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Distance education for gifted students: leveraging technology to expand academic options

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Technological advances and widespread access to the Internet are facilitating new educational approaches that go beyond the traditional face-to-face classroom setting. Distance education has emerged as a valuable option for a number of special populations of learners whose needs are more difficult to meet in the classroom, of which gifted students are one. This paper explores the many varieties of distance education and the technologies that support them and examines research on the effectiveness of the approaches in different settings. Research on the distance education programs offered by the Johns Hopkins University Center for Talented Youth is summarized and best practices, based on the findings, are proposed.

Introduction

Meeting the special needs of students with extraordinary academic ability is a continuing challenge for educators, parents and society in general. A number of options are available, both within the school environment and outside it, including special gifted and talented programs, acceleration, differentiation, summer programs, such as that offered by Johns Hopkins University Center for Talented Youth (CTY), and others. Now, with access to the Internet and information technologies becoming widely available in homes, schools, libraries and other settings accessible to students, another alternative can be offered to these students: distance education.

Distance education has grown dramatically in the last decade, particularly as educators have improved strategies to leverage the power of communications technologies. In the USA, for example, the majority of institutions of higher education now offer some form of distance education, and enrollments have soared (Waits & Lewis, 2003). Most of the enrollments are at the undergraduate level, but

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graduate courses and programs offered at a distance are growing as well. For pre-collegiate students distance education options have also expanded (Carr & Young, 1999). For example, virtual high-schools have opened in which students can take one or more courses online, and even earn a high-school degree. Administrators view distance education options partly as a means to reach specialized groups of learners who are unable to enroll in regular classes or who may not be well served in larger classrooms in which the curriculum targets the majority of students (Berman & Tinker, 1997).

For the specialized group of learners who are academically gifted, distance education offers unique opportunities to supplement and expand academic programs available locally. Specially developed virtual learning environments may provide a means for highly able students to take on more advanced work on flexible schedules, obtain guidance from geographically distant instructors and interact with their intellectual peers around the world. While distance education programs may benefit gifted students, there is considerable variety in the nature of distance education programs and debate over the effectiveness of distance education in general. This paper examines the issues surrounding distance education and describes the CTY model.

Defining 'distance education'

Terms such as distance education, distance learning, E-learning, telelearning, virtual learning environments and distributed learning are now in common use, but their definitions are not entirely clear (Garrison & Shale, 1987; Verduin & Clark, 1991; Keegan, 1996; Rekkedal & Qvist-Eriksen, 2003; Wallace, 2004). Programs identified by the same term may differ substantially in many ways and programs with different names may be quite similar. A wide range of technologies have been used to support the programs and definitions of distance education have been muddled by the particular technologies that were used. Although these technologies can have important influences on the success and effectiveness of the program, they are not necessarily connected to the terms listed above.

Consider, for example, the use of interactive videoconferencing to interconnect geographically separated classrooms. A teacher is in one of the classrooms with 10 or 20 students sitting in rows of desks and a camera transmits the teacher's image to the remote students, located in other classrooms, typically in different schools. Cameras in the remote sites transmit images to the teacher's class and may zoom in when one of the remote students has a question, so everyone can see who is talking. The class, with its three separate locations and one teacher, meet each day during a regular class period. This model has been deployed in many school districts to offer a wider range of courses to students in the school setting, when enrollments would be quite small in each school and only one teacher is available. Classrooms connected through interactive video in this fashion have been mistakenly equated to the entire universe of 'distance learning'. Nevertheless, this model is considerably different from other models of distance learning, such as web-based online courses or self-paced computer programs.

A commonly used framework to characterize distance education programs stresses the dimensions of geographical location or space and time (Figure 1). The lower left encompasses the typical classroom environment, in which students and teacher meet in the same place at the same time. The other three quadrants show learning environments which separate students and the teacher geographically, in terms of time or both. Although a simplified taxonomy is helpful to better understand how learning activities occur outside the face-to-face classroom environment, many of the most effective distance programs incorporate elements of more than one quadrant. Increasingly programs are 'hybrids' that blend elements together to create a richer learning experience and to meet the needs of a specialized population of learners.

Technologies used for distance education

Various technologies have been used to support distance education programs and each one can produce educational experiences that are quite different from one another (Taylor, 2001). Technology is often used to deliver content, through online lectures for example, and also to support and enhance the media richness of the communication channels used for interactions. Figure 1 provides examples of common technologies mapped against the space and time dimensions and shows that certain technologies are best suited to support a particular quadrant. Interactive videoconferencing supports the 'different place, same time' approach, while a web-based discussion forum, in which students read posted messages and make contributions at any time, supports 'different place, different time'.

