ECOLOGIES OF PARENTAL ENGAGEMENT AND PRESERVICE SCIENCE TEACHER EDUCATION: THE DESIGN AND DEVELOPMENT OF A MULTIMEDIA CASE-BASED ENVIRONMENT “ P A R E N T S ”

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ABSTRACT
The purpose of this paper is to present the rationale and principles that guided the design and development of a multimedia case-based environment, called PARENTS. Following a development research approach, the tenets of constructivist learning, and the advantages of case-based instruction, we utilized and incorporated the findings of a longitudinal study -*Ecologies of Parental Engagement*- that focused on parents in high poverty urban communities and the roles they play in elementary schools that are active in implementing reform-based science education. The main purpose of PARENTS is to help preservice science teachers to explore and reflect on themes of parental engagement in high poverty urban school settings. In this paper we present and explain the design conceptual framework behind the first prototype of PARENTS, which is grounded on a group of design principles and themes: 1) Authenticity, 2) Interpretation and Argumentation Construction, 3) Multiple Perspectives, 4) Rich, Multi-modal, Non-Linear Information Resources, 5) Scaffolding and Support, and 6) Multimedia Case-Based Learning and Instruction.

KEYWORDS
Parental engagement, science, preservice, teacher education, multimedia case-based environment, design principle.

INTRODUCTION

This paper discusses the design and development of a multimedia case-based environment, called PARENTS, for use in preservice science teacher education. PARENTS is being developed as one of the various products that will be used to communicate the knowledge generated by the NSF-funded “Ecologies of Parental Engagement” project (REC 9980592) (Calabrese Barton & Drake, 2000)- an ongoing project that examines, in theoretically rich and practice-based ways, parental engagement in high poverty, urban elementary schools that are active in implementing reform-based science education. PARENTS uses an interactive multimedia environment to communicate these findings. In the following sections we provide an outline of why and how such an environment was developed along with the rationale and principles that guided its design.

PARENTS, TEACHERS, AND SCIENCE EDUCATION:

PARENTS: An attempt to bridge a gap in Preservice Science Teacher Education

The research around parental involvement in education provides substantial evidence that this involvement positively influences student school success (Dodd & Konzal, 2000; NRC, 1996). Hyde (1992) indicates positive impacts such as a) students and parents communicating about school more often, b) parents sharing feelings of accomplishment, c) increases in students' self-esteem, and d) improvements in student-staff and school-parent relationships. Moreover, other studies have shown fewer student referrals and classroom behavior problems (Flaxman & Inger, 1991), higher student attendance and high school completions (Swap, 1987), fewer student failures and higher student grades (Brandt, 1989), and more positive student identification with and acceptance of teachers (Comer, 1988). More importantly, these studies have indicated that parents do not have to be well educated in order to help their children with school.

However, there is little research in science education that focuses on parents and urban poverty. The research that does exist shows that when underprivileged urban parents want to help their children with school science, they either do not feel comfortable with their knowledge of science (Scribner-Maclean, 1996) and of how school works; or even when the parents do have some knowledge about science, it is often inadequate (or viewed as inadequate) for the purposes of schooling (Calabrese Barton et al, 2001). Furthermore, the level of alienation that many parents have from their children's schooling is due not only to low levels of scientific literacy but also due to their own negative schooling experiences (Fine, 1991; Valdes, 1996).

Research evidence also shows that participation and support by parents has a positive impact on student achievement and attitudes towards science (Fleer & Rillero, 1999; George and Kaplan, 1998; Osborne & Collins, 2000). More specifically, when parents feel empowered with school and with science, they more readily provide guidance and support in their children's science education (Thompson & Cittadino, 1991; Marino & Hammond, 1998; DeMerchant, Lytton & Lytton, 1995). This has been shown to be a particularly important influence on increased student achievement, especially when parents learn to be advocates in standards-based science instruction (Education Trust, 2001). These studies also have shown that children learn to do and use science more quickly and confidently when they do science-based activities with their parents at home.

Several studies have documented the ways teachers can involve parents in their children's scientific and technological discoveries both in school and at home (Feely, 1994; Fuller, 1996; Geake, 1993), including helping to design supportive home-based experiences. Fuller (1996) indicates that these types of initiatives open channels of communication between teachers and parents that potentially impact both what happens at home and at school.

