

# Understanding Educational Technology through Special Education and Autism

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## ABSTRACT

This paper presents complementary views of education to the more traditional cognitive learning view of education represented in educational technology and Human-Computer Interaction (HCI). These views incorporate ideas from both a cultural anthropological view and a structural societal view and seek to expand how we think about education and thus how we think about HCI in education. This paper first presents a case study for which this extended model is considered and then overviews some of the historical treatment of education, special education, and technology for education.

## INTRODUCTION

Research in educational technology and more broadly in education within Human-Computer Interaction (HCI) often centers on a focus on learning, initially construed cognitively, but over time expanding to include informal learning, tacit knowing, and so on. The origins of HCI largely within both cognitive psychology and computer and information sciences explains much of this interest in cognition and efficiency even within the focus of learning—tools to support it, collaborative learning, effectiveness of pedagogical techniques, etc.

Taking a slightly broader look, however, we must consider two important points. First, an individual experiences education. Learning, skill development, cultural construction, and so on are just parts of that individual experience. Borrowing from the cultural-anthropological view of education, it ultimately relates to humans striving and how young humans learn to act and to think as they must act and think to maintain the culture into which they have been born. Second, education is itself an institution. Borrowing from the sociological view of the educational institution, it has an enduring social structure comprising roles, responsibilities, processes, and traditions that carry social meaning. What's more, education can be considered specifically a moral institution. That is to say that education, as an institution, is framed as a moral enterprise, one that serves the morality of society as a whole, one that focuses on what society should morally do for its members, and one that adds a moral dimension to the activities that happen within it.

These views represent just the tip of what researchers have been exploring within education and learning. The large domain problem of “education” is actually an innumerable multitude of problems worthy of study. Likewise, within my community of HCI, we have the opportunity to consider a variety of perspectives in education. Taking advantage of differing theoretical lenses, we can identify complementary themes, many of which can be supported with tools and techniques from HCI.

In the same way that examination of educational toys and games for children or websites, online learning, and new forms of technology enabled sense-making, allows us to think differently about traditional education and educational technology, so too does the examination of a different sub-domain, such as special education. Efforts such as the Autism Speaks Innovative Technologies program take a holistic view of technology support for a particular disorder, that of Autism Spectrum Disorder. Similarly, efforts such as the Autism and Technologies Special Interest Group at CHI 2007 or the Augmented Cognition workshop at the University of Rochester in 2007, likewise focus on a holistic view of these technologies, including both those related to education and those that expand into areas of well-being and physical health. We must consistently ask ourselves where these technologies fit and where the boundaries of educational technology lie. If we focus only on those that fit a structured, traditional educational environment, we leave out those technologies that are concerned with home education, learning in the world, and so on. If we include those technologies that support knowledge transmission and knowledge construction, we may leave out those assistive technologies that can be paramount to communication and to learning.

A cultural-anthropological approach to thinking about the education problem focuses on cultural production in a learning environment and fits with theoretical systems common in HCI, such as ethnomethodology and social phenomenology. On the other hand, a structural approach to examining the institutions within which those who teach, and those who learn, are

framed fits well with other theoretical systems common in HCI such as the structuralism common to Levi-Strauss, Foucault, and others. This brief review attempts to take a balanced look at special education, seeing agency and structure as complementary forces. This paper first presents a case study and then overviews some of the historical treatment of education, special education, and technology for education.

### **CASE STUDY: THE H.A.V.E.N. ACADEMY**

The H.A.V.E.N. (Hope, Achievement, Victory, Encouragement, Nobility) Academy is a regional program serving students with Severe Emotional and Behavioral Disorders (SEBD) and Autism. The program serves students from three large counties North-West of Atlanta, GA. The program includes multiple schools, two of which focus on foundational and basic skills and many of which serve as transitions between these schools and traditional schools that include students in both regular and special education. The mission of the H.A.V.E.N Academy is “successful reintegration of students into less restrictive environments,” a goal that meets with federal mandates for students to be educated in the “least restrictive environment.” The four cornerstones of this mission are:

- “Safety,” including “the physical, social and emotional health needs of the students, staff and the communities served”
- “Student Success”, including “skills training in order to facilitate increased independence”
- “Curriculum and Services...aligned with state standards and curriculum initiatives” and including expanded programs, such as “vocational programs, community based instruction, therapeutic programs, hands-on learning and access to curriculum and resources on an equal basis to regular education students”
- “Mutual Respect and Good Communication” designed to create a “harmonious, consistent and supportive educational environment”

I spent three years working with teachers, staff, and students from one of the schools in the H.A.V.E.N. Academy, a school focused on students with a variety of disabilities, all of whom exhibited severe behavior and none of whom were able to perform at higher than an elementary school level. Teachers with whom I worked had no more than 8 students in their classes, and all had the support of a variety of other personnel:

