Distance Learning for Gifted Students: Outcomes for Elementary, Middle, and High School Aged Students

Patricia Wallace
The Johns Hopkins University Center for Talented Youth

Although distance learning often is cited as a potentially useful strategy to provide appropriately challenging academic coursework to gifted students, little research has been conducted on its use or effectiveness with this population, particularly with younger students in elementary school. In this study, distance learning outcomes for gifted students from age 5 to 17 were examined, drawing on student and parent evaluations and final grades, and comparing results by age group. Overall, the students and their parents found the course an effective learning experience. Elementary school age students reported different reasons for enrolling, rated their instructors significantly more favorably, and found their course to be slightly less demanding compared to older students. However, they rated software usability somewhat lower. The findings point to the potential for distance learning for gifted students, even those in elementary school, and suggest issues that should be considered to ensure success.

Technology-based distance learning programs have grown considerably in the past decade, expanding academic options for students in many different situations. Much of this growth has been fueled by programs designed for college-level students (Waits & Lewis, 2003), with soaring enrollments at both the undergraduate and graduate levels. Online distance learning opportunities for younger students also are expanding. For example, a survey of public school superintendents conducted by the National Center for Educational Statistics found that about one third of public school districts had students enrolled in distance courses during the 2002–2003 academic year (Setzer & Lewis, 2005). Seventy-two percent of those districts planned to expand further. Distance learning programs also have become more widely available and accessible to homeschoolers and to students who participate independently, outside the auspices

Patricia Wallace is with the Johns Hopkins University Center for Talented Youth, as Senior Director of CTY*Online* and Information Technology.

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of their schools. Increasingly, students and schools are taking advantage of distance learning programs to expand access to a wide range of academic material and coursework.

Research on the effectiveness of distance learning programs vis-à-vis classroom instruction has been voluminous, at least for college-level students and older (for reviews, see Berge & Mrozowski, 2001; Jung & Rha, 2000). The research studies, for the most part, have employed comparisons of outcomes for students enrolled in distance education courses and students in traditional face-to-face courses, a design that has certain limitations in terms of the conclusions that might be drawn about any differences that distinguish the two settings (Zhao, Lei, Yan, Lai, & Tan, 2005). The characteristics of the two learning environments have varied dramatically across the studies, and a number of meta-analyses have appeared that attempt to synthesize large numbers of studies. For example, Shachar and Neumann (2003) examined 86 studies and found a slight advantage for distance education students in terms of final grade. Another meta-analysis (Allen et al., 2004) came to a similar conclusion, with slightly better performance for distance education students, based on a review of more than 500 journal papers and other manuscripts. A meta-analysis that focused on student satisfaction found slightly higher satisfaction levels for students taking traditional classroom instruction compared to those in distance education settings (Allen, Bourhis, Burrell, & Mabry, 2002). Bernard and colleagues (Bernard et al., 2004) analyzed 232 studies containing hundreds of measures of achievement, attitude, and retention outcomes and concluded that overall, there were essentially no differences between the two learning environments on these variables. Meta-analyses on studies of distance learning outcomes for students below the college level are more limited, but findings have been similar. Cavanaugh (2001) analyzed studies that compared classes taught via interactive video versus regular classroom instruction and found no differences in student achievement measures.

Although overall differences in attitudes, performance, or other measures are typically small or absent, a common ingredient for all of the meta-analyses is high variability, suggesting that the "devil is in the details." Some distance education settings with some populations

of students result in quite positive outcomes, while others do not. The same variability appears in classroom settings.

Gifted students represent one of the populations for which distance learning may be particularly suitable (Adams & Cross, 2000). Although research on the use of distance learning in this group is limited, the findings suggest positive results. For example, early distance learning projects involving gifted students in rural settings using synchronous, interactive technologies have shown promising outcomes, with students becoming more independent learners in addition to having access to courses that would not otherwise be available through their schools (Lewis, 1989; McBride & Lewis, 1993). Another project involving high school students at the North Carolina School of Science and Math offered advanced classes through interactive video to talented students at sites throughout the state (Wilson, Litle, Coleman, & Gallagher, 1997). Students reported that they learned a great deal and felt that time was not wasted, but some preferred to have the teacher in the room. This kind of distance learning also has been used effectively in Israel to reach talented students in geographically isolated and underdeveloped areas (Offir, Barth, Lev, & Shteinbok, 2003).

