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Compensatory Computer Technology for Disabled College Students: Applications and an Evaluation of Student Use, Satisfaction, and Academic Outcomes

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Abstract

In this paper we will provide a summary of evaluation results on student use, satisfaction, and academic outcomes resulting from the use of compensatory technology services. Evaluation results indicated a high level of student use, belief by students that compensatory systems were helpful, and improved student academic performance.

Much of the literature on computer services for postsecondary disabled students has focused on Sections 504 and 508 concerns related to making campus computer resources accessible to disabled students (e.g., Brown, 1987, 1989; Keddy, 1988, 1989). Although access to existing computer resources is a necessary aspect of postsecondary disabled student services, a second type of computer service, compensatory technology, can also be provided. Compensatory technologies are applications that integrate the language generation, information processing, and communication capabilities of computers with the capabilities of the student to enhance overall functioning and alleviate limitations on participation (Horn, Shell, & Severs, 1986b, 1988).

The purpose of this paper is to provide postsecondary service personnel with an overview of compensatory technology applications and a summary of evaluation results on student use of compensatory technology applications, student satisfaction with compensatory services, and student academic outcomes resulting from the use of compensatory services. The data to be discussed were obtained from a three-year evaluation of the Educational Center for Disabled Students (ECDS) at the University of Nebraska-Lincoln, a demonstration project established through a Federal Department of Education Grant (see Horn & Shell, 1988; Horn, Shell, & Severs, 1986a, 1987).

Compensatory communication systems all utilize a basic computer system consisting of a microcomputer and word processing software. They can be created on any of the commonly used personal computers, although, some applications cannot be implemented on Macintosh computer (see Brown, 1987,1989; Shell, et al., in press for more complete discussions of implementing compensatory systems on specific computers). To utilize a compensatory application, students must be able to operate the computer hardware and software and enter text. Adaptive interfaces are necessary for students who cannot effectively use the standard computer interfaces of keyboard, video display screen, or mouse. An extensive body of literature exists on available adaptive equipment and software (see Brandenburg & Vanderheiden, 1987a, 1987b, 1987c; Brown, 1987, 1989; Keddy, 1988, 1989).

The types of compensatory systems described in this paper are designed to meet the educational needs of students and enhance their educational performance. With these goals, it is critical to know if students will utilize compensatory applications if they are provided, whether students are satisfied with available compensatory applications and find them to be beneficial, and if providing compensatory computer applications will have a positive effect on academic success.

At the ECDS, compensatory communication systems were provided to students with physical, visual, speech, hearing, and learning disabilities for three years. These systems were designed to improved the expressive capabilities of students by augmenting existing communication abilities or providing alternative communication methods. The computers were housed in an accessible facility near the Handicapped Services Office of the university. One full-time coordinator and two graduate assistants were available to train students in operating the systems, assist with system set-up and operation (e.g., booting programs, physically changing disks, assisting with printer operation), and provide help with program operation. Since the establishment of the ECDS, students have utilized ECDS compensatory communication systems to complete papers for courses, take examinations, communicate in classrooms, and deliver oral reports. Detailed discussions of the technical aspects of compensatory communication systems with specific examples are available in Horn, Shell, and Benkofske (1989), Horn, et al. (1988), and shell, Horn, & Severs (1989).

Evaluation Results

Student Use

Student use of services in the ECDS was measured with a Use Log kept by staff. During the second year of the project, an open-ended Log was used in which staff recorded the date, student time in and out, and a description of student activity. The Log was kept for a four-month period. A summary of recorded student use indicated that 45 students used the ECDS a total of 415 hours during November and December and 203 hours during the last week of January and all of February. Compensatory applications were the most used ECDS service, accounting for 66% of the logged time.

During the third year of the project, a more specific Use Log was developed utilizing categories that occurred most frequently on the previous year's log. The Log contained a checklist of 26 specific activities (see Table 1). Staff recorded the date, student time in and out, and indicated student activity on the checklist for each student using the ECDS during a one month sample period. Student activity was grouped into three categories: (a) compensatory technology system use, (b) academic support services general studying; staff help with tutoring or other course-related activities; non-course related skill building such as instruction or practice in writing, typing, or study skills; and proof reading assistance), and (c) traditional disabled student services (registration assistance, alternative testing services, reader services, contact with the ECDS coordinator). A summary of recorded student activity time indicated that 65 students used the ECDS for a total of 233 hours of logged time during the sample period (it should be noted that a number of students had compensatory systems of their own by this time and therefore did not use ECDS systems). By category, students had 122 hours of compensatory technology use, 41 of academic support service use, and 71 hours of traditional services use. Compensatory technology applications were again the most used ECDS service, accounting for 52% of logged time.