	Synchronous Interaction	Asynchronous Interaction
Different Place	Group interactive video Desktop interactive video Live chat sessions Webcams Audioconferencing/Phone Collaborative groupware Internet whiteboards	Online discussion forums Email Voicemail Videomail Video on demand Webcasting Collaborative document editing
	Classroom-based Instruction	Shared Use
Same Place	Electronic blackboards Presentation equipment "Smart" classroom Teaching theater Groupware (Live)	Computer labs Self-paced shared courseware Classroom computer station
	Same Time	Different Time

Figure 1. Distance education matrix and supporting technologies

Most programs use more than one type of technology and blend them together in ways that create an optimal mix. For example, a web-based course in which most of the interaction among students and with faculty is through an asynchronous discussion forum may also include scheduled virtual meetings. Students might simultaneously log onto an interactive whiteboard in which all can see and contribute to a shared online workspace.

Technologies found useful for distance education have also begun to penetrate traditional educational settings, often as supplements. Course web sites have become common in higher education, for example, and instructors use them to post lecture notes, assignments, syllabi and other material. They often include discussion forums as well, in which students can interact asynchronously.

Comparing distance education and classroom instruction

Considerable research has been conducted to compare the effectiveness of distance education and classroom instruction (for recent reviews see Jung & Rha, 2000; Berge & Mrozowski, 2001). Much of this research involves comparisons of individual courses taught at a distance to a counterpart taught in the classroom. Results from these studies have been quite varied: many show no differences in outcomes such as student satisfaction and student achievement, while others show advantages for distance education or for classroom instruction. Unfortunately, most studies suffer from one or more methodological flaws, such as lack of random assignment of students, the use of different teachers or different course materials, variation in course requirements or expectations, among others.

More recently, several meta-analyses of the research have been conducted in an attempt to quantitatively synthesize the results from the large body of heterogeneous research findings. Again, the results have been mixed. Shachar and Neumann (2003) examined 86 studies and found that, overall, student performance was higher for the distance education students. Allen *et al.* (2002) found slightly higher levels of student satisfaction for classroom instruction in their study pool, but no differences in other outcomes. Bernard *et al.* (2004) examined 232 studies and found essentially no differences in student achievement, student satisfaction or student retention. However, this major study did find a very high degree of variability in the effect sizes, indicating that many distance education settings far outperform their classroom counterparts, but many others perform far worse. Another intriguing finding was that asynchronous distance education settings were associated with higher student achievement compared with classroom instruction, but the reverse was true for synchronous distance education settings.

Most studies comparing distance education with classroom instruction involve higher education, but some analyses have been performed on distance education for K-12. Cavanagh (2001) conducted a meta-analysis of studies in which classes taught via interactive technologies, such as the interactive video example described earlier, were compared with regular classroom instruction. No significant differences in student achievement were found.

From the findings and trends described above it becomes clear that efforts to compare distance education and classroom instruction have led to few if any conclusive results. The studies fail to capture the range and richness of the variety of both classroom and distance education settings. A more fruitful approach is to examine the range of alternative educational strategies that have, through advances in information and communications technologies, become available to reach special populations whose educational needs are not fully met. How should distance education be used to create rich learning environments that supplement classroom settings, but not necessarily replace them? What benefits can distance education offer gifted students that may not be available at all through regular classrooms? CTY's distance education program for gifted students, described in the next section, takes this approach.

The Center for Talented Youth distance education program

The CTY at Johns Hopkins University began a pioneering distance education program for students of very high ability in 1984, with a writing course developed through funding from the National Endowment for the Humanities. Since then the program has grown to more than 6000 enrollments per year and offers more than 45 courses in writing, mathematics, computer science, biology, chemistry, physics, psychology and other subjects. Students come from over 50 countries throughout the world and work on their courses from their homes or schools. Mathematics courses are available to students as young as 5 years old and writing courses are open to Grade 5 and up. Teenagers have many options for advanced courses, including a wide range of advanced placement courses.

Students become eligible to enroll in CTY's distance education based on their performance on above grade tests (Brody & Mills, 2005). Those who show advanced ability in the verbal area are eligible to take courses in writing, humanities or the social sciences. Students who qualify on the quantitative portion can enroll in mathematics, computer science or science courses. CTY's philosophy is to focus on nurturing each student's strongest areas.

CTY's program is not intended to be a substitute for a full curriculum. Instead, the program provides gifted students who are attending school with year round options for advancement, acceleration and enrichment in the students' strongest subjects. Some students, with support and guidance from their own teachers and school administrators, use CTY distance courses to replace a regular course at school and earn credit and/or placement. Instead of attending the regularly scheduled mathematics course, for example, the CTY student goes to the computer laboratory and works on a more advanced course appropriate to the student's ability. Other students take distance courses as supplements to their regular school curriculum, and a great many enroll during the summer. CTY distance courses have also become integral components in the curriculum for homeschooled gifted children.