More recently, distance learning programs relying on the Web have overtaken the older technologies, which primarily relied on closed, interactive video networks linking physical classes in different locations together. The newer programs are far more accessible, more conducive to "anytime, anywhere" learning, and emphasize more asynchronous interactions with instructors and other students via discussion forums and e-mail, which have been found to produce more positive outcomes (Bernard et al., 2004). Although the newer distance learning formats often include some synchronous interactions, students and teachers can access the Web-based virtual classrooms from any computer equipped with multimedia capability, so they do not have to be physically present in a specially equipped classroom. Olszewski-Kubilius and Lee (2004) studied gifted students taking distance honors-level and AP courses relying mainly on a Web-based learning environment and found that students were generally quite satisfied with the program and that the courses prepared them well for the AP exams. The most common reasons for enrolling

in a distance course were interest in the subject area, a desire to enrich their learning, or the course was not offered in their schools.

Research on the effectiveness of distance learning for younger students, particularly younger gifted students, is extremely limited. Nevertheless, the number of students in elementary and middle school engaged in distance learning is growing, and research is needed to explore the effectiveness of this approach. Such programs can offer a number of advantages, including tailored learning opportunities and access to specialized coursework not available through the student's school. Young gifted students who excel in mathematics, for example, can be offered advanced coursework through distance learning without the need to transport the student to a higher level school or hire teachers for very small, advanced classes. The flexibility offered by distance learning programs to students in lower grades, along with the ability to customize the coursework to each student, make the programs more attractive.

Purpose of the Study

The purpose of the present study was to explore the effectiveness of distance learning for gifted students along several different dimensions and to compare the outcomes for students in different age groups. The study was intended to examine, both as a whole and by age group, the reasons gifted students enroll in distance education, how they evaluate their academic experience and instructors, how their parents evaluate the course's suitability, how well they perform in terms of final grade, and how the distance learning course affects their interest in the subject. The evaluations and findings from the younger gifted students of elementary school age were of special interest in this study because little information about the effectiveness of distance learning in this age group is available.

Method

Participants

Participants were drawn from the students enrolled in the Johns Hopkins University Center for Talented Youth (CTY) distance education program who submitted online course evaluation forms between July 1, 2005, and March 30, 2007. The sample included 690 students, (age 5.23 to 17.67, $M = 12.75$, $SD = 2.18$; 56.5% girls, 43.5% boys). More than 94% resided in the United States, and the remainder registered from 16 other countries.

Course Formats and Evaluations

The students had all taken 1 of 54 different courses in math, writing, science, language arts, computer science, and Advanced Placement. Although there is variability in the actual course formats, these distance learning courses share a number of characteristics. They are all led by instructors who interact with the students using e-mail, interactive whiteboard, online discussion forums and virtual classrooms, and telephone. Most interaction with students is asynchronous, although some synchronous communications are scheduled using virtual classrooms; shared whiteboards with support for math symbols, drawing, text, and audio; and by phone. Instructors in certain math courses, in particular, make use of the interactive whiteboard to work with students, while writing instructors emphasize written interaction and occasional phone calls. Course materials vary by course and may include multimedia software on CD-ROM, online course materials and activities, textbooks, workbooks, videos, and audio files. Assignments and assessments of academic progress are embedded in the courses and occur frequently.

After the end of the course, students are asked to complete a course evaluation via an e-mail containing a link to the evaluation forms. Forms that did not include valid student identification numbers were omitted from the pool because they could not be reliably paired with demographic information or course data. Students who submitted forms but for whom birthdates were not available were

also omitted. Finally, students who had submitted more than one evaluation form because they had enrolled in more than one course during the period were identified, and only the earliest course evaluation form was included in the sample.

The online course evaluation process also included a separate form for parents to complete that assessed satisfaction with the logistical aspects of the course, as well as the parents' evaluation of the suitability of the course for their child. Of the 690 students in the sample, 340 parents completed and submitted a form. Their responses were merged with the students' records for analysis.