However, this limited research on parental engagement in schooling has also revealed a deficit model relationship between teachers and high poverty urban parents. That is, many teachers consider low-income parents to be "deficient" despite their general intentions to be helpful (Davies, 1988; Delgado-Gaitan, 1996). The parent-teacher relationships might seem cordial but often are distant (Carrasquillo & London, 1993) and even hostile, as a result of long and complex histories of miscommunication and school failure (Wolfendale, 1989; 1992). This deficit model relationship places teachers and parents into a cycle of blame. Cullingford (1996) states that when teachers are faced with rebellious students, they often blame parents' failure in teaching their children respect and proper behavior. On the contrary, many urban parents, frustrated by the decay in society and in schools, blame the teachers and the schools in general for the low academic performance of their children.

The "cycle of blame" is also found by other studies, which show that teachers often view children's failure in school as a responsibility of the parents (Swap, 1993). School administrators and teachers favor parents who attend school functions (i.e. conferences) regularly and view those who do not as uncaring (Wolfendale, 1989; 1992). In addition, Swap (1990) reveals that despite the parents' interest in more participation in their children's schooling, many teachers are satisfied to have parents remain in "bake sale" roles.

More recent research reveals a number of barriers that poor, minority, and immigrant parents experience in their attempt to be involved in their children's education. Henry (1996) and Funkhouser & Gonzalez (1997) describe barriers such as a) the reluctance of teachers to allow parents' participation, b) biases and prejudices based on linguistic or cultural differences and c) the school's -or the families'- unwillingness to collaboratively work towards a cultural change. Additional real and perceived obstacles to parental engagement are parents' limited formal education and lack of cultural or social capital, as well as traditional conceptions of parents' and teachers' roles (Samaras & Wilson, 1999). As a result, parents often end up with a school-controlled "laundry list" of ways they ought to be more involved in their children's education.

The "Ecologies of Parental Engagement" [EPE] project (NSF REC 9980592), attempts to bridge this gap in preservice science teacher education, by providing a deeper and comprehensive framework for a critical understanding of parental engagement in high-poverty urban schools that initiate reform-based science education. More specifically, the focus of EPE is on parents in high poverty urban communities and the roles they play in elementary schools that are active in implementing reform-based science education. In the EPE project our research group worked closely with a group of 20 parents (in English and in Spanish) in two low-income urban schools to understand how parents think about engagement with their children's schools, particularly in science education, as well as the spaces in which they engage, and the capital they draw on to engage in those spaces. Utilizing activity theory and critical race theory in our analysis we developed a model for understanding parental engagement (see also Calabrese Barton & Drake, 2000, 2002). From this perspective, parental engagement is framed as the "mediation between space and capital by parents in relation to others in school settings," where mediation is understood as both an action and an orientation to action. This model allows us to use "parental engagement" as our unit of analysis, rather than the parent, the teacher, or the event itself designed to engage parent and teacher. Our research has revealed that *actions that engage* are about: a) how parents activate the resources available to them in a given space in order to author a place of their own in schools, and b) how they use or express that place to position themselves differently so that they can influence life in schools.

An ecologies of parental engagement perspective provides us with a novel way of understanding why parents appear to engage - or, more often, to not engage - in school science. This model helps us to see how school science ought to be understood as a "special case" of parental engagement because science as a school-based academic space is both *unique* (i.e., one with a different set of priorities, boundaries, and capital than other academic spaces) and *difficult* (i.e. because leveraging capital in support of science or parental engagement in science conflicts with standard school-based practices) by virtue of how spaces are mediated at both the macro and micro levels by parents and school personnel.

The above EPE project findings further emphasize the importance of parental engagement in the education and science education of our children, a widely consistent message in recent science education reform documents (AAAS, 1993; NEG, 1999; NRC, 1996; NSTA 1998). In an attempt to communicate the knowledge that has been generated by the EPE we first considered the field of preservice science teacher education. We come to ask how do the preservice teachers -and specifically preservice science teachers- understand the issues of parental engagement in high poverty urban schools? While we have learned a great deal in recent years about how to help teachers build their knowledge of both content and pedagogy, as well as how teachers can learn to listen to and build on children's thinking, we have made little progress in helping teachers learn to engage more productively with parents, especially around content concerns. Furthermore, prior research (Horvath & Lehrer, 2000; Koehler & Lehrer, 1998; Lehrer, Petrosino, & Koehler, 1999; Lampert & Ball, 1998; Merseth & Lacey, 1993; Merseth, 1996; Putnam & Borko, 2000; Van den Berg & Visscher-Voerman, 2000) has illustrated the power of multi-media and case-based tools for promoting and scaffolding teacher learning; however, few, if any, of these tools have addressed the issues surrounding parent-teacher and parent-school engagement. The challenging lack of any current research study that addresses more specifically the theme of preservice science teacher education in relation to the parental engagement, along with the data that have been generated by the "Ecologies of Parental Engagement" project, illuminate the need of designing the PARENTS multimedia case-based learning environment.