Analysis of the program

Enrollment patterns in distance education courses indicate strong growth trends, with increases of over 12% per year for the past 3 years. Since the program's inception students from more than 50 different countries have enrolled. Approximately two-thirds of students re-enroll and take one or more additional courses through CTY's distance education program. Students enroll in CTY distance courses for a variety of reasons, such as a desire for greater intellectual challenge, a strong interest in the subject or an interest in obtaining advanced standing or credit in their schools in subjects in which they are most able. Depending on the subject, their intentions vary significantly. For example, 50.6% of students enrolling in mathematics courses report seeking credit or placement, compared with 37.9% of students enrolling in writing courses.

The mean age at which students enroll has changed over time. Initially most students were in middle-school, but as more students in elementary school became eligible and more courses were made available to them, the mean age of students declined (Figure 2). Enrollment patterns by gender show that boys tend to be more likely to qualify in the quantitative area than girls and also tend to choose courses in that area, especially mathematics. In 2004, for example, boys constituted 64.1% of

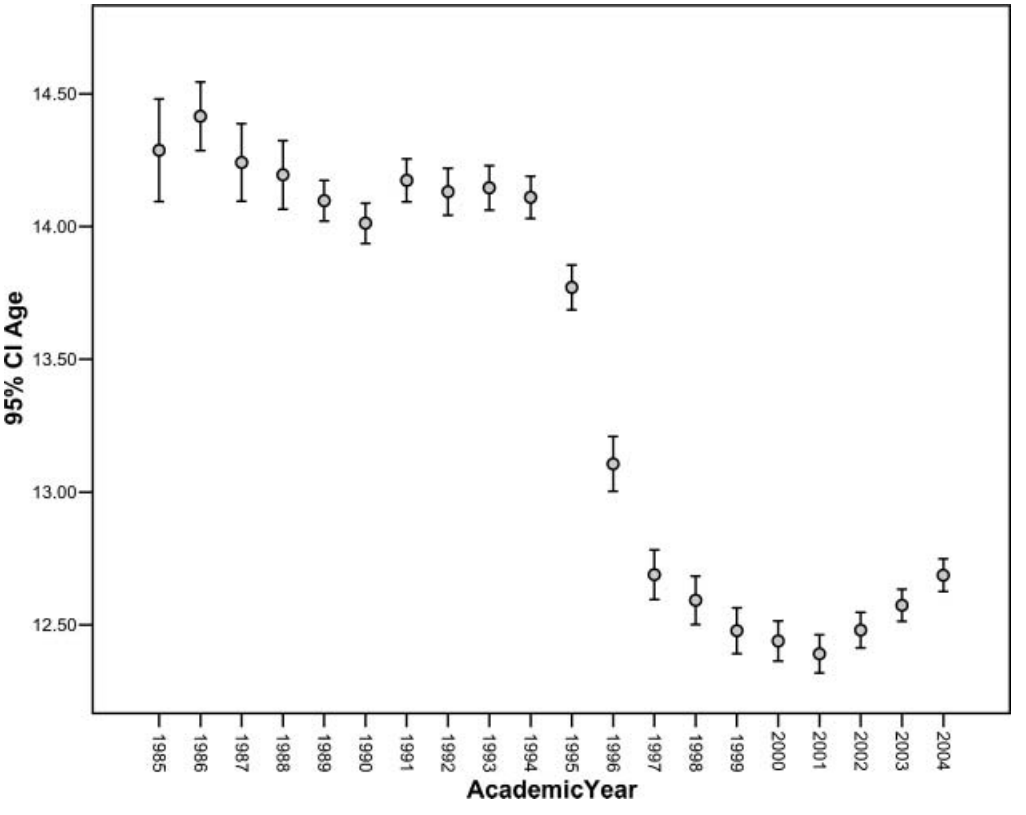

Figure 2. Mean age of students enrolling in CTY distance education courses since 1985

Table 1. Correlations among student attitudes toward their distance education courses

	Overall I am satisfied with my academic experience	Instructor's overall effectiveness as a teacher	Instructor's knowledge of the subject	Instructor's ability to explain difficult concepts
Overall I am satisfied with my academic experience	1	.488(**)	.347(**)	.408(**)
Instructor's overall effectiveness as a teacher	.488(**)	1	.502(**)	.620(**)
Instructor's knowledge of the subject	.347(**)	.502(**)	1	.563(**)
Instructor's ability to explain difficult concepts	.408(**)	.620(**)	.563(**)	1

** Correlation is significant at the 0.01 level (2-tailed).
n=1340

enrollments in courses requiring a qualifying score in the quantitative area. In contrast, courses requiring a qualifying score in the verbal area, such as the writing courses, have gradually become more balanced in terms of enrollment by gender since the mid 1990s.