Data Analysis

Information for the study included (a) responses to the course evaluation forms submitted by the students, (b) responses submitted by their parents for the same course, (c) demographic data contained in the student information system, and (d) final course grade. The information addresses several dimensions, including (a) reasons for enrolling, (b) appropriateness of the course for the student, (c) instructional effectiveness, (d) software effectiveness, (e) overall satisfaction, and (f) student outcomes as measured by performance and interest in the subject after completing the course.

Based on the age at which students began the course, students were grouped into three age categories, generally corresponding to the ages of students in elementary school, middle school, and high school. The students' actual grade levels may not correspond to this age grouping perfectly, however, since the age of gifted children may underestimate the actual grade in school. Nevertheless, the group labels serve as a useful guideline and are used to identify the age groups: (1) Elementary: under 11.00 years (n = 140, M = 9.59, SD = 1.29); (2) Middle School: 11.00 to 13.99 years (n = 335, M =12.56, SD = .83); and (3) High School: 14 years and older (n = 215, M = 15.14, SD = .84).

Table 1

Responses to "Which Best Describes Your Academic Plans?" by Age Group

Responses	Elementary	Middle	High School	Total
No specific plans	23.9%	19.6%	21.5%	21.0%
Plan to repeat the same class at school	3.7%	3.8%	4.5%	4.0%
Hope to get credit/placement and use as prerequisite	22.4%	25.6%	20.5%	23.3%
Hope to use as prerequisites for other CTY courses	42.5%	35.3%	27.0%	34.3%
Hope to get credit or placement	7.5%	15.8%	26.5%	17.4%
N (valid responses)	134	317	200	651

Results

Reasons for Enrolling

Students' reasons for enrolling, as indicated by their academic plans, are shown in Table 1. A nonparametric test comparing frequencies shows significant differences by age group, Pearson χ^2 (8, N = 652) = 25.969, p = .001 (two-tailed), w = .20. Younger students are somewhat less likely to be interested in taking the course for credit or placement and are generally more likely to want to use the course as a prerequisite for other CTY courses or to have no specific plans. The effect size w indicates a small to medium effect (Cohen, 1988).

The students' responses about their feelings about the subject matter before taking the course also shed light on their reasons for enrolling. Table 2 shows the results from this question by age group. The responses also differ significantly by age group, Pearson χ^2 (6, N = 659) = 23.975, p =.001(two-tailed), w = .19. Younger students express a strong interest in the subject matter before the course begins, suggesting that a major reason for enrolling is simply a strong interest in the subject. The effect size w indicates a small to medium effect (Cohen, 1988).

Table 2

Responses to "Feelings About the Subject Before Taking CTY Distance Course" by Age Group

Responses	Elementary	Middle	High School	Total
Not interested in subject	2.2%	5.3%	7.9%	5.5%
Did not know enough about subject	4.4%	11.3%	10.9%	9.7%
Somewhat interested in subject	39.4%	49.7%	39.1%	44.3%
Very interested in subject	54.0%	33.8%	42.1%	40.5%
N (valid responses)	137	320	202	659

Table 3

Responses to "My Course Was . . ." by Age Group

Responses	Elementary	Middle	High School	Total
Too short	5.7%	7.2%	5.6%	6.4%
Just the right length	83.6%	77.2%	79.4%	79.2%
Too long	10.7%	15.6%	15.0%	14.4%
N (valid responses)	140	333	214	687

Appropriateness of the Course for the Student

Tables 3 and 4 show responses to the question about the course's length and intellectual challenge level. There were no significant differences in students' perceptions of the length of the course by age group, Pearson's χ^2 (5, N = 687) = 2.869, p = .580, but differences did appear for the level of intellectual challenge, Pearson's χ^2 (8, N = 689) = 19.868, p = .011(two-tailed), w = .17. In general, older students tended to rate their courses as somewhat more demanding compared to younger students, with an effect size w evaluated as small to medium (Cohen, 1988).

