

Special Learners Included Through Computers in Education (SLICE)

Evaluation Report

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Special Learners Included through Computers in Education (SLICE) is a computerized educational system that allows printed text to be converted into electronic text, and then spoken aloud by a computer. The system was developed in 1995 to support learners who have difficulty with written language, specifically dyslexia, ESL, or LEP. The primary mission of SLICE is to cultivate inclusion to the maximum extent possible and to foster academic success in the general curriculum.

Participation in the SLICE program is based on a student's need for alternative access to written material in school. In order to meet those needs, SLICE students have online access to digitized versions of school textbooks, novels, or other instructional material that their teachers have assigned for reading. On the SLICE website, students view a written image of the text online while the computer reads the material aloud to them through headphones. This approach meets student needs for alternatives to written material without resorting to different textbooks or modified assignments. Additionally, SLICE students can complete their homework or studies anywhere an Internet connection is available.

Since 1997, SLICE has been used by individuals, families, public and residential schools, adult literacy agencies, and tutorial labs in North Dakota, Texas, Colorado, Arizona, and Utah. Anecdotal evidence in these locations indicated that SLICE students who consistently read their assignments using SLICE became better readers. The purpose of the current study was to conduct a more systematic and objective evaluation of the effects of SLICE in raising student achievement. The context was two schools serving Native American students from the Navajo Nation in the Four Corners region of

the United States. The research questions, method, and results are described in the following sections.

Research Questions

1. Did students who used SLICE have greater gains in reading achievement compared to the control group?
2. Did students who started with lower reading achievement have higher gain scores than did those who started with higher reading achievement?
3. Was the level of student involvement with SLICE related to increases in reading achievement scores?

Method

Sample

Kayenta Community School is comprised of Grades K-8, located in Kayenta Arizona. The school has 483 students and the student-to-teacher ratio is 16.3:1 (see Table 1). One hundred percent (100%) of the student population qualified for free lunch and the majority (98%) of the students were Native American.

The second site in the sample was Naa Tsis' Aan Community School located at the base of Navajo Mountain, Utah, but only accessible via Arizona highways and gravel roads. The campus at this school includes a cafeteria, teacher housing, and a dormitory that boards students during the week. Naa Tsis' Aan Community School serves 101 students in kindergarten through the eighth grade. The school population was comprised primarily of Native American students (98%); 100% of the students qualified for the free lunch program.

Table 1
School Demographics

	Kayenta Community School	Naa Tsis' Aan Community School
Grades Served	K-8	K-8
Total Students	483	101
Student-to-Teacher Ratio	16.3:1	8.4:1
Percent Native American	98	98

A total of 60 students from these schools were given an opportunity by their schools to participate in SLICE in the 2001-2002 school year. Of these 60 candidates, 49 had complete pre/post test data available and 11 were eliminated due to incomplete data. Of the remaining 49 students, 30 used SLICE regularly (SLICE treatment group). The remaining 19 students comprised the Control group, consisting of students who were eligible for SLICE, but found it impossible to participate because they lacked access to computers with an internet connection or had classroom teachers who did not allow them to use SLICE in an inclusive environment. The control group, therefore, was a derived subsample of the participant group selected on the basis of the low number of hits on SLICE, which was then verified by verbal reports from the students' special education teachers. Thus, the comparisons in this study assessed the relative benefits of using SLICE only for those students who were given opportunity to use SLICE.

Instrumentation

The state-mandated test of student achievement in Arizona is the Stanford Achievement Test (ninth edition). Total reading scores on the SAT-9 were used as the measure of reading achievement in the study. Raw scores and scale scores from 2001

and 2002 were both available for SLICE and Control students. For present purposes, scale scores were used in the analyses to facilitate comparisons across grades and years. Archival data were also available for students using SLICE. Such data consisted of (a) the number of SLICE webpages accessed by each student on a weekly basis, which were recorded as “hits;” and (b) the number of weeks that students participated in the SLICE program.

Procedures

Reading achievement gain scores were calculated for all students in the study by subtracting the 2001 Total Reading Scores from the 2002 Total Reading scores (see Table 2). Students were also grouped on the basis of their 2001 reading achievement scores. A frequency distribution was first constructed to identify the median 2001 reading achievement score (*Median* = 568). Students were then grouped into the above-median category or the below-median category. This procedure permitted an analysis of students who started below the median in 2001 with those students who started above the median.