The findings from the use logs of student activity indicate that when compensatory applications are provided by disabled student service programs as an ongoing service, students will utilize them. The level of student use of compensatory applications in the ECDS in particularly encouraging because the majority of students had no experience with computers prior to using them in the ECDS.

Student Satisfaction

A mail survey was conducted following the third year of ECDS operation. Sixty-five surveys were sent to a stratified sample of the total population of students who used the ECDS at least once during the previous year. Thirty-two complete surveys were returned for a response rate of 49%. Of the 32 respondents, 20 (62%) indicated use of compensatory applications in the ECDS (physically disabled = 13; visually impaired = 2; hearing impaired = 2; speech impaired =1; learning disabled = 2) and another 3 indicated use of their own computers for compensatory writing applications (physically disabled = 1; learning disabled = 2).

Students were asked to rate the compensatory applications they used as either very helpful, somewhat helpful, or not helpful. They were also asked to rate support services for computer use provided by the ECDS. Student responses are summarized in Table 1. All compensatory applications were rated as either somewhat or very helpful as were all support services except help with operation of the computer that was rated not helpful by one student. These findings indicate that students were satisfied with the compensatory applications and found them to be beneficial.

Students were asked to indicate whether use of a computer for writing had helped them improve their writing and their confidence in their writing. Of the 20 students responding to these questions, 17 (85%) indicated that use of a computer helped them write better and 15 (75%) indicated that use of a computer helped them feel more confident about their writing ability. The high percentages of student users indicating that use of a computer helped improve their writing and their confidence about writing again indicate that students were satisfied with compensatory applications and found them to be beneficial.

For students indicating that the use of a computer helped, an open-ended question asking them how the computer helped was provided. Fifteen student (88%) provided responses to how the computer helped them write better. Thirteen students (87%) provided responses to how the computer helped them feel more confident about their writing. Content analyses were used to classify and group student responses. Responses to how the computer helped students write better were classified as referencing (a) mechanical aspects of writing (e.g., time required for writing, spelling/proofing, etc.), (b) process aspects of writing (e.g., organizing, editing, rewriting, etc.), or (c) other. Responses to how the computer helped students feel more confident about their writing were classified as referencing (a) writing abilities (e.g., improved mechanics, improved efficiency, improved creativity, etc.) or (b) affect (e.g., less worry, less frustration, etc.). Responses could be classified in multiple classifications if a student provided more than one reason how the computer helped.

Results of the content analysis are summarized in Table 2. Students' comments confirmed that they believed compensatory applications are effective in improving their written communication skills and, as a result of this improvement, make them feel more confident about their writing abilities. It is important to note that students saw

improvement and had increased confidence in higher level writing processes such as organization and creativity as well as in the more mechanical aspects of writing that are most directly affected by compensatory applications. The following examples are reflective of student responses related to writing improvement:

• Organization, legibility, proofing, editing, and efficiency of using the computer has decreased many hours of typing or word processing.

Table 1

Log Sheet Categories

Activity
Study
see Center Coordinator
staff help
test/quiz
photocopy
ECDS testing
Socialize
print only
registration
Cognitive Skills Training
skill building
counseling
equipment
proofreading
go-between
paper writing
read text
Software Used
Prof. Write
PFS write
PFS WSKE
E-Z Keys
Word Perfect
Appleworks
data base
file program
Typing Tutor
Other

Table 2

Student Ratings of Compensatory Applications and Support Services

Student Ratings

	Very Helpful		Somewhat Helpful		Not Helpful	
	N	%	N	%	N	%
1. Word Processing	17	85	3	15	0	0
2. Spell Checking	13	77	4	23	0	0
3. Computer Operation Training	13	81	3	19	0	0
4. Word Process Training	11	85	2	15	0	0
5. Help with Operation	15	83	2	11	1	6
6. Help using Programs	15	83	3	27	0	0

• I've learned to compose on the computer and that has made my paper writing much faster and easier.

• I am able to compose papers at the keyboard of the computer. I am able to proof my own papers and change the format of the paper. I enjoy writing now.

• With my physical disability, that is the only way I can write.