The evaluations by parents also bear on the issue of appropriateness. Table 5 shows the mean responses on the question concerning the suitability of the course by the age group of the child taking the course. A 5-point Likert scale from 1 (*very dissatisfied*) to 5 (*very*

Table 4

Responses to "The Level of Intellectual Challenge in my Course was . . ." by Age Group

Responses	Elementary	Middle	High School	Total
Not demanding	9.3%	2.7%	3.3%	4.2%
Somewhat demanding	20.7%	17.6%	20.6%	19.2%
Demanding, but appropriate for me	54.3%	59.4%	49.1%	55.2%
Very demanding and tested my limits	15.0%	19.4%	26.2%	20.6%
Too demanding	.7%	.9%	.9%	.9%
N (valid responses)	140	335	214	689

Table 5

Parents' Evaluations of the Suitability of the Distance Education Course for the Child, Rated From 1 (*Very Dissatisfied*) to 5 (*Very Satisfied*)

Age Group	*M*	*n*	*SD*
Elementary	4.44	105	.784
Middle	4.52	164	.795
High School	4.37	71	.960
Total	4.46	340	.828

satisfied) was used, resulting in an ordinal scale. In general, parents were quite satisfied with the course in terms of its suitability (M = 4.46, SD = .828). A large majority of the respondents (89.2%) indicated that they were *satisfied* or *very satisfied* with the course's suitability. An analysis of variance shows no significant differences among the age groups, $F(2, 337) = .897$, $p = .409$.

Student Perceptions of the Instructor's Effectiveness

Students using a 5-point Likert scale from 1 (*strongly disagree*) to 5 (*strongly agree*) responded to several questions assessing their perceptions of their instructor and their interactions with their instructor.

Table 6

Students' Evaluations of Instructors by Age Group, Rated From 1 (*Strongly Disagree*) to 5 (*Strongly Agree*)

	Elementary			Middle			High School			Total		
	M	*n*	*SD*	*M*	*n*	*SD*	*M*	*n*	*SD*	*M*	*n*	*SD*
My instructor knew a lot about the subject.	4.76	140	.507	4.66	332	.637	4.54	215	.660	4.64	687	.624
My instructor explained ideas and concepts to me well.	4.44	140	.807	4.35	332	.840	4.19	215	.930	4.32	687	.867
I felt comfortable asking my instructor for help.	4.39	140	.895	4.28	332	.832	4.23	215	.918	4.29	687	.873
My instructor provided timely feedback.	4.75	140	.467	4.41	333	.858	4.35	215	.954	4.46	688	.840
My instructor provided useful feedback on my work.	4.59	140	.720	4.49	331	.821	4.36	214	.913	4.47	685	.835

Table 6 shows the means for each of these questions by age group. To assess group differences on these related questions, a multivariate analysis of variance (MANOVA) was performed and Wilks' lambda computed for age groups, $F(10, 1354) = 3.010, p = .001$. The results indicate that the age groups differ significantly with respect to their responses on these questions. Between-subjects tests for each question (see Table 7) indicate that significant differences at the .05 level appear for four of the five items, and, in all of those cases, younger students rated their instructors more positively compared to the older students. For the item about feeling comfortable asking the instructor for help, the younger students' mean response was also higher than the other two age groups, but the difference was not significant.

Table 7

Tests of Between-Subjects Effects for Evaluations of Instructors by Age Group

Dependant Variable	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Effect size*
My instructor knew a lot about the subject.	3.941	2	1.970	5.113	.006	$\eta^2 = .015$ $\omega^2 = .012$
My instructor explained ideas and concepts to me well.	5.909	2	2.954	3.956	.020	$\eta^2 = .012$ $\omega^2 = .008$
I felt comfortable asking my instructor for help	2.312	2	1.156	1.515	.221	None*
My instructor provided timely feedback.	14.980	2	7.490	10.968	.000	$\eta^2 = .032$ $\omega^2 = .029$
My instructor provided useful feedback on my work.	4.327	2	2.163	3.121	.045	$\eta^2 = .009$ $\omega^2 = .006$

Note. Effect sizes for η^2 and ω^2 can be interpreted as small (.01), medium (.06), and large (.14; Cohen, 1988; Volker, 2006). Effect sizes were not computed for nonsignificant findings.