FOCUS AND PURPOSE OF PARENTS: A MULTIMEDIA CASE-BASED ENVIRONMENT FOR PRESERVICE TEACHERS

PARENTS is a multimedia case-based learning environment. The main purpose of designing and developing the PARENTS environment was to help preservice science teachers explore and reflect on themes of parental engagement in high poverty urban school settings. More specifically, through the use of and interaction with this environment, we aim to help preservice teachers:

- Identify issues, problems, and ideas that are embedded in the multimedia environment by having them pose their own **questions** or **dilemmas**.
- **Interpret** those questions from multiple perspectives, using the various information resources provided in the product.
- Form their initial **conjectures** around the issues they identified and explored.
- Provide **evidence** and supporting information, gathered throughout their interaction with the environment, that will help them shape informed suggestions or solutions to their initial questions or problems as well as other "problematic situations" introduced by the system itself.

Beginning with these goals, our challenge was to design and develop a product that could be integrated into a preservice science education course, and serve as both a starting point and a resource for exploration, reflection, and discussion of the aforementioned issues. We expected that implementing and testing a prototype version with a small number of preservice science teachers would provide valuable insights to our main research questions:

- How are preservice science teachers' beliefs and ideas about parental engagement in high poverty urban school settings crafted, mediated, or expressed within a graduate course that draws upon the PARENTS multimedia environment?
- What are the a) design features and functions, and/or b) content parts of such an environment that frame/enable/enhance students' thinking about parental engagement in high poverty urban school settings? How (in what ways) is this achieved/done and to what degree? How does each feature, function and/or content part contribute to students' thinking?

Our prototyping approach has relied upon two complementary frameworks: (1) Development Research and (2) Constructivist Case-based Environments. We describe each of these influential frameworks below, pointing out how they have framed our prototype.

(1) Development Research

In particular, we have grounded our research in the theoretical framework of "development research", that originated with Ann Brown (1992) and Alan Collins (1992), and was further discussed by Van den Akker (1999). In an analytical review of research methodologies in the field of instructional technology, Reeves (2000) provides a diagrammatic description of "development research" (Figure 1):

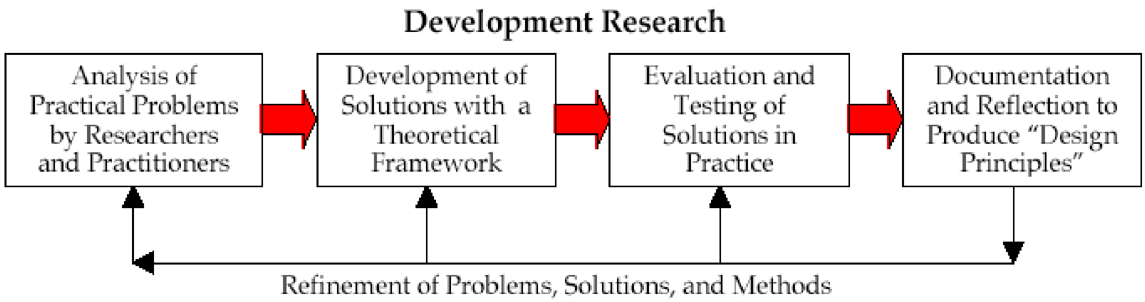

Figure 1. Development approach to instructional technology research (taken from Reeves, 2000)

Van den Akker (1999), as quoted by Reeves (2000), juxtaposes development research, to the traditional empirical approaches to educational research and he stresses "an iterative process of 'successive approximation' or 'evolutionary prototyping' of the 'ideal' intervention is desirable" (pp. 8-9). Following Van den Akker's evolutionary prototyping idea that is embedded in the cyclical process of development research (Figure 1) as well as the fundamental tenet of collaboration among practitioners, researchers, and technologists (Reeves, 2000), we have proposed a solution (the trial version of PARENTS), which we have based on a tentative framework of design principles. We consider the research activities of this study as ways to improve PARENTS, in a continuous effort to come up with the most optimal version. The documentation and analysis of the research data will inform all our steps throughout this design process.

