excerpts illustrate the interpretative process and have been chosen as representative episodes in relation to the respective issue at hand.

The characteristics of social interaction within groups

Groupthink

All groups in our cases seemed to strive to project a group identity in their communications with the outer world (teacher, classmates, videocamera). However, they rarely engaged in communication or actions towards organizing their thinking and coordinating their activities as a group in a systematic and coherent way. Members of all groups seemed to lack the ability to structure their efforts and communicate their intentions and ideas to the other members of the group. Instead, they seemed to strive to prove themselves and pursue leadership goals within the group by keeping their thoughts for themselves and waiting until they get the role of controlling the keyboard. The term groupthink (Janis, 1982) describes the phenomenon in which members of a group strive towards consensus in their decisions while they fail to evaluate in a realistic way all the options and alternatives available during their decision making. We found this notion relevant to our observations with respect to the extent to which pupils gave too much priority to achieving consensus, so that it actually hindered deep inquiry, exploration or effectiveness in relation to the task at hand, both individually and for the group as a whole.

E: Hey guys what will I do? (they wave her aside) Hey, I do not want to do this - there's two against one.
D: OK, sorry. Shall I say something?
M: Let's make a picture frame and something inside it.
D: Think about doing something easy but complicated at the same time - and think about this now.
M: A cake.
E: What?
M: A cake (picks up a pen to draw it).
E: Wait a minute wait a minute (stops M from drawing).
D: Stop you guys (turns to E) wait a bit.
E: What is this, mate? (Condescendingly)
M: (laughing) A cake.
E: Get out of here! I say a cat, which is dead easy, first a little circle then another circle one of these.
D: Can you do this?
E: Yes.
D: OK, do it, go on then.
E: OK. Shall I sit? (at the keyboard).
D: OK, good, M get up. But I'm going to be writing the commands while you do it ok?
E: You'll be telling me too ("graciously" inviting them to join in).
M: Next time I'll be the one on the keyboard! (addressing E)
At the end of the investigation:
(The girls read their project report in front of the class)
We chose to make this design (a cat) because cats are beautiful, sweet, and lovely.

Excerpt 1: Groupthink

Excerpt 1 illuminates the way in which a group of fifth year girls finally decided to make a cat for their project. M was sitting at the keyboard and had assumed she would have the role to provide ideas on what to construct. E intervened ready for dispute, demanding to be given a role. D, who had the neutral role of keeping a record, began by asking M to find something which would enable trouble-free undemanding activity and would be spectacular to the outer world at the same time, insinuating that M had not done so up till that point. E seemed to inadvertently use Dís comment to continue claiming a better role, by both criticizing M and making a well-argued proposal in line with Dís set of criteria. This intervention interrupted M, who was in the process of drawing her suggestion (a cake) on paper. When E confirmed she could easily construct the cat, both D and M agreed. We suggest that, in different ways, D and M conceded to E so that both the immediate oncoming dispute would be resolved and so that what the pupils perceived as potential source for later dispute (deciding on an unclear or difficult task) would be avoided. The reason given later and in public for choosing the cat was completely different, not revealing the real criteria or the alternative arguments.

Role conflict and vagueness

In every structured society, collaborative activity towards a common goal is characterized by the individualsí adoption of a role. According to a groupís structure members of the group are supposed to behave in certain ways that contribute to the fulfillment of the groupís expectations and specific goals (Biddle, 1979). In our study, the three pupils in a group were supposed to take the following roles by rotation: keyboard controller, record keeper (the person who writes down commands given to the computer and decisions made by the group), and activity controller (the person who checks the execution of commands on the computer).

S: (talks to K who's regained his position at the keyboard after pushing S away) You've put...
K: OK, OK.
S: Without being able to see where it is (turtle has been hidden).
K: (grabs the writing book for which S is responsible and writes down the next command) BK 12
S: Now, what's left is...
K: Clear Screen (V whispers something to him) Go away.
V: You go away, get on with it, you're not going to type everything yourself, go on, get up, you got it?
K: (acts as if he's ignoring this and talks aloud the commands he's typing in) and now the flag's perimeter.
V: We'll tell Miss - you're not going to type it all in yourself.

