Collaboration as Pedagogy, Collaboration as Window

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Abstract

Collaborative use of educational software may be thought of as a pedagogical means for provoking an intended conceptual change. When a collaborative situation makes team members dependent on each other's actions for success, their negotiations during problem solving ought also to provide a window into their reasoning. However, in work with young children none of this is straightforward. At first sight their collaboration may look like it creates more opportunities for misunderstanding than for learning, and their reasoning does not make the conceptual content very explicit.

A hermeneutic analysis which follows simultaneously the development of the varying perspectives from which the individual participants' understand the task, and the development of a joint approach to the task may provide a useful window into the learning process.

The paper presents some highlights from an example of this kind of hermeneutic analysis. The development of the interaction between two children playing a new game intended to promote a conception of "the system of numbers as a whole-to-parts system" illustrates how children may provide each other with learning experiences even in the midst of misunderstanding.

Keywords — Hermeneutic analysis, early arithmetic, educational software, classroom discourse, alignment of perspectives.

1. Introduction

In spite of frequent recommendations for group work with computers as superior over individual work it is still far from obvious how collaboration supports progress [7]. Collaborative problem solving is often used for pedagogical reasons with the goal of provoking conceptual change in students. It may also be thought of as a window into the conceptual foundations of the reasoning of the participants. When a collaborative situation makes team members dependent on each other's actions for success, their negotiations during problem solving ought to bring thinking out in the open, making it available for educational diagnosis or research purposes.

However, young children may not use explicit conceptual arguments in their collaboration, even in dealing with an arithmetic content where conceptual explanation would be the most powerful. Nevertheless, children in collaboration seem to be resources for mutually precipitating learning, even if this sometimes does not always agree with their intentions: when they try to share their knowledge they do not always succeed, but on the other hand they may provide each other with learning experiences even in the midst of mutual misunderstanding. Knowledge concerning these collaborative processes of learning is of great educational interest and value.

2. Conceptual Change and Collaboration

Conceptual change, in our view, is a phenomenon always taking place within the zone of proximal development [9], a zone of capacity for enhanced performance under adult guidance or in collaboration with peers. When developing educational software applying this concept, we have always admittetd the guiding role of the teacher. We thus agree with Rogoff [8] when she takes both guidance and participation in culturally valued activities as essential to children's cognitive development. As a consequence we have not designed our software to function in isolation from human intervention.

As our aim in the long run has been to produce games suitable for classroom use, peer collaboration is of focal interest to us. Actually peer collaboration carries a dual function in our studies. It exemplifies the classroom pedagogy we are aiming at, and it is our research tool for exploration of the processes of children's learning in interaction with our games. In both cases our pedagogic stance has been to minimize, but not totally withdraw adult guidance. Pedagogically we see learning through peer collaboration as promoting cognitive as well as social aspects of development.

Collaboration as a research instrument provides us with a window into children's joint reasoning.

This is not to say we try to open a window upon the mind in the sense of "an inner world of relatively stable and enduring cognitive representations" [1]. We do not study internal representations but, human *experiential relations to the world* [4, 5], and the window may be thought of as overlooking a jointly developed conceptual space, as it is structured from varying participant perspectives.

3. Hermeneutic Analysis

We suggest that one way to illuminate the dynamics of learning in collaborative computer use is the application of a fine-grained hermeneutic analysis to selected cases of collaborative interaction. Such an analysis proceeds by systematically exploring what each contribution to an ongoing interaction can tell us about the appearance of the shared space from the perspective of the contributor, as well as what it brings into the developing common space. This approach exploits for purposes of educational research the interplay and merging of horizons [2] that may further our ways of knowing in educational as well as in research situations.

This is not an attempt to "empathize" with the people subjected to inquiry. Nor is it an attempt to get into people's heads. Rather, it is an endeavour to listen carefully to what they have to tell us about the world from a certain perspective. We need to remember that this perspective is possibly different from ours, which does not mean that it will forever remain inacessible. Being prepared to grant a measure of reasonableness even to seemingly obscure remarks, we may follow them back to their point of origin and find the implicit assumptions embedded in that perspective on the topic under treatment.