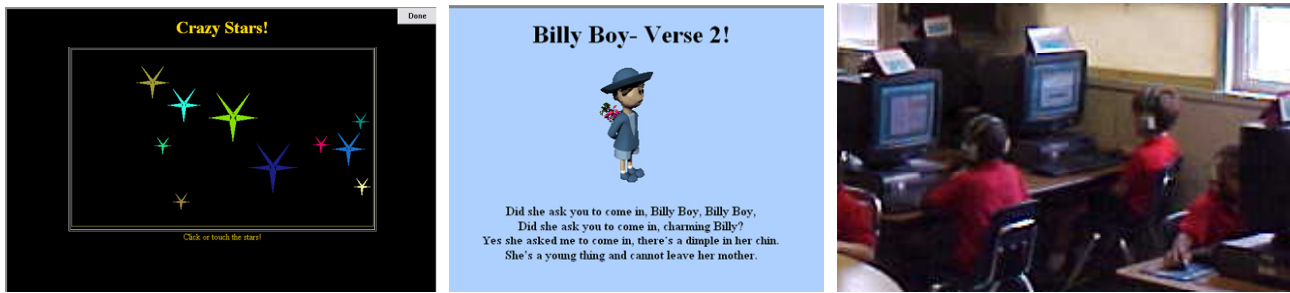
- Aides or para-professionals who work in the classroom with the teacher and typically have minimal training in special education
- Social workers who primarily provide case management, and in one classroom during my interactions, provided crisis counseling in response to the unexpected death of one of the students
- Psychologists and behavior intervention specialists who assist with testing and treatment plans
- A nurse who assists with the administering of regular medications and with any accidents or injuries
- Physical education and occupational therapy teams who instruct the students during gym and support physical interventions and treatments
- Speech and language pathologists who support speech and alternative communication therapies, including assistive technologies for communication



**Figure 1: Various tools and strategies for augmentative communication (from left) an alphasmart keyboard; a child choosing pictures in a row with a modified PECS board; a keyboard showing pictures for keys that then outputs spoken words; a student's communication “wallet” that he used to select individual items to request of the staff.**

Interactive computing abounds at this special school, and thus, so do the opportunities and challenges for HCI in education in this environment. Many of the students struggle to communicate, and a variety of tools and methods may be used to augment their communication skills. Communication tools range from networked keyboards to devices that take push button input and generate speech output from stock phrases to picture-based small mobile boards or collections for communicating basic needs and desires. Many teachers also communicate with students using a variety of physical objects mixed with sign language and verbal utterances.

Students also often interact with more traditional desktop computers, either through the keyboard and mouse or via touchscreen for those individuals lacking the manual dexterity to use a keyboard and mouse. Software, such as the Discrete Trial Trainer (Accelerations Educational Software, 2007) provide students with additional instruction during unscheduled time. The computer can also serve as a reward for students who get their other work completed.



**Figure 2:** Software like the Discrete Trial Trainer is used to augment classroom instruction (from left) an exercise to help students learn hand-eye coordination and to increase manual dexterity asks them to click on each star; a visual and audible rendition of a popular children’s song serves as a reward when students complete an exercise successfully; computer labs allow students to access this software, but modifications such as headphones must be made to ensure the students can focus on their own work.

Another common set of tools in special education classrooms includes the use of visual schedules and scheduled rotations at work stations. “Visual schedules display planned activities in symbols (words, pictures, photograph, icons, actual objects) that are understood in the order in which they will occur” (ICAN 2007). They present the abstract concepts of activities and time in concrete forms by using pictures, words, and other visual elements to describe what will happen, in what order, and where. Unfortunately, visual schedules can also be difficult to update quickly and the paper-based forms aren’t able to respond automatically to queues in the environment. Some teachers have attempted to keep scheduling information in digital formats. By so doing, they can create reports using the schedules and more easily recreate similar schedules or updated ones. They still must use the rudimentary tools supplied to them, however, and in most cases, are unable to print these digital schedules to a large format to be used by the students. Thus, they are often confined to the paper-based formats traditionally found in schools. I am currently developing computing visual schedule solutions to support greater interaction and collaboration amongst teachers, parents, and students through intelligent, connected systems.



**Figure 3:** Visual schedules can be placed on the wall for group activities (left) or created for individual use in a mobile or carryable format (right). The personal “wallet” shown here was developed as part of an integrated communication strategy, wherein the teacher would use verbal cues coupled with visual cues to remind the student of his tasks and ask him which reward he would choose. She often used this wallet as a visual schedule, showing the sequences of events like pages in a book.

Teaching students independence and job skills is paramount at this school. Two special learning labs support these goals: the Home Lab and the PAES (Practical Assessment Exploration System) Lab. The Home lab is a wide open room laid out like a studio apartment. It has a bed, dresser, and nightstand with lamp on one side. On the other side, there is a kitchen counter and cabinets, refrigerator, and microwave. In the center of the room is a table and chairs. All of the items have Velcro attached to them that corresponds to a laminated picture and text-based label describing the item. Depending on skill level, students may be given these labels as a collection and asked to place them on the objects or do more advanced activities such as setting the table or making the bed. Teachers work hard to make these low-tech solutions work as educational tools but complained that it was hard to document successful completion of the tasks and it took a long time to set up the activities, including tasks like collecting all of the labels.