Student Evaluations of Software

Students' evaluations of the software were assessed in three questions on the course evaluation form to evaluate ease of installation, ease of use, and overall effectiveness. Table 8 shows the mean responses to these questions by age group. To assess group differences on these questions, a MANOVA was performed and Wilks' lambda computed for age groups, $F(6, 336) = 3.653$, $p = .001$. The results indicate that the age groups differ significantly with respect to their responses on these questions. Between-subjects tests for each question (see Table 9) indicate that significant differences at the .05 level appear for the question about usability. Younger students indicated that they found the software somewhat less easy to use compared to older students. Differences between the means by age group were not significant for

Table 8

Students' Evaluations of Software by Age Group, Rated From 1 (*Strongly Disagree*) to 5 (*Strongly Agree*)

	Age Group											
	Elementary			Middle			High School			Total		
	M	*n*	*SD*	*M*	*n*	*SD*	*M*	*n*	*SD*	*M*	*n*	*SD*
The software was easy to install.	4.29	78	.839	4.47	148	.742	4.45	117	.866	4.42	343	.809
The software was easy to use.	4.08	78	1.05	4.50	148	.733	4.45	116	.806	4.39	342	.855
Overall, the software was an effective learning tool.	4.28	78	.866	4.26	147	.892	4.15	117	.976	4.23	342	.915

Table 9

Tests of Between-Subjects Effects for Evaluations of Software by Age Group

Dependent Variable	Type III Sum of Squares	*df*	Mean Square	*F*	*p*	Effect size*
The software was easy to install.	1.719	2	.859	1.323	.268	None*
The software was easy to use.	9.698	2	4.849	6.858	.001	$\eta^2 = .195$ $\omega^2 = .165$
Overall, the software was an effective learning tool.	1.297	2	.648	.772	.463	None*

Note. Effect sizes for η^2 and ω^2 can be interpreted as small (.01), medium (.06), and large (.14; Cohen, 1988; Volker, 2006). Effect sizes were not computed for nonsignificant findings.

the questions about ease of installation or about effectiveness as a learning tool.

Students' Overall Satisfaction Level

Table 10 shows student responses to the item on the course evaluation form concerning how much they enjoyed the course. The majority (74.3%) of the students reported that they usually or always

Table 10

Student Responses to "I Enjoyed my Course . . ." by Age Group

Responses	Elementary	Middle	High School	Total
Never/Almost never	4.3%	3.0%	5.6%	4.1%
Sometimes	16.4%	21.5%	25.1%	21.6%
Usually/Always	79.3%	75.5%	69.3%	74.3%
N (valid responses)	140	335	215	690

Table 11

Mean Student Responses to "How Satisfied Are You With Your Academic Experience?", Rated 1 (*Very Dissatisfied*) to 5 (*Very Satisfied*)

Age Group	*M*	*n*	*SD*
Elementary	4.32	137	.757
Middle	4.37	320	.700
High School	4.25	202	.835
Total	4.32	659	.756

enjoyed their course. There were no significant differences based on age groups. Frequencies were used to describe the results for this measure because of the nature of the response categories.

Table 11 shows the means for the question concerning overall satisfaction (rated on a Likert scale from 1 [*very dissatisfied*] to 5 [*very satisfied*]). Students generally were quite satisfied with their courses ($M = 4.32$, $SD = .756$) A one-way analysis of variance (ANOVA) to test differences among the means by age group revealed no significant differences, indicating that overall satisfaction levels were about the same for all groups.

Student Outcomes

Measures used to assess outcomes in the course included the final course grade and the students' response to a question on the course evaluation form about the students' feelings about the subject after

Table 12

Mean Final Course Grades by Age Group

Age Group	*M*	*n*	*SD*
Elementary	4.04	92	.34
Middle	3.92	142	.42
High School	3.97	86	.35
Total	3.97	320	.38

having taken the course. As a program for highly gifted students, instructors with CTY do not award grades for many courses; instead instructors provide a detailed final evaluation and critique designed to help students improve, even if students are already earning what would be considered an A+ in a regular class. However, students are awarded grades in many classes, particularly math, science, and computer science courses in which quantitative assessments are common and articulation with school curricula may lead to higher placement. Grades also are assigned upon request. For the 690 students in the sample, 320 had been awarded grades. For the purpose of analysis, letter grades were converted to numeric grades (A+ = 4.33, A = 4.00, A- = 3.67, B+ = 3.33, B = 3.00, B- = 2.67, C+ = 2.33, C = 2.00). Table 12 shows the mean grades by age group. Overall, students performed extremely well, with a mean grade of approximately A ($M = 3.97$, $SD = .38$). Furthermore, a one-way ANOVA revealed no significant differences among the means for the three age groups on course grades.

