ICT-Numeracy Practices in a School Serving a Disadvantaged Community

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This paper reports a sociocultural analysis of ICT and numeracy practices in a school serving a disadvantaged community. It focuses on a classroom episode involving a rich task that included ICTs and numeracy. The teacher engaged the students in higher-order thinking and established interactive norms of collaboration and shared expertise. The unique features of this site are described, in terms of its context, the activity, the tools and the interactive patterns between participants, in order to understand how such a system might function in other similar contexts.

The ICT-Numeracy research project (Zevenbergen, Renshaw & Lerman, 2003) was designed to investigate how ICTs might be deployed for numeracy learning and numeracy tasks at school and home in various disadvantaged communities across Queensland. In this paper I focus on one specific site – a School in the southern suburban area of Brisbane. In theorizing numeracy practices for this analysis, I have drawn upon sociocultural theory (Renshaw, 1996). From a sociocultural perspective numeracy, like other social and cultural practices, develops from interactions between people as they attempt to communicate ideas, plan events, distribute resources, ensure equitable exchanges, adjudicate disputes, and reach agreements etc. The communicative means employed in these social transactions are transformed and internalized to provide the tools necessary for higher-order thinking. But such thinking itself is mediated and transformed by the various technologies that are employed to assist in performing tasks. Technologies transform both the activity and the human person, and create new forms of social practice, and of particular relevance in this paper, new forms of numeracy. Numeracy, as a feature of social practice, is part of a functional system that is stretched across the context, the activity, the mediational tools, and the individual-in-interaction-with partners (Cole & Engestrom, 1993). In the analysis that follows I will briefly describe each of these key aspects of a sociocultural functional system – namely the context, the activity, the tools, and the individuals-in-interaction.

Approach to Research

Initially we intended to conduct a broad survey of practices, but after reflecting on preliminary interviews with teachers, we decided to adopt a more proactive approach consistent with the notion of research as design (see Cobb, Confrey, DiSessa, Lehrer & Schauble, 2003). Research as design attempts to address simultaneously and iteratively the processes of discovery, exploration, consolidation, and dissemination (Kelly, 2003, p.3). In its goals and its context of use, research as design is an extension of the methodology pioneered by Vygotsky whose approach was guided by the view that cultural phenomenon need to be investigated as they change, in motion rather than in still-frame. The system of relationships supporting particular practices are revealed more clearly when there is some attempt to change or transform them. So, rather than simply describing what might be occurring in communities and schools regarding the deployment of ICTs for numeracy, we

decided to plan a specific intervention with a small group of teachers (see below under *Activity* for a description of the intervention.)

The Context

The episode for analysis occurred in late 2003 in a 6th grade classroom in a State Primary School in an outer-suburban area of Brisbane. The School was established in the 1870s, but in recent years rapid suburban sprawl has reached and engulfed the school and its immediate community. It received financial assistance in 2003 for different initiatives including "discovering democracy", "ICTs for learning", as well as "literacy enhancement". Of particular significance was a large financial grant that the School won in late 2001 for 100 state-of-the-art desktop computers. After receiving the grant, the Principal stated, "We want to create opportunities for (our) students by giving them skills and knowledge across the curriculum that make them competitive in the world that exists beyond 2010. (This) grant gives our children the capacity to become technologically super-literate." The School established two computer laboratories and located four online computers in each classroom to facilitate ready access to the Internet via Education Queensland's 'Connect Ed' network. Currently the School has a computer **:** student ratio of 1**:**3.5. While the School is clearly well-equipped, and committed to developing students' technological literacy, it also shows strains in terms of available space and dual use rooms. The episode described below occurred in one of the computer laboratories that was adjacent to a series of classrooms. Students entering or leaving these classrooms had to traverse through the room and at times distracted the students using the computers. Nonetheless, it seemed that the students shared a sense of pride that their school had won the grant, and that they could become "technologically super-literate." As two boys explained to me during the classroom episode, the computers at school were more advanced than ones at home – I wondered why they said that at the time, and only later realized that this School had won the computer grant and that their comments probably reflected their pride in the School's in state-of-the-art computers.