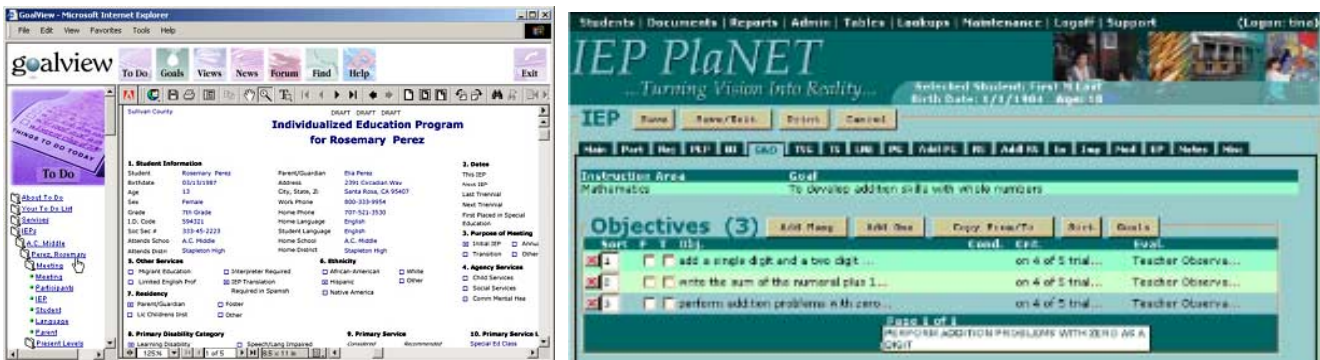
The PAES lab includes a large center table with chairs around it for staff and students to work together. On the outer walls are locked cabinets with potentially dangerous tools, such as saws and screwdrivers, and unlocked shelves and cabinetry holding activity kits. These kits allow students to practice tasks like screwing together two pieces of hardware, tying string,

or separating and sorting various items. For more advanced students, there are also cash registers, calculators, and other workplace items to be used to practice. For students with social and emotional disabilities but who are intellectually capable of achieving scholastic success, teachers also try to teach job training skills to help these individuals to learn to deal with the stresses of a workplace. Some are even going so far as to research “work from home” job opportunities and other non-traditional employment to support these students. Of course, being able to teach the students using the actual software employed by these distance work companies would also be desirable, but no teachers had been able to go this far in the effort.



**Figure 4: PAES lab equipment**

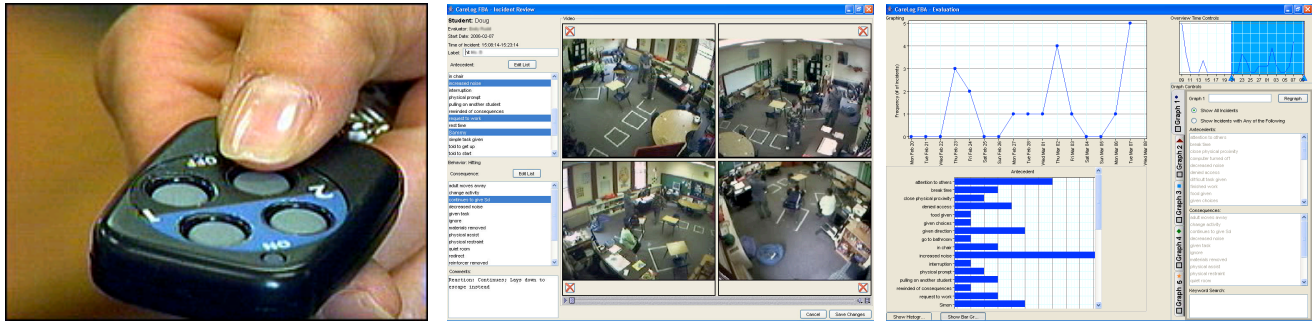
In addition to the many types of technology employed throughout the school for interaction with the students directly, teachers and staff members make use of a large amount of technology for their non-teaching work as well. For example, all students in special education in the United States must have an Individual Educational Plan (IEP) on file that has been agreed upon by all stakeholders. Teachers use this plan to monitor success throughout the year. Software vendors have created solutions to streamline this process (see Figure 5), but teachers still regularly complain that they can not easily use these systems to report true progress in skill acquisition. The person entering the data must write text-based descriptions of the skill and the progress, but this solution does not match teacher practice. For example, rather than describing improvement in the ability to cut paper following lines, most teachers keep work samples that are dated and quickly visually show progress. Similarly, for a skill like brushing one’s teeth, many teachers reported that recording a video weekly for the year of the student learning to brush his teeth would be much more effective than describing the progress. A special education teacher from another school with whom I worked during this same time period described taking great pains to create multi-media Power Point presentations to demonstrate this type of progress. As good as they are, none of the teachers at the H.A.V.E.N. Academy with whom I worked had the right combination of skills and tools at their disposal to create similar artifacts.



**Figure 5: Goalview and IEP PlaNET are both web-based solutions for entering and tracking IEP information. These are just two examples of this type of software. Goalview is used at the H.A.V.E.N. Academy and in many public schools.**

A very large part of the educational process in schools for students with severe emotional behavioral disorder (SEBD), on the autism spectrum, and with other social and behavioral disabilities is the reduction of severe problem behavior. At one extreme, these students may be putting themselves and others in serious physical danger. Reducing the behavior is paramount not only to safety but also to the ability to acquire any other knowledge or skills. At the other end, students who are relatively high functioning but have difficulty with certain behavioral issues, reduction of these behaviors may be the last hurdle needed to place these students back into a mainstream schooling environment or into the workplace. Determining why a student exhibits severe behaviors, or the function of the behavior, is the first step in treating the problem. It can also be the hardest part, because so many students are non-verbal, and their behaviors can be quite complicated and difficult to understand. The best practice for determining the function of behavior is called Functional Behavior Assessment and involves a lot of pen and paper record keeping, occasional video recording or observation by an external expert, and occasionally referral to specialist teams. These teams, known at the H.A.V.E.N. Academy as Technical Assistance for

Severe Behavior (TASB), sometimes record data in the classrooms and often test functions clinically in their offices and testing areas in another part of the school. During these sessions, the behavior experts use a DOS data recording program so old that a special laptop is kept in the office just to run it, because the software will not run on new computers. To support this process, I worked with teachers and other researchers to design and deploy a system known as CareLog at this school. The results were extremely positive and can be found in detail elsewhere (Hayes, 2007).