(2) Designing a Constructivist Case-Based Environment

Our attempt to create a design framework for PARENTS has also been informed by relevant theories from the field of instructional technology design as well as from major studies that addressed similar tasks. Constructivism and Case-Based Instruction in Teacher Education – along with the goals that we have previously set- are two main themes that guided the design of PARENTS.

2 (a) Constructivist Learning Environments

The design of learning environments is a popular field in educational research. Major research projects in this field are now defining these learning environments as computer-based (or digital) constructivist learning environments. Wilson (1996) provides a general definition of a constructivist learning environment: "a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities" (p. 5). In other words, learning is viewed as an active procedure where the learners construct meaningful interpretations, drawing upon their background knowledge and on the resources and activities provided by the computer-based environment.

The design of the environment we have been developing is grounded in the learning principles of constructivism. Constructivism theory suggests that in the attempt to make sense of their world, individuals construct their own representations or models of their experiences. Thus, knowledge is constructed, not transmitted, and is embedded in the activities and interactions that we have had (Jonassen, Peck, & Wilson, 1999). Brown, Collins & Duguid (1989) further explain that the knowledge we construct is anchored in and indexed by the context in which the learning activities occur (*Situated Cognition*). Knowledge construction requires not just a series of activities, but also articulation, expression, or representation of what is learned. This communication of knowledge suggests that learning is a socio-dialogical process (Duffy & Cunningham, 1996). That is, while the individuals have ownership of their constructed knowledge, meaning may also be shared with others, so meaning making can also result from conversation. Scardamalia & Bereiter (1993) state that this social dialogue effectively occurs within knowledge-building communities.

The application of digital technology to education has produced a substantial rethinking of how educational experiences can be designed and delivered to more effectively meet the individual needs of learners. The ideals of constructivist learning theory that emphasize the importance of grounding learning in the intrinsic interests of students and building on their prior knowledge in a way that supports their problem solving goals has recently become of ever increasing importance in contemporary education (e.g. Anderson, 1997). Computer-based education promises to enhance our realization of these goals by providing a learning interface where the learner has much greater control of information access and greater autonomy in selecting the range of experiences to promote learning, especially those aspects that are uniquely important to the learner (Harasim, 1990; Duffy and Jonassen, 1992; Jonassen, 1996).

2 (b) Cases and Case-Based Instruction

Another important aspect that we had to decide upon was the nature of the content of this constructivist learning environment. The brief overview we are providing below explains why the field of case-based learning and instruction was an appropriate way to respond to the goals of PARENTS. As a core component of this environment we built a set of cases, presented in multiple formats (video, text) that illuminated the issues of parental engagement in high poverty urban education settings and were meant to guide the preservice science teachers into a constructivist exploration of this multimedia environment.

In a comprehensive review of the use of cases and case methods in teacher education, Merseth (1996) categorizes cases in three groups: a) cases as exemplars, b) cases as opportunities to practice analysis and contemplate action, and c) cases as stimulants to personal reflection. For the purpose of this study, the cases we have developed and incorporated into PARENTS fall into the last two categories; we aim to foster preservice teachers' reflection and critical thinking around parental engagement. Furthermore, these multimedia cases serve as a basis for teachers to analyze, construct interpretations, and propose solutions to problematic situations.

A growing body of research has been documenting a number of advantages of using cases and case-based multimedia learning environments in teacher education (i.e. Merseth & Lacey, 1993; Merseth, 1996; Lampert & Ball, 1998; Koehler & Lehrer, 1998; Lehrer, Petrosino, & Koehler, 1999; Horvath & Lehrer, 2000). Van den Berg & Visscher-Voerman (2000) summarize findings of such studies and suggest that multimedia cases offer educational advantages for (prospective) teacher learning as they stimulate an active learning attitude in learner controlled environment; yield the possibility to revisit classroom events in order to make sense of them; show the cases in myriad perspectives; offer procedural support for instructional design and classroom teaching; lessen the gap between theory and practice, by giving practice a more profound and integrated position into teacher education programs (p. 6).

The non-linearity of multimedia (or hypermedia) learning environments such as those developed by Lampert & Ball (1998) is an enhancing factor to the effective use of cases. As Putnam & Borko (2000) explain, this non-linearity as well as the abilities a) to "visit and revisit various sources of information quickly and easily", and b) to "build and store flexible and multiple links among various pieces of information, allow users to consider multiple perspectives on an event simultaneously" (p. 8). This "Cognitive Flexibility Theory" (Spiro et al, 1992) principle is also included in our design of PARENTS.