4. An Example: Making Sense of The Rabbit's Game

As an example of this type of analysis we have used an interaction sequence from two first-grade children, Lisa and Kevin, playing an educational computer game by taking turns towards a common goal. The game was new to these two children, and it was intended to promote a conception of "the system of numbers as a whole-to-parts system" over a conception of "numbers as an object of step by step counting" [3, 6].

In the game in question, *The Rabbit's Game*, a sequence of completion problems (a+? = c) are presented in the form of a board game track. The track in the present example runs from 1 to 30. The numbered "stones" along the track are hidden at the start of each new game, and reappear one by one to provide the randomly generated subtasks, the goal being to make the Rabbit jump from his current position to the nearest stone visible further along the track.

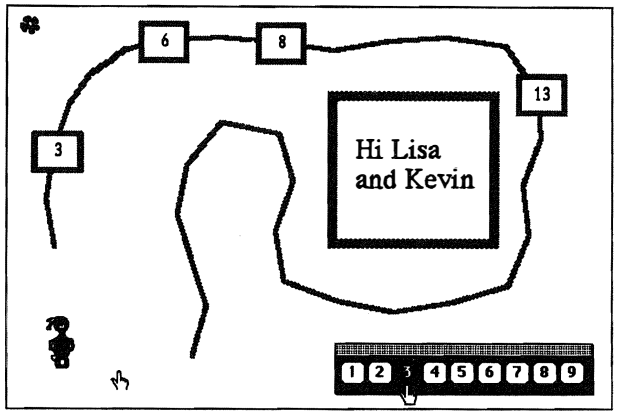

Figure 1. The Rabbit's Game, edited screen dump.

This game was very often initially perceived as being about *targeting and naming the endpoint* of the current leg of the journey, instead of (as intended) about *determining the number of steps in the next part* of the whole journey. The chosen case was found especially interesting as one of the children, Lisa, managed to hold on to the first and inappropriate understanding of the game for an uncommonly long period. In this way the processes by which this perspective is first maintained and then subverted are made more visible. However, due to restrictions of space we are not able to present here the full analysis of the twelve-minute sequence, but just a sample narrative.

4.1. The adventures of Lisa and Kevin

The children have no trouble getting to the stone appearing first, which is "number three." Then, however, in their attempts to get to "stone 6" they select first "7" and then "6" on the number panel. Each time the Rabbit bolts back to the beginning of the game. The third time they face the task of getting from "stone 3" to "stone 6" Kevin (prompted by the teacher to think of how it would work in a dice game) selects the correct numeral "3" to designate the three steps needed. Both children appreciate the success, but from what happens next it is obvious that they have seen its cause differently. Lisa still thinks the task is to name the target, whereas Kevin now adheres to the steps-in-a-part version.

The next stone to appear is "stone 8," the task is consequently to figure out how many Rabbit steps there are from "stone 6" to "stone 8." There is no discussion whatsoever of the appropriate number selection, no suspicion from either of the children of any divergence in perspectives. Kevin simply hands the mouse over to Lisa, who picks "8" on the number panel and clicks on the Rabbit without comment from Kevin. When she does, the Rabbit promptly bolts back to home base for the third time.

46K: Oh noohh! What's he going back for?
47L: Why, I **pressed** the eight!
48K: But you have to **press** on how many numbers there are in **between** here!

Both children are startled, although for different reasons. Lisa is offended by the game's rejection of the number that from her perspective is the unquestionably correct choice: targeting the endpoint. Kevin, who has taken it for granted that Lisa naturally would have chosen "2 steps" for getting from "stone 6" to "stone 8" is jolted into explaining his rationale. However, it is not transparent from Lisa's perspective that he is talking about a *chunk* of the track in his explanation. Although the episode seems to have rocked her faith somewhat, Kevin's explanation does not illuminate the step principle like a bolt of lightning and make her abandon the target principle she has embraced so far.

When the Rabbit is back in the same place again Lisa very cautiously accepts Kevins suggestion that she should select "2." It works, but she still turns to the teacher with a worried comment on the next situation, where the Rabbit has to go to "stone 13":

82L: (looking at the screen) That doesn't **work**.
83L: (turning to the teacher) He's got to have the one and the three now, doesn't he?