**Figure 6: CareLog included video cameras installed in the ceiling of each classroom that could be activated by the teacher with a small remote (left). Once recorded, teachers examined the behavioral incidents using our software and tagged the video data for analysis (middle). A graphing interface shows the tagged data in various formats used for reporting as part of the behavioral intervention and IEP process (right).**

The H.A.V.E.N. Academy serves as an excellent case study of special education. They are well equipped with staff members who try a wide variety of methods to help teach their students. They regularly hold educational and training seminars within the school to share success stories and trouble shoot as a group. They also struggle greatly with not getting as much technology as they would like or getting the wrong technology. They often describe getting used equipment from other schools, including equipment that is not necessarily appropriate for special education classrooms. All physical artifacts in a classroom, from computers to desks to cleaning supplies, must be stored in safe ways and be much stronger and more robust than one might need in a regular education classroom – it was common during my time in the schools to have such items thrown across the room. At the same time, significant investment must be made in the tools needed by students to communicate with teachers and by teachers to get the help they need in creating structure for the classrooms and reports for the required records.

## **A BROAD VIEW OF EDUCATION**

All of the activities at the H.A.V.E.N. Academy are a part of the educational process. These teachers don't differentiate teaching a student to brush his own teeth from teaching calculus in a high school. They see keeping a student from hitting himself as just as valuable as a student learning to dissect a frog. Thus, the technologies needed to support these activities are all educational technology—they all need better understanding of HCI in education. In this section, I review some ways to look at education that expand it from simply a notion of knowledge transmission or even knowledge construction. By understanding other ways of looking at education, we can, as a community, begin to look at HCI in education in a broader, more inclusive way. A unified view that considers both agency and structure proved useful in analysis of my experiences at the H.A.V.E.N. academy most specifically and in special education more generally. In this section, I focus first on an examination of cultural production in the educational environment and then on education as a structural institution.

### **Cultural Production in the Educational Environment**

Examination of cultural production within the educational environment provides us important tools to reveal a set of values about what “functioning” means in our society and about how we use education as a means for creating individuals who can “function” under those definitions. Within this understanding, we can then tease apart not only what it means to function appropriately within certain cultures—and thus how one comes to know the cultural mores inherent to that functioning—but also how these notions embody a set of properties, such as being a good citizen. I explore this concept of creating good citizens in a little more depth, due to its other interesting property of the temporality of citizenship and participation in our culture. The cultural transmission necessary to being building towards good citizens begins in childhood, for both neurotypical students and those with various social and cognitive disabilities. By exploring how culture is taught at this young age, we can envision how these “building blocks” lead into a longer term trajectory of cultural construction and how we might as a community influence that trajectory by arranging what is taught and in what order as a part of the cultural transmission process. Special education offers an opportunity to examine these issues quite explicitly, because both the pedagogical techniques and the technologies employed in these processes are focused on creation of students who can one day be “main-streamed”—that is to say, creating students who understand the implicit and explicit rules of our culture well enough to function appropriately within them.

### *Teaching as a Means for Cultural Transmission*

The LinguaLinks Library defines cultural transmission as “the process of passing on culturally relevant knowledge, skills, attitudes, and values from person to person or from culture to culture” (LinguaLinks Library 1999). Using this definition, teaching can readily be considered a dominant method for cultural transmission. Special education, and particularly the education of children with severe behavior disorders, is no different. At the H.A.V.E.N. Academy, teachers and staff use a variety of methods for teaching students “how to think, act, and feel” (Spindler and Spindler 2000, p.142) as part of this cultural transmission. Displaying “appropriate behavior” is an important goal, because appropriate behavior by all citizens is essential to the maintenance of the various cultural systems, both within and outside the school.

What is known as a Behavior Intervention Plan or BIP is often implemented in a school or in a home to help manage severe behavior. This plan details concrete responses to particular events. For example, a plan may include positive reinforcement items, such as giving a child the “thumbs up” every five minutes he is “on task.” It may also include responses to negative or inappropriate behaviors, such as restraining a child who is hitting himself or others. Some standard plans exist, such as the Psychoeducational Treatment Model (Criste *et al.* 2003), the SAM Model (unpublished work by Criste and Neal- White) and the Boy’s Town Approach<sup>1</sup> (Dowd *et al.* 1993; Baker *et al.* 1996) but many are individually developed for a particular child. These plans are essentially “culturally patterned lessons” in which the culture is particular to the school, home, country, etc. (Spindler and Spindler 2000, p. 144). One important part of the process of cultural transmission through teaching is the “management of discontinuity” (Spindler and Spindler 2000, p. 174), where “discontinuity occurs at any point in the life cycle when there is an abrupt transition from one mode of being to another.” Traditionally, educational anthropologists have focused on significant periods of transition that are also often accompanied by significant physical changes, such as at adolescence. In the case of children with severe behavior disorders, however, even points of discontinuity that may seem minimal on the surface, can be devastating. Thus, the introduction of a new behavior plan represents a period of discontinuity for these students. As a result, behavior may even spike temporarily. For example, a common BIP for a student who hits himself to get attention would be to ignore that student’s hitting, unless of course, it became so severe that his safety was in danger. Initially, the student may hit himself more, ostensibly working under the assumption that more hitting will eventually get him the attention he desires and he has received in the past. The goal of such plans, however, is to manage this period of discontinuity by following the precise directions until the behavior eventually subsides, as the student learns the new cultural norms of the classroom.