The following examples are reflective of student responses related to improved confidence about writing:

• I feel more confident because I know I can insert words or sentences anytime, but the greatest advantage is the spell check. I don't have to worry about misspelling words while I'm composing on the computer.

• I can write much better because correcting mistakes and rewriting is much easier; therefore, I can put a better effort in then (sic) if I had to retype and retype over and over.

• I feel I can be more creative when I use c computer because it is much easier to write and make changes. I write more now and that has helped build my skills.

Student Academic Outcomes

During the second and third years of ECDS operation, evaluations of student academic outcomes were conducted. Student GPA, suspension or probation frequency, and frequency of passing all attempted credit hours were examined. The results of these

evaluations are described in detail in Shell, Horn, and Severs (1988) and Shell and Horn (1989). We will provide a summary of the findings.

Three student groups were evaluated. A sample of students attending the university prior to the start of the ECDS (N =28) constituted a control group reflecting the performance of students not receiving ECDS compensatory computer services. Two groups of students who entered the university during the second year (N = 20) and third year (N =16) of ECDS operation constituted experimental groups reflecting the performance of students having ECDS compensatory computer services available at entry into college. The performance of the experimental groups during their first semester in college was compared to the performance of the control group in the semester immediately prior to the start of ECDS operation. Also, the change in performance of the initial student users of the ECDS (N = 20) who were attending the university prior to the start of the ECDS and continued to attend during the first year of ECDS operation was examined.

Table 3

Content Analysis of Student Open Ended Responses

Classification	N
How has using the computer helped you write better?	
Mechanical	
Improved ability to spell/proof	7
Reduced time needed for writing	4
Process	
Improved editing capabilities	4
Improved rewriting/organizational capabilities	3
Other	
Made writing easier	5
How has using the computer helped you feel more confident?	
Writing Abilities	
Improved mechanics of writing	6
Improved efficiency/time utilization	5
Improved content/idea generation/creativity	4
Affect	

The performance of both experimental groups on all measures was substantially better that the control group. During the semester prior to the start of the ECDS, the control group had (a) an average semester GPA of 2.20, (b) 23 of 28 students on probation (46%), and (c) 12 of 28 students passing all attempted credits (43%). During their first semester, the second year experimental group had (a) an average semester GPA of 2.80, (b) 3 of 20 students on probation (15%), and (C) 17 of 20 students passing all attempted credits. (85%). All differences between the second year experimental group and the control group were statistically significant at the .05 level. During their first semester, the third year experimental group had (a) an average semester GPA of 2.63, (b) 2 of 16 students on probation (13%), and (c) 14 of 16 students passing all attempted credits (88%). Differences between the third year experimental group and the control group in probation frequency and frequency of passing all attempted credits were statistically significant at the .05 level; however, the difference in GPA was not significant.

The performance of the initial student group showed improvement following the start of ECDS services. Semester GPA for the initial student group was 2.32 during the first semester of ECDS operation, and 2.74 during the second semester of ECDS operation. This increase was statistically significant. The initial group also had fewer instances of probation and a higher frequency of passing all attempted credit hours during the first year of ECDS operation; however, these changes were not significant at the .05 level.

These findings indicate that the ECDS program has had a positive effect on student academic outcomes. The results, however, must be interpreted cautiously. Because the ECDS provided other types of academic and disabled student support services in conjunction with compensatory applications, the findings can only provide indirect evidence that compensatory technology use has a positive impact on academic performance. The previously discussed findings that compensatory technology was the most used ECDS service and a finding, following the second year of ECDS operation, that the amount of computer use time significantly predicted semester GPA in a regression analysis (Shell, et al., 1988), however, suggest that compensatory technology use was the primary contributor to the identified improvements in student academic outcomes.

Summary

Based on our experiences, we would caution against providing computer technology in isolation from other services. The compensatory computer applications used in the ECDS were not modifications to existing campus computer resources to allow disabled students to access and use these resources (cf., Keddy, 1988, 1989); rather, they were implemented as one aspect of an integrated service delivery program (Horn, et al., 1986a, 1986b,1988). Other projects in which computers have been effective in enhancing disabled student academic performance also have provided computers in conjunction with other services or as part of a broader academic class (e.g., Farra et al., 1988; Maik, 1987; Margolis & Price, 1986). Thus, empirical support for the effectiveness of

technology has been found when technology is integrated with other ongoing student services.