Selecting "13" will not work, as there is no single symbol for 13 on the panel, and no way to select two numerals simultaneously, either. At this point Lisa gets an explanation from the teacher:

84T: No he has to figure out how many steps you need to take to get from eight to thirteen...

Meanwhile Kevin has realised that a gap this size cannot be measured by approximation. He resorts to solving the problem on his fingers, counting-on in an audible whisper.

85K: **Yes, that's** it... *nine ten... nine ten... eleven twelve thirteen...* Now I know **exactly** what it is.

In this rapid series of events Lisa is first confronted with the inadequacy of the game to her perspective — or that it might even be her perspective that is inadequate to the game. She is provided with a formulation of the alternative perspective, and then, immediately, with Kevin's openly displayed invention of a working solution method for counting those "numbers in between." It is evident from her next move, that here the landscape from her perspective has at last changed into a problem of the current *part* of the whole journey.

She watches as Kevin selects "5." This successfully brings the Rabbit from "stone 8" to "stone 13," and produces the appearance of "stone 16" as the next problem for her to tackle. What she then says expresses in a minimal form her new understanding:

88K: See. Yeah!
89L: Oh, **//sixteen**... thirteen:n.
90K: //You can do it on your fingers. Fourteen fifteen sixteen...
91L: **Three**.

Lisa's observation of the situation is formulated differently this time. She notes not just where the Rabbit is going, as she has done before, but also what his current position is. She has finally realised that this is a pertinent aspect for solving the problem of calculating a part of the journey. In overlap with her assessment of the situation Kevin offers to share the method that he successfully used in the preceding turn. He demonstrates counting-up on the fingers as the way to figure out the correct number of steps. Lisa immediately gets the message, now that she has switched into a perspective on the task where this is relevant. She is the one to sum up Kevin's finger count and from now on they both use the finger counting method in all but the smallest jumps.

5. An Emerging Pattern of Interaction

The full analysis attends closely to the perspectival assumptions expressed in the utterances of each child in the unfolding chain of episodes. Here we can only comment on some features of the interaction between the children and its relation to their learning. It is notable that they do try to help each other with the problem solving, to share their understanding with the team partner. It is just as notable that they are not very skilled in detecting that they are speaking from discrepant perspectives.

There is, for example, a pattern of failure and remediation that occurs twice, once with Kevin positioned as responsible for the failure and once with Lisa in this position. In both cases the child who has not been directly responsible for the faulty selection first provides some kind of explanation. This is evidently expected by the explaining party to be obvious to the other child, who on the contrary manages to incorporate the explanation with his or her present perspective.

In both cases the "failing" child turns out to persist in his/her earlier preference, and in both cases the child who is in a position to see the other as responsible for a failure then leaves rational explanation and resorts to the persuasive force of her/his conviction as expressed in a repeated and emphatic offer of her/his own preferred choice — Lisa's happening to be based on a mistaken assumption and Kevin's on a correct one.

In both cases the child positioned as responsible for the latest failure then acts upon the strongly expressed advice of the other child.

Lastly, in both cases the child who has been responsible for a failure seems to be especially receptive to the more or less explicit hints provided by the teacher after having gone through the unsettling experience of first having their solution rejected by the computer, then receiving a more or less incomprehensible explanation from their peer, and then submitting – still without, comprehension – to a suggestion by the other child.

The pattern is suggestive of an interactional dynamics for a perspective switch on a local scale as an interplay between unsettling and supporting agents. Without unsettlement there would be no perceived need for a new idea. Without support there would most likely be desorientation instead of re-orientation.

6. Conclusion

By following closely the unfolding interaction between Lisa, Kevin, the teacher, and the computer game, considering at each step both the understanding making a specific contribution reasonable from the perspective of the individual, and its function in the interaction, we were able to study in detail how the "common space" of the actors was structured and re-structured throughout the sequence of episodes where first Kevin and then Lisa came to take the intended perspective on the game. Through Lisa's persistence in finding solutions in agreement with her perspective, we had an instructive highlighting of how a limited understanding is brought to the critical point where it can no longer be maintained. In this way the interaction between participants, despite being uneven and fraught with mismatches provided opportunities for learning.

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