For children with autism, cultural transmission generally and periods of discontinuity specifically can be particularly difficult to manage. In describing the interactions of a family affected by Asperger’s Syndrome, Sacks reports the family members “know the rules and conventions of ‘normal’” but are unable to internalize these, to understand them at the level that those without such disabilities interpret the culture around them. Instead they learned “to ape human behavior” without fully understanding what’s behind the customs (Sacks, 1995, p. 263). Hendriks’s discussion of Collin’s Theory of Action (Collins 1990) as applied to an empirical study of a ward for children with autism (Hendriks 1998) illuminates many of these issues. Collins defines polymorphic and mimeomorphic actions to describe how it is that machines and humans continue to interact despite differences in their abilities to process certain types of stimuli and rules. Polymorphic actions are those that can be accomplished successfully in a wide variety of ways (poly, meaning many) and understood only within the context of society (poli, from the Latin root for people). He argues that people are only able to adjust to these minimal and changing rules, because they are raised by other people within a society and culture that are able to correct and provide feedback to those children regularly. Machines, on the other hand, must make use of more strict rules having not been raised by humans in the same ways. By his argument, man-machine interaction is only made possible by humans using only mimeographic actions, that is those that can be cleanly described and replicated in “space-time coordinates” (Collins, de Vries, and Bijker 1997, p.269, see also Collins and Kusch, 1998 for a slightly more recent examination). Hendriks notes that “there is a risk of being uncaring, even *hurting* autistic people, *precisely by treating them as fellow human beings.*” (Hendriks 1998, emphasis in the original text). According to Hendriks’s discussion of autism set against this theory of action, then, one way to communicate with children with autism is via a reductionist stance that changes many polymorphic actions into mimeomorphic descriptions that are communicated more easily to these children<sup>2</sup>. Thus, behavior intervention plans as tools for cultural transmission may

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<sup>1</sup> For students with intellectual and cognitive functioning within “typical” ranges, the H.A.V.E.N. Academy uses the SAM model primarily and custom interventions occasionally. On the other hand, the SAM model’s heavy emphasis on verbal communication makes it infeasible for the majority of the students with whom I worked. Instead, teachers of these students primarily combine and adapt other methods and create individual plans.

<sup>2</sup> It should be noted that Hendriks (and I) in no way meant to imply that children with autism are machine-like in the larger sense, only that this theory serves as an interesting backdrop for analysis of communication interactions between neurotypical and autistic individuals.

be so concrete, definitive, and unchanging in part because they aim to avoid a naïve humanistic stance that would be confusing and unclear for these children. On the other hand, however, as Hendriks also notes, “by setting its goals too narrowly, the approach carries a risk of reducing interactions ... to mere behavioral problem solving” (Hendriks, 1998). Thus, it is not surprising that behaviorists, teachers, and parents alike throughout my interactions with them often described behavior management as only the first step to broader educational goals.

#### *Education as a Path to “Good Citizens”*

When taken in a broad sense, the concept of education can be considered as a slightly more formalized version of “bringing up” into society while providing fundamental instructions regarding life in society. Thus, some sociologists have described education as a political system, intended as a pathway to the construction of good citizens (Bendix 1964; Tyack 1966; Meyer et al. 1979). Children learn constantly, and formal education may simply be a manner of attempting to adjust what it is children would learn naturally into what the adults of the culture wish those children to learn. Thus, educational systems can be seen both as descriptions of what is currently important in society, including social roles, and descriptions of what society wishes for the future (Meyer 1977; Kamens 1988).

As one example of examining the path towards citizenship from a cultural-anthropological, individualized perspective, Luykx (1998) describes how the state-run education system in Bolivia creates concrete practices of schooling work towards professional training and against indigenous identity formation and maintenance. The students, extremely poor native South Americans, marshal their own resources, including indigenous cultural resources, to “absorb and contest the ethnic, class and gender images meant to transform them from ‘Aymara Indians’ into ‘Bolivian citizens’.” Similarly, in special education in the United States, the goal is often to transform students from those with disabilities to typical functioning students and eventually to good American citizens. A counter-movement has begun in which individuals with autism protest the notion of transformation into outwardly appearing “neurotyps” for the sake of society. They argue, rather, that society should adapt to them, as has occurred to some degree in the past for individuals with physical disabilities. The scope of this paper, however, necessitates going into no more detail on this rich and interesting phenomenon.

Given a perspective of creating good citizens who function well in society, it is easy to imagine the ways in which behavior management can become a top priority amongst educators. To the degree that education is not only a political system but also an economic force, it can be seen as preparing good citizens who are also good workers.