Yoon et al (2002) mention additional evidence that supports the use of cases and case-based instruction in both preservice and inservice science and math education programs. They indicate teacher learning outcomes such as higher order reasoning, reflective thinking, decision-making, strategic inquiry, and collaboration. (see also Abell, Bryan & Anderson, 1998; Barnett, 1998; Benzce, Hewitt & Pedretti, 2001; Harrington, 1995). The above advantages and outcomes are relevant to our design purposes and are also supporting the design framework that we are describing in the following sections.

A FIRST LOOK AT PARENTS

At its current stage of development PARENTS consists of five main components:
a) ***Introduction***: In this initial screen, the users login to the program, and have access to all components of the environment through graphical or textual buttons, grouped in menu bars, accessible at any screen of the program,
b) ***Challenge*** page: Users are introduced to a multimedia case that sets the stage for a purposeful exploration of PARENTS while suggesting the task and role of the users. The challenge asks the users to adopt the role of the teacher and using their i-Journal (described later), write their initial reactions. At the end of their exploration, the users revisit this initial challenge and propose solutions or suggestions to the challenge that set the stage for a purposeful and intriguing exploration,
c) ***Parents*** page: This component presents the three parents who are featured in the cases (three cases for each parent) and provides the user with: a multimedia Parent *Portrait*, contextual information (*More Info*) about the school the parent's children attended, and links to the three cases of that specific parent. These three parents were purposefully selected to represent different ethnic backgrounds, different levels of engagement, and different reasons and challenges for engaging. *Cases* and *Parents* are cross-linked allowing the user to start their exploration by viewing the cases or the parents.

d) ***Cases*** page: The cases constitute the core of PARENTS. The user may choose to view these cases in any order. Each case is presented in text and video formats. The user may simultaneously read the corresponding transcript of the video in an attached text window. Using the video control buttons and time line they may view the entire video clip of each case or skip to a specific point. Video clips may be bookmarked and saved in their i-journals. While at the case screen, users are prompted to use their i-Journal to record their initial questions, interpretations, and conjectures around the cases.
e) ***i-Journal***: The i-Journal is a note-taking and organizing tool, and is accessible from any screen of the program. The i-journal provides the user with scaffolding by prompting the user to reflect upon their questions, their interpretations of the cases (using space and capital as organizing constructs), their conjectures, and their evidence they have gathered throughout the environment in support of their conjectures.
Additional sub-components of PARENTS include a) the ***Other Perspectives*** pages, where we provide our research group's view on the issues discussed by each parent, and the conjectures that the writing of each case was based upon. The visual ***Help*** guide that is also provided in the system informs the user about the available features and tools, and how they can utilize them.

DESIGN CONCEPTUAL FRAMEWORK

Drawing upon constructivist beliefs and the advantages of case-based learning and instruction, we describe a set of principles that have guided the design of PARENTS. These design principles appear in a variety of constructivist learning environments, but we group and present them in a way that serves the purposes of this study, while describing the way these principles function in the current version of PARENTS:

1. Authenticity

The need to present learners with authentic tasks and provide them access to authentic information is essential in constructivist learning environments (i.e. Black & McClintock, 1996; CTGV, 1993; Brown, Collins & Duguid, 1989). Jonassen (1999) suggests that authentic problems are those, that represent a meaningful challenge to the learners and engage them to think like a member of the practice community. Schank et al (1993) also stress the learning benefits of engaging learners in authentic tasks. For our purposes, the users of PARENTS are faced with roles and challenges that will be of real interest: they adopt the role of a teacher in order to explore authentic cases of real parents discussing issues of parental engagement in schooling. This role is described in the very first screens of the PARENTS: the *Introduction* and the *Challenge*, where we encourage the users to read and reflect upon the cases, to gather information from the parents' stories, comments, and experiences, and suggest how them, as teachers, would respond to the issues that emerge from the cases and stories (both the *Introduction* and *Challenge* are presented through a video and a text format).

Moreover, the users face, right from the beginning, sample questions that were raised by the parents themselves; the parents whose stories, voices, struggles and experiences are presented throughout this multimedia environment. Given that the users are teachers-to-be, they encounter real-life situations in a purposeful and motivating way (Reisbeck, 1996). Furthermore, by having the *Introduction* and the *Challenge* as their starting point, all the users have a shared, contextualized experience – an anchor – which could be used a reference point throughout the use of PARENTS in a course, or could be revisited by each user at any stage of their exploration. In this way, learning is anchored in a realistic and relevant context (Bransford et al, 1990; Honebein, 1996; CTGV, 1997; Schwartz, Lin, Brophy, & Bransford, 1999).