Table 2
Means and Standard Deviations on the SAT-9 Total Reading Test
Disaggregated by Grade and Achievement Categories

	2001 Scale Scores						2002 Scale Scores				Gain Scores			
	<i>N</i>	<i>M</i>	<i>SD</i>	<i>N</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Grades 3-4	7	534	51	12	555	31	606	19	575	26	71	36	21	41
Grades 5-6	12	559	21	4	595	25	623	25	632	42	64	33	37	31
Grades 7-8	11	615	30	2	623	4	633	18	650	18	18	28	27	23
Above Median	15	609	27	10	598	21	631	18	612	45	22	27	14	40
Below Median	15	538	31	8	537	20	613	25	576	26	75	30	39	29
Overall	30	573	46	18	571	37	623	23	596	41	49	39	25	37

To further examine comparability of the SLICE and Control groups, the percentages of students in each grade are presented in Table 3. As shown, the SLICE students are fairly evenly distributed across grade levels (with the mode in grades 5-6) whereas Control students are predominantly represented in grades 3-4.

Table 3
Grade Level by Treatment and Control Group Status (Percentage of Students)

Grades	SLICE	Control
3-4	23	67
5-6	40	22
7-8	37	11

Results

Research Question #1 – Did students who used SLICE have greater gains in reading achievement compared to the control group?

Research Questions #2 - Did students who started with lower reading achievement have higher gain scores than did those who started with higher reading achievement?

A 2X2 Analysis of Variance (ANOVA) was conducted on the SAT-9 reading achievement gain scores. ANOVA is an inferential statistical analysis procedure used to compare means for two or more groups. The two independent variables were SLICE/Control group and Above/Below Median. The interaction term was not significant [$F(1,45)=2.7, p=.105$]; however, the main effects for SLICE [$F(1,45)=6.5, p=.014, ES=+0.61$] and for Above/Below Median [$F(1,45)=17.0, p=.000, ES=+0.62$] were significant. As shown in Table 2, the mean gain scores for SLICE students ($M=49$)

were higher than were those from the Control group ($M=25$). Students who participated in SLICE thus demonstrated significantly higher gains than did students in the Control group. The second main effect (Above/Below Median) was also significant, indicating that below-median students ($M=63$) gained significantly more than did the above-median group ($M=19$) regardless of their participation in SLICE. These results may be due to regression to the mean.

The interpretation of results, however, must take into account the confounding of grades in the analyses. Specifically, the SLICE and Control groups were significantly different in the grades represented by each group as shown by Chi-square test results ($X^2=9.12, p=.010$). Chi-square is a test of the relationship between two or more nominal variables. In the present case, the significant chi-square outcome means that there is a greater than chance probability that the SLICE and Control groups had differing proportions of grade levels represented in their respective samples. As previously noted (see Table 3), 67% of the Control group students were in the third or fourth grades while 77% of the SLICE group students were in the fifth through eighth grades. This differential sampling must be considered as a possible source of error or bias in interpreting results. For example, as shown in Table 4, there are larger SLICE advantages for grades 3 and 4 (Mean difference = 50) than for other grade levels. Actually, this pattern would seem likely to reduce the potential SLICE effect given that the lowest proportion of the SLICE sample was in the grade category (3-4) realizing the largest program benefits. Only by testing more closely matched SLICE-Control group samples can a more accurate picture of the effects be obtained. Specifically, with a more closely matched sample, the proportion of SLICE and Control students at each grade

level would be comparable. Thus, grade-level differences in propensity to demonstrate gains on the SAT-9 scale scores would be equal for the two groups.

Table 4
Grade Level by Treatment and Control Group Status (Mean Gain Scores)

Grades	SLICE	Control	Difference
3-4	71	21	50
5-6	64	37	27
7-8	18	27	9

Research Question #3. Was the level of involvement with SLICE related to increases in achievement scores?

For this analysis, correlations were computed between the number of pages accessed by students on the SLICE website each week (hits), the number of weeks each student was in the program, and reading achievement change scores. As shown in Table 5, the correlation ($r = -.057$) between reading achievement change scores and hits was not significant ($p=.763$). However, the positive correlation between the number of weeks students participated in SLICE and reading achievement change scores was significant ($r = +.470$, $p=.009$). This indicates that the longer students participated in SLICE, the more likely they were to have higher gain scores.

Table 5
Correlations Between Reading Achievement Change Scores, Hits, and Weeks (n=30)

	Correlation Coefficient (r)	Probability level (p)
Change score and Hits	-.057	.763
Changes score and Weeks	.470	.009
Hits and Weeks	.304	.102

Conclusions

The main outcomes of the study need to be interpreted with the sampling limitations in mind. They consist of:

- SLICE students had significantly higher gain scores than did Control students.
- Lower achieving students gained more than high achieving students for both SLICE and Control groups.
- Younger students appeared to have larger gains in both samples.
- The students who participated for a longer time in SLICE showed higher gains.

Although the overall results are positive, caution must be used in interpreting the results. As shown in Tables 2 and 3, change scores are confounded with grade levels. An additional concern is the ex-post facto nature of the design, whereby students were grouped not on a random or matched basis, but on the basis of contextual events. For these reasons, the above overall positive effects must be considered as only suggestive pending further studies with larger samples and closer treatment-control matching.