Thus, a primary goal in some special education systems is to reduce behavior while building “job skills.” As described earlier, the PAES lab is an example of an explicit effort to develop such skills. Other social systems are also in place to scaffold the learning of these types of skills by children with special needs, such as job coaches. These coaches not only teach the particular skills required by a job (e.g., how to use a cash register) but also work with children and adults to help them understand the behaviors that are considered appropriate in different social settings by society as a whole and the workplace in particular. For those children with severe cognitive and/or physical deficits, a future goal of traditional work may be unrealistic. However, these children will still function in society within their roles. They may interact with other people outside of the home (for example, in the grocery store or on public transportation). They will certainly interact with individuals within their homes and at school. Thus, again, behavior management and adaptation to the rules that society has developed have emerged as goals within the education system.

#### **Education as a Structural Institution**

Special education, and the rights of and support for the students within it, make a fascinating case study for examination of education as a structural institution. Special education advocates, working hard to get students the best care possible, have inadvertently created a situation within which the modern state has established a new form of “governmentality,” (Foucault, 1979) in which the very nature of protecting the rights of this population, we subject them to a rational, normalizing lens. Dimitriadis and Carlson (2006) describe the process by which “special education” students become so labeled:

*This process draws together professional educators, psychologists, and doctors in diagnosing the learning “disorders” of individual students and then prescribing a “treatment.” The effect is that students are brought together under a totalizing and regulatory gaze, and teachers’ role is reconstituted around testing, record-keeping, monitoring, and surveillance.*

After the initial diagnostic and labeling period, students are still subject to measurement throughout their schooling. In my early interviews of parents with higher functioning children, in fact, one of the most recurrent themes of frustration surrounded this need to periodically re-assess to ensure that a child should continue to receive special treatment, indeed to ensure that the child still had the disability. Schools must make progress of some kind by law. They also must spend their limited resources in ways perceived to be most beneficial across the entire system. Thus, continued efforts towards designing the right metrics and measurement systems, implementing them, and taking action based on their results are prevalent. Furthermore, these issues fundamentally bring up considerations of how these organizations shape and frame questions of

what is ultimately taught. In this section, I first review concepts of measurement and accountability and then focus on how these organizations maintain societal structure based on decisions of what is ultimately taught.

### *Measurement and Accountability*

In line with a discussion about educational systems as creators of good citizens who function well in society is a note about the ways in which progress in these areas can be measured. In the 1980's and 1990's in most of the industrialized world a trend towards concepts of 'outcomes' and 'performance indicators' began to appear in education. Such movements have generally fallen under the categories of outcomes-based education (OBE) and standards based education (McNeir 1993). Nearly two decades later, a debate rages on within the education and sociology of education communities regarding the (de)merits of these metrics (see, for example, Glatthorn 1993, McKernan 1993, and Schafly 1993 in education and public policy and Smyth and Dow 1998 and Hargreaves and Moore 2000 in sociology). I summarize briefly in this section the primary issues and arguments inherent to this debate.

Outcomes-based education is one suggestion for educational reform designed to shift focus from the inputs, such as curriculum development, to the outputs, and work backwards from there to define the schooling experience. The definition of the outputs varies widely from school to school, system to system, and child to child. They can be described as anything from what the child learns to how the child tests to what the child does. Of course, some outcomes are vastly easier to measure in standardized ways than others, prompting some of the debate around these systems.

In special education, OBE has translated for the most part into the notion of Individual Education Plans (IEP). These plans are negotiated for each individual child on a regular schedule (typically once a year, but sometimes more frequently) and can include educational, behavioral, and independent living goals. Thus, the IEP can serve both as an individualized yearly curriculum plan and a yardstick by which to measure progress. As previously described, in many special education settings, software for the IEP is one of the most common interfaces to computing teachers experience.

Much like other outcomes based curricula, the teacher still holds at least nominal autonomy when it comes to the how of the implementation of these plans. Also like other OBE efforts, the exact levels of success of these plans, of teacher autonomy, of parental satisfaction, etc. can vary and are subject to the same critiques. The individualized nature of these plans coupled with a focus on measuring success necessitates intense documentation on the part of school staff including sample work products, behavioral reports, and sometimes video of both educational and behavioral progress. Finally, goals for special education students that require workplace or independent living skills can also require schools to accommodate new types of learning environments. For example, in some schools in Georgia, special "laboratories" have been constructed to simulate the home environment, the workplace (including machinery such as cash registers and parts to be assembled), and other external environments (*e.g.*, the grocery store). Goals for performance in these environments are set out and measured in much the same way as goals in the traditional special education classroom.

### *Maintenance of Societal Structure*

Education can also often be a means of maintaining societal structure. In some cultures, successful completion of the education and indoctrination process is assured for all members of society (Spindler and Spindler 2000, p. 182-188). The system provides a myriad of continuities, regardless of the challenges and stressors encountered by the pupils of the societal and cultural systems. Thus, at the end of the process, all members identify with the shared goals of the community and are committed to maintenance of these goals and the larger societal structure. Often, in Western and particularly American cultures, this attitude of assured success and conditions of continuity in the face of strife are not encountered by minorities (Jacob and Jordan 1987), including the minority of students placed in special education. Although people may not typically think of special education students as minorities, there are some important points to consider with regard to that distinction. First, according to the Office of Human Research Protections, these students may be considered "educationally disadvantaged" and thus in need of extra protection. Furthermore, according to the Individuals with Disabilities Education Act, as of 1997 in the United States, "more [racial] minority children continue to be served in special education than would be expected from the percentage of minority students in the general school population" and "poor African-American children are 2.3 times more likely to be identified by their teacher as having mental retardation than their white counterpart" (IDEA, 1997).