Excerpt 2: Role Conflict

However, although there was a role distribution for each group at a theoretical level, all groups experienced the problem of role conflict, as is apparent in Excerpt 2. K takes advantage of his control of the resource to ignore Sís comment, impose the next move by both executing a command and writing it down in the book, suggests a sweeping clear screen command when he observes an unsatisfactory result, and fights off the increasingly stronger claims made by both S and V, on his role in the group. S joins in the dispute by means of giving K directions while V explicitly confronts the role issue threatening to bring in the teacher as referee.

Role conflict in each group mostly took the form of a resource dilemma (Pruitt & Carnevale, 1993). In other words, all the members of a group would find a reason to claim access to the same resource (keyboard controller role) at the same time. The role conflict in all groups was resolved, implicitly or explicitly, in one or more of four ways: (a) *role rotation* : more than one member of the group performs the task during the meeting, (b) *role sharing:* the task of controlling the keyboard is split into two or three parts (one types a number and the other presses the Return button), (c) *role suitability*: members of the group who have the most appropriate skills (good perceptive and

comprehensive skills, speed in typing, good knowledge of Logo programming, creativity, leadership capabilities) have more chances to undertake the role on a more frequent basis, and (d) *role assignment* : role is assigned to group members by the teacher or the physical leader of the group. Role conflict within groups was manifested mainly in the following ways: an increased tendency for criticism (task relevant, person relevant) among members of the group, poor quality of the group product, lack of satisfaction from the part of group members regarding their participation in the group, feelings of anxiety and social pressure during performance of the keyboard controller role (the group transmits its anxiety to the keyboard controller who then passes it to the computer, by e.g. pressing or hitting the keys with more strength than necessary).

Role vagueness within groups (Fortsyth, 1990) was a corollary of role conflict. The keyboard controller often performed all roles within the group, as in the case of K in Excerpt 2. The other two members would also show confusion by either being more passive in their respective roles or in their general contribution to teamwork, or alternatively, by taking on roles besides their own. The problem of role vagueness in all groups was usually resolved in the following ways: (a) teacher intervention, (b) role diffusion (group members undertake more than one or two roles), and (c) role distribution (the physical leader of each group defines and distributes roles to group members).

Excerpt 3 illustrates members of a group negotiating their roles in the group as well as the feelings of pressure and anxiety experienced by the keyboard controller.

A: ..let me sit there (on the chair where the keyboard controller sits)
B: I will type also (Logo commands) though, is that OK?
A: You will both help me, OK?
C: (towards A) But next time I will be there (sitting on the chair in front of the computer)
A: Yes, of course
C: Now, you lose your turn for next time
A: Yes
B: That's right, isn't it?
A: I won't be alone; you will help me

Excerpt 3: Role Vagueness

Even though, according to their rotation system, it is Cís turn on the keyboard, A uses the fact that she has just had an idea on what to do to claim the role despite the fact that it is not necessary for her to do the typing. B notices the disruption and claims part of the role herself instead of making a comment to re-establish order or to accept the new situation. C, on the other hand tries to refer to the rotation system to secure she will get her fair

share even if it means she will have to wait. In order to avoid hard feelings, A offers part of the activities belonging to her role on two occasions.

Group and Classroom social norms

Apart from the personal perspective and the interactive perspective of individuals within the group, we found it illuminating to analyze the data with respect to the group and the classroom microcultures, i.e. the implicitly or explicitly commonly accepted, or, as Yackel and Cobb (1996) put it, "taken-as-shared" views on processes, actions and products. We were at this point interested in identifying which of these had emerged in the two societies as the most explicitly functional, i.e. what the societies themselves had put into action. Within this framework, we felt that the most representative way to describe them was in terms of what was commonly taken as "positive" and "negative" social behavior. In this analysis, we use the term "social norms", choosing not to use subject matter as a discriminating factor between norms as in Yackel and Cobb, 1996 and Swartz and Herskowitz, 1997. This does not mean we did not take subject matter or computer use into account, but that the discrimination of norms specifically related to these was not in our focus. The following set of observations was useful in identifying group and classroom social norms.