2. Interpretation and Argumentation Construction

In their approach to constructivist design, Black & McClintock (1996), emphasize the importance of having "students construct interpretations of observations and construct arguments for the validity of their interpretations" (p. 26). Instead of using the term "learning environments", they refer to designing "study support environments" and they state that "the core of study is the hermeneutic activity of constructing interpretations" (p. 26). We expect the preservice teachers to act as "investigators" and problem solvers in a realistic scenario, and generate learning themselves. They are required to "engage in argumentation and reflection as they try to use and then refine their existing knowledge [and beliefs] as they attempt to make sense of alternate points of view" (CTGV, 1993, p. 16). The current version of PARENTS provides a very important tool that facilitates the user's task: the i-Journal.

The i-Journal is the user's electronic pad: a digital note-taking and note-organizing tool. It helps the preservice teachers record, save, and retrieve their notes at any stage of their exploration. In order to further help the users we structured the i-Journal in accordance to their *Task*: for each parent (currently there are three parents presented in PARENTS) they have a text window that addresses each of the main theme categories of notes: questions, interpretations, conjectures, and evidence. Also, a General Notes window is available, where users can type their draft thoughts or any uncategorized notes. The i-Journal also allows the user to choose which two text windows are going to be active in their screen: i.e. a user may want to revisit their Interpretations notes while typing something in their Conjectures notes, etc). In this way, we encourage, but not enforce, the user to follow a semi-structured process of constructing and recording their thoughts and ideas. This design decision is in accordance to the main goals of this learning environment. On the other hand, the preservice teachers may or may not choose to follow the i-Journal structure and decide to organize their notes in their own personal way by using the General Notes text window.

3. Multiple Perspectives

One of the most emphasized pedagogical goals of constructivist learning environments is to "provide experience in and appreciation for multiple perspectives" (Cunningham, Duffy, & Knuth, 1993 and Knuth & Cunningham, 1993, cited in Honebein, 1996, p. 11). Providing multiple perspectives or approaches to the problems or issues that will be examined by the learners, is directly related to an important model of designing learning environments: the cognitive flexibility theory (Spiro et al, 1992). According to this model, multiple perspectives are provided in order to convey the complexity that is embedded in the knowledge domain, and to illustrate the interrelatedness of the ideas.

The users of PARENTS can access multiple representations or analysis of the issues that are derived by the cases of parents, as well as commentary from other actors in the school settings. Once the preservice teachers view their challenge and task, they can "meet" each parent presented in this multimedia environment, first by viewing the parent's "*Portrait*": a document that presents each parent's biographical/family information, her educational background, and labor/work background information. Short video clips (of the parent talking) related to her portrait are also provided.

Moreover, at every screen of each parent there is available additional contextual information (information about the school the parent's children attended grouped under a general link called *"More Info"*) that aim to help the users form their interpretations from multiple perspectives:

- Principal's Commentary: video or text commentary by the principal of the school that the parent's child attends describing the school, the science programs, and the parent involvement philosophy.
- School and Community Settings: factual information (text and images) about the school (location, demographic data, philosophy) and the surrounding community.
- Science Programs of the School: description of how science education and science education reform is enacted in the school.
- Related Policy documents: state and local policy documents around science education, standards, testing, and parental involvement in schools.
- P.T.A. Description: information about the way the PTA functions (governance, rules, activities, problems) in the specific school.

In order to offer additional perspectives to the users, we included in the current version of PARENTS a section named *"Other Perspectives"* a place where they can access

a) the researchers' commentaries for the parents. There, the users have the chance to read how the researchers of our group worked with that parent, how and why they chose to write the cases and their overall analysis of their experience.

b) the conjectures that the cases (three for each parent) were based on. The conjectures for each case – and the cases themselves – were grounded in the data analysis of our EPE project. For example, Alejandra's case titled "A matter of equity", was written based on a conjecture that emerged from Alejandra's personal life story, struggles and experiences with her child's education:
   Conjecture: Parental beliefs about the quality of education and the impact of parental involvement in school life is informed by the parents' personal story of immigration, employment, social class, and existing social networks.

By reading this case and all the related information (portrait and video commentary by Alejandra, additional contextual information etc.) we expect the users to start thinking and reflecting on the embedded issues around parental engagement, first in a micro level (specific to that case) and then broadening their thinking in a macro level (reflecting, comparing, contrasting, and synthesizing issues from various data sources or perspectives, and start forming their initial conjectures on parental engagement in high-poverty urban settings).