In Benedict's early work regarding cultural discontinuities (Benedict, 1938), she describes the ways in which distinct discontinuities for minorities and other fringe members of cultures exist that prevent them from being successful within many educational settings. Particularly for those individuals with autism who are higher functioning (*i.e.*, they can often "blend" into regular society), the criticisms of behavior and their way of viewing the world can be confusing, frustrating, and resultant in assured failures. Sinclair describes many of these discontinuities from the perspective of a high-functioning man with autism (Sinclair 1992).

Another aspect of many school environments that leads to these types of discontinuities is the rise in the practice of busing students from long distances and the distance, both geographically and culturally, between students' home lives and teachers. For example, at the H.A.V.E.N. Academy, the school's specialization in severe behavior necessitates that students from all



over three large counties attend. The school in which I primarily worked served only one county, but this county is quite large at 340 square miles. Teachers very rarely visit the homes of their students, in part due to the distance, and in part due to the legal and societal norms in place to keep these environments distinct from one another.

Furthermore, all of the teachers hold at least an undergraduate degree and many have also obtained Master's levels and other certifications. Meanwhile, the students in the school primarily hail from much lower socio-economic status and education levels, with nearly 80% of the students in the school participating in the free and reduced lunch programs.

Women make up the majority of professionals in education. Meanwhile, male students are more likely to have autism and/or severe behavior concerns. Finally, the majority of students in the school are non-Caucasian (many are foreign born or African-American), while the majority of teachers are Caucasian and American. I do not analyze these issues in detail in this document but do point out these potential discontinuities as factors that are likely to influence these results.

## **DISCUSSION**

A traditional view of educational technology focuses on those systems that support knowledge transmission, sense-making, and intellectual pursuits. Indeed, there is much of interest to the HCI community as well as to the field of education to study with regard to these technologies. At the same time, however, we must remember to take a broad view of education and therefore of HCI in education. In this paper, I have engaged the question of scope of those activities that we consider to be educational in nature using the backdrop of special education. Lest we believe that within education, however, it is only special education that considers these activities to be a part of the fundamental vision, however, I refer the reader to the mission statement of Philips Exeter, an elite private boarding school:

*Above all, it is expected that the attention of instructors to the disposition of the minds and morals of the youth under their charge will exceed every other care; well considering that though goodness without knowledge is weak and feeble, yet knowledge without goodness is dangerous, and that both united form the noblest character, and lay the surest foundation of usefulness to mankind.*

Many educational activities do not fit within the traditional scope of HCI in education, primarily a cognitive learning focus. The kinds of cultural transmission, cultural construction, and internalization of basic skills and knowledge that appear to happen seamlessly for much of the population require explicit instruction and support for the special education population. Indeed, if the founders of Philips Exeter – and many other educators – are to be believed, even for the brightest stars among us, an important goal of the educator must be to teach goodness, embrace the cultural mores we hold important, and otherwise develop a well-rounded student. The tools, methods, and technologies that fill these holes are often classified as assistive technologies or as unique applications (outside of education) within varied disciplines like HCI, Computer Supported Cooperative Work, or Ubiquitous Computing.

Frequently, special educators are left to adapt educational technologies designed for regular education classrooms or technologies designed for use quite outside of education to fit their needs. As a point of discussion, then, it may be that the poor return on investment within education that is sometimes claimed for educational technology is one symptom of the larger problem that we are not examining all aspects of education and all tools and methods related to it holistically. So, policy makers, purchasers, and implementers and designers must consider these issues and ask broader, more difficult question: What is learning? What is education? Eventually, when we have expanded our view of education and of HCI in education, we must then ask, how can technology help *this* learning process within *this type* of education in *this* environment?

Other disciplines offer us complementary views of education and learning. By exploring both the cultural and individual aspects of education and its organization and structure, we can expand our view of educational technology. I have outlined some of these views and surrounding issues. I have also used a case study description of special education at one school to demonstrate the myriad of ways HCI is impacting special education. There is much more to be done, however. At conferences like Computer Supported Cooperative Learning (CSCL) and the International Conference of the Learning Sciences (ICLS), we are beginning to hear the grumblings of a conversation about the meaning of education and its scope, and therefore the meaning and scope of technologies to support these activities. This paper serves to further that conversation. It is now time to ask the HCI community to reexamine conceptualizations of education, what these theoretical underpinnings lead us to do and also what they may lead us to miss, and from this examination and discussion formulate a path to the future.

