The Effect of Active Student Responding in Computer-Assisted Instruction on Social-Studies Learning by Students with Learning Disabilities:
A Brief Report

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Abstract: An alternating treatment design was used to compare the effects of three student response conditions (Clicking, Repeating, and Listening) during computer-assisted instruction on social-studies facts learning and maintenance. Results showed that all students learned and maintained more social-studies facts taught in the Repeating condition followed by the Clicking condition.

Much of the research regarding the efficacy of computer-assisted instruction (CAI) in special education has favored its use with this population of learners. However, limited empirical research exists that isolates and identifies the curricular variables that contribute to its effectiveness. This study evaluated one instructional variable found to be critical to traditional instruction: active student responding (ASR).

One of the most consistent findings in the educational literature is that students' achievement increases as a function of the time spent actively responding during instruction. Much of the support for increasing ASR during instruction comes from large-group correlational studies (e.g., Berliner, 1980; Fisher, Berliner, Filby, Marliave, Cahen, & Dishaw, 1980). Additional support comes from empirical studies of high-ASR, teacher-led strategies such as response cards and choral responding (e.g., Gardner, Heward, & Grossi, 1994; Sterling, Barbetta, Heron, & Heward, 1997), peer tutoring programs in which increased ASR is part of an instructional package (e.g., Barbetta & Heron, 1991; Utley, Reddy, Delquadri, & Greenwood, 2001), and error correction which includes ASR (Barbetta, Heron, & Heward, 1993; Barbetta & Heward, 1993; Drevno, Kimball, Possi, Heward, & Barbetta, 1994). With respect to CAI, a limited number of studies exist that demonstrate empirically the effects of ASR on student learning (Shin, Deno, Robinson, & Marston, 2000; Tudor 1995; Tudor & Bostow, 1991), and only one study was conducted with students with disabilities (Jerome, Barbetta, Rosenberg, & Brady, 2001). Jerome et al. (2001) compared ASR and on-task (OT) CAI instruction on the acquisition and maintenance of science facts among students with mental retardation. In the ASR condition, when prompted by the computer, students wrote the science facts on a study guide. During OT instruction, students listened to the science facts being read by the computer. Results showed that students learned science facts in both conditions with performances in the ASR condition being slightly higher.

The present study was designed to extend the results of Jerome et al. (2001) by comparing two types of ASR conditions (Clicking-ASR and Repeating-ASR) and an OT condition (Listening-OT) conditions on the acquisition and maintenance of social studies facts among students with learning disabilities using a hypermedia software program. This study differs from the previous study in that it was conducted with students with learning disabilities using social-studies curriculum. In addition, the present study was designed to determine whether the type of ASR used during CAI is critical to student learning by comparing two types of ASR (instead of one) with OT instruction.

Method

Participants and Setting

Participants were five fifth-grade students with learning disabilities, two females and three males, enrolled in a private school for students with learning disabilities. Parental permission, student consent, availability during the time of the study, and the participants' computer skills were used as inclusion criteria. The study was conducted in an assigned room.

Procedures

Each week for six weeks, the five students were provided daily one-to-one instruction on sets of 21 unknown social-studies facts using a hypermedia computer program. A new set of facts was practiced each week. Each set of 21 facts was divided randomly into three equal response-procedure groups: Clicking-ASR, Repeating-ASR, and Listening-OT.

Hypermedia lessons began weekly with the concept introduction lesson, followed by practice and testing. The concept introduction lesson consisted of a presentation of a hypermedia card that provided background information for the week's lesson. Practice using the three conditions (7 facts per condition) occurred immediately after the concept introduction and occurred four days per week, per set. During Clicking-ASR, the student was required to make an active response by clicking on the correct response. The social-studies fact was presented in print on a hypermedia card and was orally read by the computer. The student then moved to the next card and was directed to click on the correct response. For example, printed on the first card was "The US got its independence from Britain." The student then moved to the next card that had this same fact printed on it in a fill-in-the-blank form with two choices to complete the response. In this example, "The US got its independence from _____" was followed by the two choices, "Spain" and "Britain." On this card, the computer read the fact, and the student then clicked on one of the two responses ("Spain" or "Britain"). If the student clicked on the correct response (e.g.,"Britain"), the computer read it. If the student clicked on the incorrect response a *breaking glass* sound was produced. The student then moved to the next card.

During Repeating-ASR, the student was required to make an active response by orally repeating the fact that was presented in print on the card and orally read by the computer. For example, "The first president of the USA was George Washington. Repeat." The student orally repeated the fact. The student then moved to the next card. During Listening-OT, the student listened to the social-studies fact that was printed on the card as it was read by the computer. The student was then prompted by the computer to listen as it was read again. For example, when the student clicked on the card, the computer read the social studies fact printed on the card. For example, "Ponce de Leon explored Florida. Listen. Ponce de Leon explored Florida." The student then moved to the next card. During weeks seven and eight, instruction occurred with seven unknown facts using only the best treatment.

Dependent Measures

Data for four dependent variables were collected: same-day tests, next-day tests, and one and-two week maintenance tests. The researcher orally administered the individualized tests. Same-day testing took place Mondays through Thursdays directly after the practice sessions and next-day testing immediately prior to practice sessions and/or Fridays' pretesting and/or maintenance tests. Maintenance tests were given one and two weeks after instruction on a set ended. An independent second observer collected interobserver agreement data and treatment integrity data to help ensure procedural reliability.