There seemed to be a distance between social norms in this computer ñ based classroom activity and in the traditional classroom activity within the wider framework of the educational paradigm. Serious classroom work is based on the acquisition - rather than the construction, emergence or discovery - of knowledge, concepts and rules and in activity closely directed by the teacher. According to the pupils, the teacher seems to be there to provide information and solve problems so that activity can go on and to assess the accuracy and speed with which pupils can respond to teacher-initiated questions. We suggest that there was a natural tendency to avoid confrontations with situations requiring deep thought, accepting uncertainty, experimenting and exercising creativity and instances where the teacher tried to encourage these, instead of providing the technical means to avoid them, were not understood. Since pupils lacked wide and lengthy exposure to the concepts, practical skills and role models for effective collaboration and how it works, collaboration at a group level seemed to take the form of individualistic coexistence and interaction characterized by role confusion. Criteria of positive and negative social behavior thus focused from the outside in. The principle of ëonly what can be seen matters, not the substanceí dominated the attitude of all groups. In fact, it seemed that the social norms related to positive and negative social behavior had emerged from a background characterized by low frustration tolerance and impatience.

The norms which seemed to dominate social interaction both within groups and in the classroom were as follows. At a group level, the criteria of positive social behavior were considered to be fast computer typing and knowledge of programming. At the level of the classroom, the norms for positive social behavior seemed to be the ability of group members a) to conceive of a project objective which would be unproblematic and simple to construct and at the same time produce a visually impressive graphical output and b) to project an image of non-problematic and successful collaboration at group level,

concealing other evidence when necessary. The norms for negative social behavior at both a group and a classroom level seemed to be to be seen to make mistakes and to criticize in any way.

In the context of the Greek educational system, good pupils are not supposed to make mistakes; likewise, it is implied that good groups (i.e. collaborative) are not supposed to make mistakes either. Finally, the demand for absence of criticism seemed to be dictated by two factors: first, the belief that collaboration equals unanimous decision-making and second, the fact that in-group criticism usually takes the form of personal attack. This form of social behavior served the following functions: re-negotiation of positions and roles at a group level, redefinition of group tasks and finally expression of feelings of frustration and tension from the groupís inability for systematic work and coordination of effort.

The following communication episode involved a group of third year girls and their teacher. In this episode the pupils report to the teacher their failure to accomplish their original idea (drawing of an ice cream); there is no evidence that the pupils feel the need to discuss with the teacher the real problems that led them to this situation.

Pupil: Sir, sir. We canceled the ice-cream idea because there was no way to do it.
Teacher: I don't understand this.
Pupil: We canceled the ice-cream idea.
Teacher: Yes, but why did you do that?
Pupil: Because we couldn't do it. We got muddled up all the time.
Teacher: Wait a minute. How can this be? I remember that I saw the ice cream on the screen. So, what happened? What are you talking about?
Pupil: We didn't make the ice cream.
Teacher: Of course you did - I remember that very well.
Pupil: You probably saw the glass - we did the glass and then we were about to make the ice-cream and then we had all those commands - and then we erased them all - it just wasn't right - it was going in this direction (indicates with the finger on the computer screen).
Teacher: But why did you not ask for my help at that point. Here's what you will do. Next time, you will start all over again from the ice cream; you will try to do it again. I'm sure you remember the commands. You should know how to do it.
Pupil: Yes, but how… anyway, it doesn't matter.

Excerpt 4: Group and Classroom Norms.

Before this episode took place, the pupils had decided to construct the ice-cream design and had gone a long way in completing it; they had constructed the first ball and were

trying to find an appropriate angle to turn the turtle so that it would create the second ball in the appropriate position. In the process of doing so, they had found difficulties, had to make several trials and accept temporary failure and had to think on what decisions to take next. In the end, they seem to have run out of steam to the extent of not even asking for their teacherís help. Instead, they opted to abandon the project altogether. That is exactly the point: abandoning the project seemed less costly than persevering even with the help of their teacher and in front of the danger of the final design not being impressive. The teacherís prompt was met by trying to avoid confrontation with the conceptual aspect of the project.