The results for the item on the course evaluation form about the students' feelings about the subject after completing the course are shown in Table 13. Overall, more than 61% indicated that they became more interested in the subject, while only 3.5% indicated they became less interested. No significant differences by age group were found for this item.

Discussion

The findings in this study address several aspects of the effectiveness of technology-based distance education for gifted students at

Table 13

Student Responses to "Which of the Following Statements Best Describes Your Feelings About This Subject Now That You Have Taken This Course?" by Age Group

	Age Group			
Responses	Elementary	Middle	High School	Total
Less interested in subject	2.9%	2.7%	5.2%	3.5%
No change in interest	37.1%	34.1%	36.3%	35.4%
More interested in subject	60.0%	63.2%	58.5%	61.1%
N (valid responses)	140	334	212	686

different ages and compares outcomes for elementary, middle, and high school aged students. Although distance education options are becoming increasingly available for students seeking advanced coursework, most of the courses are designed for older students, particularly those in high school or college. Some evidence is available that supports the effectiveness of distance education options for these older students, yet little is known about how well this approach will work for younger students.

The reasons for enrolling in a distance learning course for the participants in this study vary by age group. Older students were more interested in taking a course to obtain credit or placement, while younger ones appear to be less concerned about those issues, and more interested in the subject matter of the course. Many high schools award credit for distance learning courses, and a growing number of schools are enrolling students as a credit-bearing alternative to regular classes. In contrast, far fewer middle schools offer distance learning, and elementary school programs are extremely rare. Setzer and Lewis (2005) found in their survey that among all the public schools with students enrolled in distance learning courses, 76% were high schools, 20% were combined or ungraded, 4% were middle schools, and fewer than 1% were elementary schools. This preponderance of offerings at the high school level also is reflected in the age groups of the enrolled students. Of the estimated 328,000 distance education enrollments among public schools students, 68%

were in high school, 29% were in combined or ungraded schools, 2% were in middle or junior high schools, and 1% came from elementary schools (Setzer & Lewis, 2005).

In general, students of all ages considered the course they took to be appropriate in terms of its length and its intellectual challenge. Younger students, however, rated their courses as somewhat less demanding compared to middle school and high school students. Younger students tended to rate their instructors more positively compared to middle and high school students. They also indicated that they felt comfortable asking the instructor for help, an important component that contributes to the effectiveness of distance learning. Remote instructors are not able to see puzzled facial expressions, so a proactive willingness to ask for help is important to the student's success.

Parents also considered the course in which their child was enrolled to be quite suitable, regardless of the child's age. Parents were given guidelines about how to support the child's distance learning experience that emphasize the parents' role in encouraging the students to do the best work possible and providing reminders about timeliness and frequent communication with instructors. They were not expected to serve as instructors or tutors, although some may have wanted to help the student with difficult material, much as they would for a classroom-based course. Parents also may have helped students with the use of the technology, particularly very young students.

Student ratings of the software by age group were mixed. All mean ratings on this question were above 4.0 on a 5 point scale, so, overall, the students found the software to be generally easy to use, easy to install, and effective as a learning tool. However, the students' ratings of usability differed significantly by age group. Posthoc comparisons using the Scheffé test indicated that the significant group differences were largely due to the lower ratings given by the elementary-level students. Software usability is important in all distance learning settings but is particularly so for younger students.

Students' overall evaluations of their course reflected generally quite positive attitudes with no significant differences by age group. Students in different age groups also earned equally high grades, and the majority of all age groups indicated that their interest in the subject increased after having taken the course.

Limitations

This study examined a variety of measures related to the effectiveness of distance learning for gifted students in K–12 by analyzing the overall responses and also comparing the results according to the age of the student involved. A limitation on the conclusions regarding any differences between the age groups in attitudes or outcomes is that age group is partially confounded with instructor, course, software, previous experience with technology and distance learning, and other variables. For example, instructors typically teach students taking several different courses in one discipline, such as math, science, or writing, although most focus on certain grade levels. The course in which the student is enrolled is a confounding variable in this study, although not as strongly as might be expected because of heterogeneity in age within individual courses. Many courses, such as most Advanced Placement courses or math for grades 1 through 4, enroll students from only one age group; however, others include students from two or even three age groups. For the 54 courses in this study, student ages were confined to one age group in 24 of the courses (44%) and spanned two age groups in 26 courses (48%). Seven percent of the courses enrolled at least one student from every age group.