Experimental Design

An alternating treatments design with final best treatment phase was used to assess the effects of the three response conditions. The presentation order of the three conditions was randomized and counterbalanced to reduce the influence of sequence effects. Visual analysis of the graphed data was used for data interpretation. During the last two weeks of the study, only the "best" condition was administered to establish the relative effectiveness of its use in isolation and to demonstrate a much stronger functional relation.

Results

All five students learned and maintained more facts learned with Repeating-ASR followed by the Clicking-ASR and Listening-OT. On same-day tests, students scored highest in Repeating-ASR on 89 of 124 (72%) tests (See Table 1). On next-day tests, the students scored highest in the Repeating ASR condition on 81 of 124 (65%) tests (See Table 2). The one- and two-week maintenance tests results show that all five students maintained more Repeating-ASR facts. On one-week maintenance tests, students maintained 91.6% of the Repeating-ASR facts, 79.4% of the Clicking-ASR facts, and 75.1% of the Listening-OT facts. On two-week maintenance tests students maintained 93.2% maintained in the Repeating-ASR condition, 82.2% in the Clicking-ASR condition, and 74.3% in the Listening-OT facts.

Discussion

Students with learning disabilities learned and maintained more social studies facts instructed with Repeating-ASR followed by Clicking-ASR and Listening-OT. These findings lend further support to research showing a positive relation between active student responding and student achievement. This study adds a dimension to the ASR literature in that it demonstrated the positive effects of ASR during computer-assisted instruction.

The superior results of the two ASR conditions (compared to the OT condition) are supported in the ASR literature (Barbetta & Heron, 1991; Barbetta et al., 1993). As to why Repeating-ASR was more effective than Clicking ASR is not as clear. One possible reason relates to the practice and testing response requirements. During Repeating-ASR, students repeated the entire social studies fact, whereas during Clicking-ASR, students passively attended to the computer reading of much of the fact and actively engaged only while selecting the response to fill-in-the-blank. Subsequently, Repeating-ASR was more active than Clicking-ASR. Another possible reason relates to practice-testing response similarities. The type of responses students make during instruction may be related to their ability to respond correctly to similar test questions later (Gardner et al., 1994). During Repeating ASR, the practice and testing response requirements were identical.

The results have implications for classroom practice. Teachers should select or design CAI that promotes high rates of ASR. Further, the type of ASR required is critical. Although preliminary, these results suggest that the teachers should have an oral component in their CAI assignments. Students could be required to say the critical information (facts, numbers, concepts, names) as they select or click with the computer mouse (a traditional requirement).

The generalization of this study's results will require direct and systematic replication of critical variables, such as learners, curricular area, level of thinking skill required, software features used, and/or ASR variations. A similar study could be replicated among students with other disabilities, typical learners (regular education students), students of other ages, and across other curricular areas. Future research could investigate the effects of ASR-CAI on higher-order thinking skills, such as drawing inferences or synthesizing information. More comprehensive use

of the components of hypermedia instruction (e.g., sound, animation, video-segments, and non-linear progression) could be included in future research.

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Table 1

Mean Number of Facts Answered Correctly on Same-Day Tests

Student	Clicking					Repeating					Listening				
	Day 1	Day 2	Day 3	Day 4	Grand Mean	Day 1	Day 2	Day 3	Day 4	Grand Mean	Day 1	Day 2	Day 3	Day 4	Grand Mean
1	1.4	2	2.5	3.7	2.4	3.4	4.5	4.8	4.8	4.3	1.6	2.2	3.2	3.5	2.6
	(0-3)	(0-5)	(0-6)	(2-6)	(0-6)	(2-4)	(2-7)	(4-7)	(3-7)	(2-7)	(0-4)	(0-4)	(2-5)	(2-5)	(0-5)
2	0.8	1.2	1.8	2.3	1.5	3.6	4.4	5.2	6.0	4.8	0.2	0.8	1.5	1.7	1.1
	(0-2)	(0-3)	(0-3)	(0-4)	(0-4)	(1-6)	(2-7)	(4-6)	(5-7)	(1-7)	(0-1)	(0-2)	(0-3)	(0-4)	(0-4)
3	3	4.3	5.3	5.5	4.5	4.8	5.5	5.8	6.5	5.6	1.0	1.8	3.0	3.8	2.4
	(2-6)	(2-6)	(4-7)	(5-7)	(2-7)	(3-7)	(4-7)	(4-7)	(5-7)	(3-7)	(0-2)	(0-3)	(1-5)	(1-6)	(0-6)
4	1.2	2.2	2.7	4.8	2.7	3.2	4.8	6.0	6.3	5.0	1.0	1.8	3.0	3.8	2.4
	(0-3)	(1-4)	(1-4)	(2-7)	(0-7)	(2-5)	(4-6)	(5-7)	(6-7)	(2-7)	(0-2)	(0-3)	(1-5)	(1-6)	(0-6)
5	2.3	3.5	4.8	4.4	3.7	4.3	6	6.2	6.6	5.7	1.2	3.0	3.6	4.0	2.9
	(1-5)	(1-6)	(3-7)	(3-7)	(1-7)	(3-6)	(5-7)	(5-7)	(5-7)	(3-7)	(0-2)	(1-5)	(2-4)	(2-5)	(0-5)
Group	1.8	2.6	3.3	4.1	2.9	3.9	5.1	5.6	6.0	5.1	1.0	1.9	2.8	3.3	2.3
	(0-6)	(0-6)	(0-7)	(0-7)	(0-7)	(1-7)	(2-7)	(4-7)	(3-7)	(1-7)	(0-4)	(0-5)	(0-5)	(0-6)	(0-6)

Note. The top rows of numbers represent mean performance on same-day tests on individual days and across all days (Grand mean). The bottom rows of numbers represent the range of scores.