In summary, the evaluation findings in this study indicate that students will use compensatory technology when it is provided, they generally perceive compensatory technology services as beneficial, and their academic performance improves after compensatory technology is made available. Because of the diverse student population served by the ECDS and the fact that computer services were provided in the context of ongoing services rather than in a specialized program, we believe that the findings for ECDS students will best generalize to other postsecondary settings implementing similar services and that we would conclude that computer technology can be an effective, valuable component of a comprehensive disabled student services program.

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References

Beukelman, D. R., Yorkston, K. M., & Dowden, P. A. (1985). *Communication augmentation: A casebook of clinical management*. San Diego, CA: College-Hill Press.

Brandenburg, S. A., & Vanderheiden, C. G. (Eds.). (1987a). *Rehab/education technology resource book series: Communication, control and computer access for disabled elderly individuals, Resource book 1: Communication aids*. Boston: College Hill Press.

Brandenburg, S. A., & Vanderheiden, C. G. (Eds.). (1987b). *Rehab/education technology resource book series: communication, control and computer access for disabled elderly individuals, Resource book 2: Switches and environmental controls.* Boston: College Hill Press.

Brandenburg, S. A., & Vanderheiden, C. G. (Eds.). (1987c). *Rehab/education technology resource book series: Communication, control and computer access for disabled elderly individuals. Resource book 3:Hardware and software.* Boston: College Hill Press.

Brill, J. (1987). Writing, technology, and liberation. *Journal of Postsecondary Education and Disability, 6*(1), 68-71.

Brown, C. (1987). *Computer access in higher education for students with disabilities*. San Francisco: George Lithograph company.

Brown, C. (1989). *Computer access in higher education for students with disabilities, 2nd edition.* San Francisco: George Lithograph Company.

Farra, H. E., Morelli, E., & Balfe, M. A. (1988). A model program using microcomputer word processing instruction and a coordinated curriculum for the community college. *Capitalizing on the Future, Proceedings of the 1987 AHSSPPE Conference, 10,* 165-170.

Heller, J. (1978). *Typing for the physically handicapped. Methods and keyboard presentation charts.* New York: McGraw-Hill.

Horn, C. A., & Shell, D. F. (1990) Availability of computer services in post-secondary institutions: Results of a survey of AHSSPPE members. *Journal of Postsecondary Education and Disability, 6,* 16-23.

Horn, C. A., Shell, D. F., & Severs, M. K. (1986a). *1985-86 final report: Education center for disabled students.* Lincoln: University of Nebraska-Lincoln, Educational Center for Disabled Students.

Horn, C. A., Shell, D. F., & Severs, M. K. (1986b). Survival skills for disabled college students: Computer technology and cognitive skills training. *Charting the Course: Directions in Higher Education for Disabled Students, Proceedings of the 1986 AHSSPPE Conference, 9,* 7-12.

Horn, C. A., Shell, D. F., & Severs, M. K. (1988). Beyond access: Classroom application of compensatory technology. *Celebrate in '88: AHSSPPE and All That Jazz, Proceedings of the 1988 AHSSPPE Conference, 11,* 209-215.

Keddy, B. A. S. (1988). Computers for disabled students: Recommendations for modification of computer facilities. *Journal of Postsecondary Education and Disability, 6*(2), 5-14.

Keddy, G. A. S. (1989). Methods of adapting computers for use by disabled students. *Journal of Postsecondary Education and Disability, 7*(1), 16-26.

Laine, C. J., & Harper, F. B. W. (1988). A pilot project using word-processing for disabled students. *Journal of Postsecondary Education and Disability, 6*(2), 3-4.

MacArthur, C. A. (1988). The impact of computers on the writing process. *Exceptional Children, 54,* 536-542.

Maik, L. (1987). Word processing in a classroom with handicapped students. *Journal of Postsecondary Education and Disability, 5*(1), 4-11.

Shell, D. F., & Horn, C. A. (1989). *Effectiveness of computer based services for disabled students: Results of an evaluation of student academic outcomes.* Manuscript submitted for publication.

Shell, D. F., Horn, D. A., & Severs, M. K. (1988). Effects of a computer-based educational center on disabled students' academic performance. *Journal of College Student Development, 29,* 432-440.

Shell, D. F., Horn, C. A., & Sever, M. K. (1989). Computer based compensatory augmentative communication technology for physically disabled, visually impaired, and speech impaired students. *Journal of Special Education Technology, 10,* 29-43.