In summary, we expect that the users will compare and contrast different perspectives on the parents' stories, concerns, hopes and struggles. This multiple-viewpoint exploration of PARENTS encourages the users – and more specifically the preservice teachers - to realize the significance of this information and understand its relevance for helping them think differently (Schwartz, Lin, Brophy, & Bransford, 1999), especially in applying this learning experience in real-life situations in the future (i.e. dealing with parents and parental engagement issues during their student teaching).

4. Rich, multi-modal, non-linear information resources

Constructivism theory suggests that learners construct knowledge through interaction with a variety of tools and information resources provided by the learning environment (Wilson, 1996). This theory further suggests that designers should encourage the use of multiple modes of representation of information (Honebein, 1996) "including text documents, graphics and diagrams, sound, video, or any other medium of information that is appropriate for helping learners understand the content well enough to be able to use it to solve problems" (Jonassen, Peck, & Wilson, 1999, p. 199). Throughout the design and development of the current version of PARENTS we have tried to utilize most of the above media. Both the "*Introduction*" and the "*Challenge*" screens that we described before are presented in dual formats: a user might choose to watch a narrated scrolling-text version or a plain text version of these pages (opening in a different window). Most importantly, the core of this environment, that is the parents' *"Cases"* (described below) consist of both text and video. We chose to have the parents themselves comment on the cases and discuss other related issues (we called those *"Story Points"*) using the video format, an immediate and powerful way to communicate the concerns, beliefs, and ideas of these three parents to the preservice teachers.

Additionally, we have organized information in a way that provides preservice teachers autonomy and control in selecting their own paths of exploration. This is facilitated by the non-linear (or hypermedia) character of PARENTS: all the components are cross-linked and accessible from almost every screen of the interface. The menu located on the top part of the screen provides access to the main parts or components of PARENTS: the *Introduction*, the *Challenge*, the *Parents*, and the *Cases*, as well as the *i-Journal* and a link to a visual help guide. Components such as the *i-Journal*, the *Other Perspectives*, and the text versions of the *Introduction*, *Challenge*, and *Task* are viewed in a different window so the user could switch from one window to the other according to their task (typing notes in their *i-Journal* while watching a parent's video commentary on a case). To sum up, we aim to have PARENTS provide learner-selectable information just-in-time to support some meaningful activity by the learners (Jonassen, Peck, & Wilson, 1999).

5. Scaffolding and support

Dunlap & Grabinger (1996), among others, emphasize the importance of providing the appropriate scaffolding in every learning environment. They stress that "rather than 'telling' the student what to do, students must be 'guided' through the learning activities […] encouraged to make their own decisions, and to pursue directions that they decide upon" (p. 78). Even though all the aforementioned design principles can be characterized as ways of scaffolding and supporting a learner, in the current version of PARENTS we also included specific tools such as symbol pads (i.e. the note-taking/organizing ***i-Journal*** component) (Perkins, 1991), a visual help guide, and contextual information relevant to the cases and issues that are embedded in the system (i.e. the *"More Info"* section).

Another important feature that accompanies every video presentation (i.e. video commentary from the parents on the cases) in PARENTS is the video book-marking tool. While watching a video, the users can bookmark the clip at specific points that they consider as important or useful. The generated bookmarks are automatically sent and saved in the i-Journal from where they can be referred to for later use (i.e. as supporting "evidence" of the user's conjectures or suggestions).

Lastly, the consistency in the navigational organization of the interface also serves a supporting function: in all the components of PARENTS, users are able to view visual cues that will help them understand the functionality of specific features or links. The interface offers visual cues in order to a) show the functionality of those links or buttons, and b) provide feedback for the actions of the users. For example, when the users moves the mouse cursor over a link or button the system will provide a pop-up, small window with a short description of how this button functions or to which screen the user will be directed.

6. Multimedia Case-Based Learning and Instruction in PARENTS

For the current version of PARENTS we have incorporated the stories from three parents who participated in the "Ecologies of Parental Engagement" project: Alejandra, Miranda, and Gloria (pseudonyms). These parents expressed their hopes, motivations, obstacles, accomplishments, and support for parental involvement with the schools and the education, including the science education, of their children. These stories reveal how urban parents struggle to find ways to help their children connect to schooling, find a place for their ideas and voices to be heard, and gain access to the science that their children need to learn.