Younger students tended to rate many features of their distance courses more favorably, even when the mean differences by age group were not significant. It is possible that younger children are somewhat less critical and show a slight response bias toward overall higher ratings. However, their significantly lower ratings for software usability would argue against this hypothesis.

Distance learning programs vary a great deal, and the findings from this study may not apply to other kinds of programs. For example, a key feature of the distance courses in this study is a high level of instructor involvement, a factor that may contribute to the overall high evaluations, and the very high evaluations of instructor effectiveness, particularly by younger students. Another feature of the program under study is that while the courses may include some synchronous interactions, such as shared use of an Internet whiteboard, most interaction occurs asynchronously. Results from programs that contain more synchronous interactions may differ from the findings in the present study.

The overall response rate for parents was considerably lower than for students, and this presents a potential bias for the findings for the parents' evaluations of the appropriateness of the course for their child. Parents who did not complete the evaluation form may perceive the course differently.

Implications for Gifted Education

Overall, this study suggests that distance education can be an effective approach to accelerate or enrich the academic opportunities available to gifted students in grades K through 12. Distance learning is frequently included as one of the options for introducing acceleration and enrichment into the curriculum for gifted students (e.g., Adams & Cross, 2000; Brody, 2004; Southern & Jones, 2004), yet research on its effectiveness for this population has been limited. Nevertheless, online programs are becoming increasingly available, not only for gifted students but for all students, and enrollments are growing in all age groups.

The role that distance learning can play in the academic development of gifted students is potentially an important one. For homeschooled students, for example, distance learning provides a means to introduce advanced studies in subjects outside the expertise of the students' parents or tutors. It also introduces new curriculum and new styles of teaching and learning. For students whose schools provide few opportunities for advanced studies or acceleration, distance learning provides a means to enrich their regular curriculum after school or during the summer months.

Distance Learning in School Settings. Distance learning also can play an important role in school settings as well, particularly to alleviate scheduling conflicts and to provide access to courses that are not offered in the school. Rural school districts, for example, are increasingly taking advantage of distance learning to expand options for their students (Setzer & Lewis, 2005).

As schools increasingly emphasize heterogeneity and greater academic and cultural diversity in classrooms, the challenge to provide differentiated education to a wider variety of learners escalates. Yet while teachers and school administrators endorse the need to

address academic differences within the classroom, effective differentiation has been challenging and often elusive (Tomlinson et al., 2003). Studies suggest that many teachers, including those teaching gifted students, either do not attempt to differentiate the curriculum, or make only minimal changes (Archambault et al., 1993; Hootstein, 1998; Moon, Tomlinson, & Callahan, 1995; Reis et al., 1993; Schumm & Vaughn, 1995; Tomlinson, 1995; Westberg, Archambault, Dobyns, & Salvin, 1993). As classes become more academically diverse, differentiation becomes even more difficult for teachers to accomplish effectively, and new approaches are needed. Distance learning presents one such approach because it is well suited to provide appropriate and individualized levels of challenge to each student without grouping high-ability students separately or busing them to schools serving higher grades. The U.S. Department of Education recently published an innovative guide containing case studies of online learning opportunities, describing how they work and how they can facilitate access to advanced courses in schools (WestEd, 2007).

Distance Learning and Young Students. The findings from this study also indicate that younger gifted students can benefit from distance learning opportunities at least as much as older students, provided their needs are taken into account. In particular, the findings suggest that software usability should be a key concern for distance learning programs for gifted younger students and that adequate technical support be available for them. Given the significantly more positive ratings that young students gave to their instructors, the findings also suggest that the role of the remote instructor may be especially critical to the success of distance learning for young students. The effect sizes for all the significant differences that were found between age groups fell in the small to medium range.

Although still few in number, elementary schools are beginning to offer distance learning options. The interest in distance learning as an alternative for these younger students may partly be due to general limits on the availability of any kind of gifted program at the elementary level. Swiatek and Lupkowski-Shoplik (2003), for example, studied high-ability students in grades 3–6 and found that distance learning programs were available to only 2% of the respondents, a

percentage that aligns with the overall availability of distance learning at the elementary school level (Setzer & Lewis, 2004). The majority of students in their study, all of whom were scoring at or above the 95th percentile on standardized achievement tests, reported no special programming available through their school.