Student evaluations of the distance education program show that students find these courses very challenging, and 75% reported that their course was either 'demanding, yet appropriate for me' or 'very demanding, and tested my limits'. Students rate their distance education very positively: over 90% report being 'satisfied' or 'very satisfied' with their experience in distance education. Overall satisfaction levels are significantly correlated with the students' evaluation of the instructor (Table 1), highlighting the importance of the instructor's role in distance education for gifted students.

Very few programs offer distance education courses for young students in elementary school. However, CTY's experience demonstrates that gifted younger students perform very well and enjoy their courses as much as students in upper grades. Comparisons of course evaluations for younger and older students reveal no significant differences with respect to overall satisfaction levels or instructor ratings. Significant differences, however, emerged between lower and upper level students on ratings involving the length of the course and the intellectual challenge involved. Younger students were more likely to report that they thought their course was too short and that they would have been able to handle more challenge.

CTY distance education program: key elements and best practice

In the two decades since the program began much has been learned about best practices for reaching gifted students through distance education. CTY's approach has evolved over time, especially as computers and the Internet have become much

more widely available and feedback from students and parents was received. As discussed earlier, there are many approaches to distance education, but the CTY approach stresses certain key elements that have been found to be successful with gifted students.

The role of instructors

Students are individually assigned to an instructor, most of whom have advanced degrees in the subject they are teaching, including a Ph.D. Students get to know their instructors in the context of a mentoring relationship. Instructors are trained on pedagogical techniques appropriate for gifted students by CTY and provided with instructor guides.

For many distance education programs the 'class' is the dominant metaphor and students are grouped into large sections with one instructor. In that model students may interact frequently in large groups, but have fewer opportunities for individual interaction with the instructor. CTY, however, stresses the one-to-one relationship between instructor and student. Although students are often grouped into virtual workshops or classes so that they have opportunities to interact with one another, all students frequently interact with the instructor, who provides timely, individual feedback to each student. Instead of a 'class' metaphor, CTY's approach emphasizes individual tutoring.

Clarifying expectations

Requirements for a course and expectations about student conduct must be made very clear to each student, and also to parents. These include expectations about assignments, deadlines, grading and other course matters, as well as rules of conduct for online behavior and interactions. Expectations for instructors must also be very clear on issues such as performance evaluation, student interactions, timeliness and student evaluations.

Academic content and pacing

Academic content and course materials must match the gifted student's need for challenge and rigor and must allow each student the flexibility to pursue his or her personal best in the subject. Typical distance education courses in which material is presented at a predetermined pace and students proceed in lockstep regardless of ability are not ideal for gifted students, who vary considerably in their ability and interest levels and also their time commitments. To meet these challenges, CTY has developed courses in different formats. Mathematics and computer science courses are individually paced and students work under the guidance of their instructors to proceed through a course at a speed appropriate for the student. Writing courses are more structured in terms of time, but assignments and instructor feedback for each student are closely tailored to the student's ability level. Course materials are selected or developed to engage gifted students and avoid unnecessary drills and

repetition. Many courses make extensive use of multimedia CD-ROMs and online material and students have extensive control over the actual pacing of the presentations.

The role of technology

CTY's approach avoids 'bleeding edge' technologies to ensure that the learning curve and set-up time are as short as possible. Most technologies support asynchronous interactions (web-based discussion board, E-mail), but a synchronous interactive whiteboard is a common feature of mathematics and science courses since it easily supports mathematical symbols and diagrams.

Support services

CTY provides various types of support for distance education students and instructors, including academic advice and counseling, placement tests and technical support. Students also have access to CTY's Diagnostic and Counseling Center, CTY summer programs and other CTY programs and services.

Support services for instructors are also critical to a successful distance education program. CTY provides a variety of training materials and programs for instructors and supports both in-person and online forums for instructors to discuss program-related matters, share best practices and assist one another. Instructor supervisors provide training and mentoring and also review many of the communications between instructor and student.

Community building

Highly gifted students often find themselves with few or no intellectual peers in their local school and CTY's distance education program can provide them with opportunities to interact with other gifted students. These interactions may take place within the context of the course, such as in writing courses in which students critique one another's work. They also occur in more general forums in which students discuss a wide variety of topics and often engage in creative projects.

Conclusions

As CTY's experience demonstrates, distance education can be a highly effective educational approach to meet the needs of the special population of gifted learners. By leveraging information and communications technologies now widely available, distance education can reach gifted students throughout the world throughout the year and engage them in learning activities appropriate to their ability levels, without taking them away from their local school environment. It can create a community of learners who are intellectual peers, capable of advanced academic challenges in particular areas, without regard to the geographic location of the students.

The CTY program does not attempt to juxtapose distance education against classroom instruction nor does the program attempt to mimic a classroom experience. Instead, it recognizes the different advantages of each type of setting and emphasizes the use of distance education to supplement, enrich and enhance each student's school-based learning environment.

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