Based on our analysis of the data from the EPE project, our research group compiled three cases for each parent. Each case was written based on the conjecture that emerged from our research with that parent, in other words the challenge faced by that parent. The user is also able to simultaneously read the corresponding transcript of the video in the attached text window (the transcript works as a scrolling caption below the video) (Figure 2). This is particularly helpful to the users since a) they could revisit this transcript later by scrolling to specific point, without viewing the video clip again, or b) in case they do not speak the parent's language – i.e. Alejandra speaks Spanish – they could always read the transcript which serves as the English translation of the video.

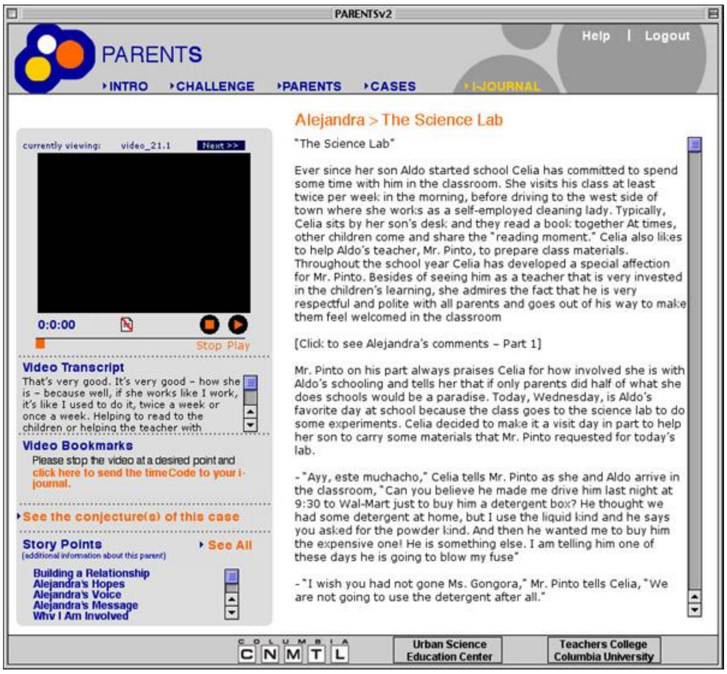

Figure 2. "The Science Lab" Case

Moreover, once in a particular Case screen, users can access additional video commentary from that parent. We called these "*Story Points*": video clips (along with the corresponding transcript) of the parents talking or discussing issues that are directly or implicitly related to the issues presented or commented in the case. In each story point the parent is responding to a researcher's question, in an attempt to further illuminate her ideas and thoughts around a specific case. We consider these video *Story Points* as scaffolding resources for a deeper and more reflective understanding of the case and the parent's views on relevant themes or issues.

USING AND EVALUATING PARENTS

The current version of PARENTS, as we described it above, was arrived at after several iterations. Not only did we base PARENTS on our design framework but also on the result of various pre-pilot tests we have performed with a small number of preservice science teachers, experienced teachers, and graduate students in science education. Using our development model we also incorporated feedback in the content and design from the project's advisory panel consisted of researchers in the fields of science education, parental engagement and technology.

Once we had a complete prototype in place that was satisfactory to both our pre-pilot teachers, graduate students and advisory panel, we formally piloted PARENTS in its intended setting: the first version of PARENTS was used by preservice science teachers who were enrolled in the "Elementary Science Methods" course, which was offered by the Science Education program at Teachers College, during the Fall 2002 semester. We employed various data collection methods, including survey, classroom observations, collection of written artifacts, and interviews with students in order to address our research questions (see Roushias et al, 2003).

Throughout our on-going data analysis we intend to document how PARENTS influenced what preservice teachers believed about parental engagement in science education, as well as how preservice teachers struggled to make sense of the practical reality of dealing with parents in the classroom, considering that they had never been responsible for a classroom in the same way that in-service teachers are. We should clarify that, since this is not a controlled study design, it could not yield claims about precise effects. In terms of user learning, we are not looking for precise effects rather we are documenting growth in thinking. Further discussion on the research analysis and findings is out of the scope of this paper.

FUTURE DIRECTIONS

It is important to remember that this study should be seen as a first step of a continuous process of design, development, and evaluation of the prototype version of PARENTS. The current prototype exhibits a set of limitations that will be taken under consideration into the next phase of its development. Based on the findings and results of the first implementation of PARENTS, several improvements or modifications will be made. These results will also inform the tentative design framework we have proposed and provide insights for a) future development of the system itself, and b) the way this multimedia case-based environment could be integrated and be used in the most effective way in the preservice teacher education setting.

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