Limits on the use of distance learning for young gifted students also may be due to teacher attitudes about the use of technology for young children and the special challenges involved (Shaunessy, 2007; Wright, 2001). Critics of the use of technology for learning with young children claim that it can be developmentally inappropriate, benefits to learning are not well researched or documented, and entertainment rather than learning tends to be the main focus in much of the educational software for that age group (Cordes & Miller, 2000). Clearly, research is needed to better understand how young children can benefit from the use of these powerful technologies, especially given the enormous variety of software available employing quite different pedagogical approaches, themes, and instructional design elements. The way the software is actually used in a learning setting will also be an important variable to consider, particularly the amount of guidance provided by the instructor. The National Center for Educational Evaluation and Regional Assistance publishes a clearinghouse of research that includes reports on trials of educational software by age group and subject, which highlights the variability in effectiveness (see http://ies.ed.gov/ncee/wwc/index.asp).

Technology-Mediated Learning Environments: Pros, Cons, and Future Developments. Distance learning is essentially a technology-mediated learning environment that involves spending significant time at the computer, interacting with remote instructors and students, working through software lessons, taking quizzes and exams, entering virtual classrooms, viewing multimedia lectures, conducting online research, writing essays, engaging in discussion, and solving problems. The components that make up this mix have improved considerably in the past decade through growing experience and best practices, widespread availability of high speed Internet access and support for audio and video interactivity, as well as the development of more effective and engaging software. A variety of software products classed as educational has generally been found to lead to learn-

ing gains for students, even very young ones, although some results have been mixed and many variables contribute to outcomes (Kulik & Kulik, 1991; Wright, 2001). Efforts are underway to develop more systematic methods for evaluating software products for their pedagogical usability, effectiveness as learning tools, motivational qualities, and even for their perceived level of "fun" (Nokelainen, 2006; Sim, MacFarlane, & Read, 2006; Squires & Preece, 1999; Wallace, 2005).

Nevertheless, distance learning presents challenges and risks that differ from learning situated in more traditional face-to-face settings. Technical problems are not uncommon, and software usability issues often continue to hinder teachers and students. Developing an online course requires specialized training and innovative thinking about how a course should be structured when the teacher is not in front of the room leading the class. Nonverbal communication is diminished considerably in distance learning environments, and greater emphasis is placed on skills such as writing, time management, technology literacy, and independent learning.

Although the technology for distance learning has improved a great deal, most programs lag well behind what students experience outside the educational arena, particularly in video and computer games and in online virtual worlds. These environments contain compelling features that may hold promise, and experiments are underway to explore their potential. For example, professors at some universities hold their distance learning classes on Second Life, a virtual world in which students can design their own avatars and interact with one another on a computer-generated landscape (Foster, 2007). Although virtual worlds offer intriguing educational possibilities, they also bring significant technical, behavioral, and educational challenges. For example, online environments tend to encourage disinhibited behavior, particularly if they are not well-moderated and if participants use fanciful avatars as their personas (Wallace, 1999). More research is needed to better understand how emerging technologies, such as the virtual worlds, can be leveraged for education, and features that add value can be integrated to enrich distance learning.

Future Research on Distance Learning for Gifted Students

Gifted students represent a special population of students for whom technology-based learning environments may be especially appropriate given their cognitive advancement and facility with technology in general (Cross, 2004; Siegle, 2005), as well as their special need for advanced coursework that may not be readily available in their schools. Based on the results of this study, gifted students at the elementary, middle, and high school levels all benefit from distance learning. Nevertheless, the area has received little research attention, and many questions remain about how to implement it, how to tailor the material to provide appropriate levels of challenge to each gifted student, and how to integrate it within a school setting. Also, more research is needed to explore individual differences and identify students who possess the level of readiness to thrive in a distance learning environment in terms of their capacities for time management, technological literacy, writing skills, and even keyboard skills. Qualitative research, in addition to the quantitative research presented in this paper, will be very useful in better understanding how individual students interact with their remote instructors and their online learning materials and how they, their parents, and their teachers perceive the pros and cons of online learning. Such research will contribute to the rapidly growing efforts to create improved online courses and instructional strategies that will help individualize and differentiate instruction for gifted learners.

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