Discussion

We looked closely at four groups of pupils in their normal classroom, each carrying out a computer - based project as part of a school-based longitudinal innovation program for their teachers to infuse collaborative groupwork in school activity. Given that the educational intervention was explicit, consistent and longitudinal, we wanted to identify the more resistant obstacles to the development of social modes of learning, to use Mercerís term. We analyzed the data taking three distinct perspectives, a personal or insiderís perspective, an interactionist perspective and a social norms perspective. The former revealed the pupil to be a person who seemed to perceive the society within which he/she was called upon to act, as a forum in which to claim and defend his/her social role. Social exchanges involving a disruption, which was due to logical argumentation related to activity processes such as experimentation, enjoyment and challenge did happen. But they were by no means within the focus of the personís intentions and were often treated as a side issue. The interactionist perspective brought forward the issue of role negotiation and its overbearing presence in social exchange in the form of groupthink, role confusion and vagueness. The pupilsí tendency to perceive the teacherís role as either that of refereeing social dispute or being an information or a direction resource so as to *avoid* the problematic in situations requiring thought, effort, dealing with the unexpected in an experiment or with uncertainty in general, was also prevalent in pupil teacher interactions. Finally, the group and classroom social norms, which seemed to have emerged as functional within these societies had a judgmental character. Positive behavior was considered to have the "knack" of controlling the computer at the level of action, to achieve the most impressive visible result with the least problem and to have engaged in collaborative activity marked by continual consensus. Divulging having made a mistake or being openly critical were seen as negative social behaviors.

With respect to the pedagogical potential of CLCS, we do not take these results as lessening the possibilities and the richness of such an environment for both cognitive and social development. Instead, we see the research as throwing some light on the problem of establishing collaborative learning environments in schools within the context of this particular educational paradigm. Using the computer as a medium for pupils to express ideas and to interact with was hindered by the apparent cognitive, emotional and social cost of unexpected feedback and of exploration and construction, often perceived by the pupils as an unwanted slowing down of the process towards the main goal which was the final result. The study reveals an aspect of this process, which should not be ignored, i.e.

that the pupils inadvertently use the computer resource to build perceptions of an uneven role distribution in the collaborating group. At the root of both these aspects is the notion of the changing *roles* and *processes* in classroom and learning activity. Apart from the role changing from passive to active, an educational objective would be for it to change from receptive to contributory. Instead in the study it seemed to sidetrack into claim and defense, which in themselves do not change the nature of the role. Changing the process from implicit and subsidiary, to being central in classroom activity also seems to find resistance. Even though pupils do engage in constructive and social activity, they still seem to feel that these are not recognized as valid and so they try to conceal that they happen.

It could well be argued that even though the teachers conscientiously developed strategies encouraging the change of roles and processes in the classroom (Kynigos, 1996), the circumstances which did not allow wider application than that of the modular inclusion of a weekly period played a major role in the resistance to change shown in the study. Classroom based research, however, has shown that there is resistance to change within systems which invite wider application of innovations to a much larger extent (Kontogiannopoulou-Polidorides, 1996). We found the integration of different research perspectives on human activity in relation to different social systems - the self, the interaction and the society - within which it unfolds was useful in illuminating aspects of that activity which are underplayed otherwise. There are cases when the same activity can be much better understood when it is seen as happening within a different level of social behavior, as in the three different ways in which the fifth year girls perceived the problem and the reasons for choosing to construct a cat. Alternatively, it is sometimes telling that a pupil activity or perception does not change in situations when he/she is operating within different systems. A point for further research would be to study how one system influences the other which may throw some light into the intricate web of processes with which the wide scale application of an innovation finally neutralizes the very aspects which were in the first place innovative (Hoyles, 1993b).

Focusing on making sense of social interactions within these three levels, led us to draw on notions from different theoretical perspectives, the cognitive, the socio-cultural, the systemic which focused on the notion of educational paradigms and the one on different perspectives to implementing school reform. Far from attempting to systematically synthesize such diverse theories, each with its own history of evolution, we adopted this ad - hoc strategy in a "holistic" phenomenographic attempt to capture the essence of learning activity within - as Smith and Confrey put it (1991) - context and history. In each case, we used our judgment to decide which particular framework would work more operatively in our interpretative effort.

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