The Activity

The activity was based on the curriculum innovation in Queensland known as "rich tasks". According to Education Queensland, the tasks should be built around assessible activities that are intellectually challenging and have real-world value. The design of more authentic, real-world tasks that had relevance both within the school and the students home/community was not only valuable educationally but from a research perspective central to our project. The activity was devised by an experienced teacher (F) who had volunteered to be a participant in the Griffith ICT-Numeracy project. She was clearly committed to providing high quality education for her students. As one of the teachers involved in the successful grant application for computers in 2001, she was determined to "close the digital divide amongst socio-economically disadvantaged children"(quote from the School Website). She chose to work on the topic of "discovering democracy", partly because this fitted with the current curriculum developments at the School, and partly because it fitted with her educational philosophy of providing students with a broad understanding of their society and its structures. The rich task engaged children in preparing for, and role-playing a ministerial budget meeting where decisions on expenditure in different portfolios had to be negotiated. The dilemma for the student "ministers" was to negotiate how to prioritise across portfolios so that the limited budget

could be distributed in a consensual manner. The specific numeracy aspect of the activity dealt with the very large numbers that are found in the budgets of ministers – in this case millions and billions. To demonstrate the awkwardness of using columns of digits to express very large numbers, on one occasion the teacher had used the whole width of the blackboard to represent a billion. Then, she had taught the class a number of different shorthand ways to write the numbers, such as 1.2b to represent 1.2 billion., or 1.6m to represent 1.6 million. This detail is important - when students tried to enter these shorthand methods into the Excel spreadsheet, there was considerable confusion as *alpha* characters could not be interpreted.

The Tools.

The tools used in this activity included the computers in the laboratory, the Excel spreadsheet, and also a range of other more conventional classroom tools, such as teacher handouts, jottings of calculations on pieces of paper. One of the main affordances of the Excel spreadsheet was the *function* facility which, as the teacher said, "automatically add-up across rows and columns." Such ease and efficiency was important in actually completing the activity because the students had to "run different budget scenarios" to work out what to include or exclude in their final budget positions. Completing these different scenarios "by hand" would have been very time-consuming and prone to error. The affordances in the technology were key to enabling the teacher to engage the students in this role-play and allowing them to act (with a degree of authenticity) as ministers considering different options - thinking with numbers rather than simply calculating them.

The students seemed at ease with the computers – they quickly turned them on, opened the spreadsheet software and began the task of entering numbers without explicit direction from the teacher. They also seemed proud of the "state-of-the-art" computers. Allan and Joel with whom I chatted during this episode, told me these computers were much more advanced than ones at home. Their obvious pride echoes the Principal's comments when he announced the successful grant for the 100 computers in 2001.

Individuals-in Interaction with Partners.

Each student shared a computer with one other student, and in a few cases three students worked at the one computer. This created teams and a more public and interactive style of working on the problems that arose. For example, the teacher told all the students at one moment in the episode, "Have a look at Daniels and Ann's. Just have a look at this." Sharing ideas and joint effort to overcome problems were strongly endorsed norms within this classroom. This extended to the teacher publicly expressing her ignorance when something went wrong. As she worked with the students, she adopted the "think-aloud" strategy, "Why does it come up with that? It's not working actually. I've done it perfectly well before. I must be doing something wrong… it's not working." So, the enacted norms in this classroom supported collaboration and distributed expertise that at times placed students in the role of "the knower", and the teacher in the role of "asking for help." The teacher used open-ended questioning to guide the students' thinking. For example, just prior to the students beginning to use the computers, she asked the following questions during a five minute segment of the episode: "What do you think? What's most important? When you go to your spreadsheet, if you go over budget, what happens?" In response to a student question, she made the following reply: "That sounds like an interesting thing you're going to have to work out." To summarise, her teaching style included open-ended

questioning, challenging students to problem-solve, inviting students to learn from each other, and admitting ignorance and seeking help from students. These characteristics are typically associated with higher-order thinking and the development of confidence among students in their own capacities to learn.

What was happening in this classroom connected in complex ways to the students' lives at home. Let me briefly illustrate with two contrasting cases. Allan, a very competent computer-user, had devised his own personal budget using Excel at home, and had already been able to successfully plan a trip based on his saving plan. The ICT-numeracy competencies that he is acquiring at school are being deployed at home in classic middle-class ways - to save, monitor the self, and plan for future satisfactions. In contrast to Allan, Joel did not have a computer at home but (he told me that) he had worked on his ministerial budget ("over the weekend when there was nothing else to do") using sheets of paper. As the transport "minister", he was able to ask his father, a truck driver, about budget priorities, and had been given a list of very relevant and pressing projects to fund, including better road surfaces and more truck pads for stopping. In this process, Joel is learning about the relation of his father's work to government spending, and perhaps beginning to understand the process of lobbying and setting priorities for spending within the public sphere.

Summary

The functional system within which these students learned to engage in ICT and numeracy practices is complex and multi-layered. It included: (i) contextual features, such as the provision of state-of-the-art computers and community pride in the school's success; (ii) features of the activity including it's real world significance and integration of curriculum areas; (iii) tool-related features such at the efficiency and ease of scenario testing using Excel functions; and (iv) interactive features including the teacher's open, problem-solving style and the classroom norms for collaboration and distributed expertise. In terms of the school-home connection, the cases of Allan and Joel suggest that similar dispositions and competencies acquired at school are played out quite differently depending on the affordances of the home.

References

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