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## REFERENCES

- Accelerations Educational Software. [www.dtrainer.com](http://www.dtrainer.com). Accessed in September 2007.
- Baker, C.B., Burke, R.V., Herron, R.W., and Mott, M.A. (1996). *Rebuilding children's lives: A blueprint for treatment foster care parents*. Boy's Town Press, Boy's Town, NE.
- Bendix, R. (1964) *Nation Building and Citizenship*. John Wiley and Sons, New York: NY.
- Benedict, R. (1938) Continuities and discontinuities in cultural conditioning. Bobbs- Merrill, Indianapolis, IN
- Collins, H.M., de Vries, G.H., and Bijker, W.E.. (1997). Ways of going on: An analysis of skill applied to medical practice. *Science, Technology, and Human Values* 22: 267- 285.
- Collins, H. M., & Kusch, M., (1998) *The Shape of Actions: What Humans and Machines Can Do*, Cambridge, Mass: MIT Press.
- Cote, J.E. & Levine, C.G. (2002) *Identity Formation, Agency, and Culture: A Social Psychological Synthesis*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Criste, T.R., Sterba, M.N., and Davis, J.L. (2003). Psychoeducational Treatment Model: Helping Behavioral Health Professionals Care for and Treat Troubled Adolescents.
- Dimitriadis, G. & Carlson, D. (2006) *Promises to Keep: Cultural Studies, Democratic Education, and Public Life*. New York: RoutledgeFalmer.
- Dowd, T., Tobias, L., Connolly, T., Criste, A., and Nelson, C. (1993). *Specialized Classroom Management: A Boy's Town approach*. Boy's Town Press, Boy's Town, NE.
- Foucault, M. (1979) On governmentality. *Ideology and Consciousness* 6, 5-22.
- Glatthorn, Allan A. "Outcome Based Education: Reform and the Curriculum Process." *Journal of Curriculum and Supervision* 8, 4 (Summer 1993): p. 354-63.
- Hargreaves, A. and Moore. (2000). "Educational Outcomes, Modern and Postmodern Interpretations: response to Smyth and Dow." *British Journal of Sociology of Education* 21(1): 27-42.
- Hayes, G.R. (2007) *Documenting and Understanding Everyday Activities through the Selective Archiving of Live Experiences*. PhD Thesis, Georgia Institute of Technology. ETD number: etd-05172007-161038
- Hendriks, R. (1998) Egg Timers, Human Values, and the Care of Autistic Youths, *Science, Technology, and Human Values* 23(4): Special Issue: Humans, Animals, and Machines, p. 399-424. Sage Publications, Inc.
- Horner, R.H. and Carr, E.G. Behavioral Support for Students with Severe Disabilities: Functional Assessment and Comprehensive Intervention. *Journal of Special Education* (1997). 31(1): 84-104.
- ICAN. "Visual Schedules" part of the Interactive Collaborative Autism Network Online Learning Modules, within behavioral Interventions. Accessed at <http://www.autismnetwork.org/modules/environ/visualschedule/index.html> in July 2007.
- Iwata, B.A. *et al.*, Toward a functional analysis of self injury. *Analysis and Intervention in Developmental Disabilities* (1982).
- Kamens, D.H. (1988) Education and Democracy: A Comparative Institutional Analysis. *Sociology of Education*. 61(2): 114-127. April 1988.
- LinguaLinks Library, Version 4.0, published on CD-ROM by SIL International, 1999
- Luykx, A. (1998) *The Citizen Factory: School and Cultural Production in Bolivia*. New York: State University of New York Press, December 1998.
- McKernan, J. "Some Limitations of Outcome-Based Education." *Journal of Curriculum and Supervision* 8, 4 (Summer 1993): 343-53.
- Meyer, J.W. (1977) "The Effects of Education as an Institution" *American Journal of Sociology* 63:55-77.
- Meyer, J.W., Tyack, D., Nagel, J., Gordon, A. (1979). "Public Education as Nation Building in America" *American Journal of Sociology* 85:978-986.
- Philips-Exeter. [http://www.exeter.edu/about\\_us/about\\_us\\_286.aspx](http://www.exeter.edu/about_us/about_us_286.aspx). Accessed in September 2007.
- Sacks, O. 1995. An anthropologist on Mars. In *An Anthropologist on Mars: Seven Paradoxical Tales*, 233-282. London: Picador.
- Sasso, G.M. *et al.*, Use of descriptive and experimental analyses to identify the functional properties of aberrant behavior in school settings. *Journal of Applied Behavior Analysis* (1992) 25.
- Schlafly, P. (1993) "What's Wrong with Outcome-Based Education?" *The Phyllis Schlafly Report* 26, 10 (May 1993): 1-4.
- Sinclair, J. (1992) "Bridging the gaps: An inside-out view of autism (or, do you know what I don't know?). In *High-functioning individuals with autism*, edited by E. Schopler and G.B. Mesibov, 294-302. Plenum, New York, NY.
- Smyth, J. and Dow, A. (1998) "What's Wrong with Outcomes? Spotter planes, action plans and steerage of the educational

workplace." *British Journal of Sociology of Education*. 19(3): 291-303.

Spindler, G. and Spindler, L. (2000) *Fifty Years of Anthropology and Education: 1950- 2000, A Spindler Anthology*. Lawrence Erlbaum Associates, Mahwah, NJ.

Tyack, D. (1966) "Forming the National Character." *Harvard Educational Review* 36:29-41.

Umbreit, J., Functional Assessment and Intervention in a Regular Classroom Setting for the Disruptive Behavior of a Student with Attention Deficit Hyperactivity Disorder. *Behavioral Disorders*, (1997) 20(4): 267-278.