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ABSTRACT

Computer-based instruction opens new avenues for increasing the variety of possible feedback strategies that a teacher may employ to optimize learner performance. Feedback effectiveness is influenced by the nature of learning task and student ability. This study investigates the effects of digitized feedback and ability on the achievement of college students during computer-based instruction; the achievement of high and low-prior knowledge students was compared among different feedback treatments. A sample of 68 university students from four sections of beginning tennis classes at Chung Cheng University (Taiwan) were categorized as having high or low prior knowledge and randomly assigned to a computer to complete one of three treatments (audio only, voice with text, and voice with text and animation). The computer-based instructional unit was an interactive video lesson on cognitive areas of tennis skill performance. Results indicate that the anticipated interaction between ability and feedback was not confirmed, and that elaborate feedback was most beneficial for cognitive ares of psychomotor skill learning; no matter which ability levels or treatment conditions the subjects were categorized in, they rated the instructional program more positively. (Contains 14 references.) (AEF)

Title:

Digitized Speech as Feedback on Cognitive Aspects of Psychomotor Performance during Computer-Based Instruction

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Introdution

The importance of feedback to facilitate learning has long been acknowledged (Kulhavy, 1977; Mory, 1992; Schimmel, 1986; Bangert-Drowns et al, 1991). Appropriate feedback confirms the learner's expectancy, directs attention to relevant factors, and stimulates recall of relevant skills and knowledge (Gagne, 1985). Computer-based instruction (CBI) opens new avenues for increasing the variety of possible feedback strategies that a teacher may employ to optimize learner performance. However, there is little empirical research to indicate that educational gains can be achieved by simply incorporating speech as feedback on cognitive aspects of psychomotor domain.

The effectiveness and impact of speech in such roles as the delivery of content, feedback and motivation in classroom instruction are well documented (Brophy, 1981, 1986; Sales & Johnston, 1993). Sanders, Benbasset and Smith (1976), for example, argue that for speech to add significantly to learning, it must not "merely take the place of a hard-copy manual or of printed text on a computer terminal." Saloman (1979, 1985) also argues that research on the effectiveness of media must look at the most essential characteristics of symbol systems being utilized. In software that utilizes digitized speech, Brophy (1986) indicates that these essential characteristics are the familiarity of the source, the nature of the learners relationship with the source, and the attitude communicated through tones and inflections in feedback to the learner.

Feedback effectiveness is influenced by the nature of the learning task and student ability. For example, KCR was most effective than AUC feedback for low ability students (Dick & Latta , 1970). In a recent studies, Clariana and Smith (1989, 1991) suggested that higher ability students benefit from the additional information provided by elaborative feedback. Furthermore, low ability students performed poorly with elaborative feedback. Speech can be a critical feedback component of instruction. It appears to be particularly valuable as a means of commutation between the teacher and the learner. To date, however, very little research has been conducted which looks at the effects of digitized feedback under different learner characteristics (e.g., high- or low-prior knowledge) on cognitive aspects of psychomotor performance.

The purpose of this study was to investigated the effects of digitized feedback and ability on the achievement of college students during computer-based instruction. The achievement of high and low-prior knowledge students was compared among different types of feedback treatments.

Method

Subjects

A sample of 68 university students from four sections of beginning tennis classes at the Chung Cheng University participated in the study. Student's preexisting tennis knowledge was tested to categorize them into high and low prior knowledge groups. High prior knowledge students were defined as those with pretest scores above the 55th percentile, while low prior knowledge students were defined as those with scores below the 45th percentile. In order to control for the ability of learning in the study, the middle 10% of the students (those falling between 45th and 55th percentile) were not included.

Materials

CBI Lesson Content. The computer-based instructional unit used in this study were an interactive video lesson on cognitive area of tennis skill performance. The interactive video instructional module employed was designed to help the beginners build up there basic foundation in tennis skills. By carefully selecting the Beginning of Tennis instructional video program, the lesson included four sections: a) The Grip; b) Correct swing technique; c) Approach shots; and d) Terminology and Rules. During the lesson, students received immediate feedback in specific skill areas as well as valuable experience in working with questions and problems posed in the style of the computer-delivered post test. All versions of the lesson provided the same information, examples, and practice on the concepts of learning. The average of three versions required 50 minutes for the subject to complete the interactive tutorial lesson.

Retention test. Two weeks later, subjects take a 40-item test in a paper-and-pencil format. In order to maintain reliability and consistency, subjects would not be informed of the retention test until it was administered. The Spearman-Brown formula was used to calculate the split-half reliability of both question sets. The reliability of the lesson immediate posttest questions was r=0.70.

Attitude Questionnaire. Following the lesson, students responded to a Likert-type questionnaire developed by author. This instrument contained ten items. It was designed to collect data on the usefulness, quality, weaknesses, and overall feeling that the students had for the interactive video-delivered instruction. Subjects responded to both positively and negatively worded statements by marking their opinions on a scale from 1 (strongly agree) to 5 (Strong disagree). The Cronbach's Coefficient Alpha reliability for the questionnaire was .92. An typical item on the questionnaire was, "The program was easy to use".

Experimental Procedures

Based on subjects' prior knowledge test scores (preexisting knowledge of tennis), students were randomly assigned to a computer and completed one of three treatment version: spoken audio only-KOR, knowledge of the correct response -KCR(voice with text), and elaboration feedback -EF(voice with text, visual and animation). To resolve logistical constraints, the study was implemented during a four-week period. All students received two days of computer-based instruction with an interactive video on the four sections of beginning tennis program. Each student spent about 45-55 minutes each day to finish two section content. Two weeks after the above activities, all subjects were individually administered the retention test(paper-and pencil). Seven absentees completed the pretest one week late. However, several other students could not complete the posttest and retention test. The total of fifty-five subjects completed the study.

Design and Data Analysis

The study employed a 3 X 2 factorial design. The first factor was feedback with three levels: spoken audio only-KOR, knowledge of correct response-KCR(voice with text) and elaborative feedback-EF(voice with text, and visual) and second was ability (High versus Low-prior knowledge). In analyzing data, ANOVAs were conducted on each set of variables. The dependent variables of the study were achievement on the delayed retention test and attitude measure scores. Calculations were made using the Statistical Package for the Social Sciences (SPSS) 4.0 for the Macintosh, (© 1990, SPSS Inc.). All tests of significance adopted an alpha level of .05, unless otherwise indicated.

Results

Achievement

Achievement was operationalized as an individual's score on the retention posttest. Means and standard deviations of student performance on retention test are given in Table 1. The results of the ANOVA showed significant main effects for Feedback, $F(2,49)$ of 6.43, $p=.003$. for Ability, $F(1,49)$ of 4.70, $p=.035$. High ability students ($M = 31.53$) performed better than low ability students ($M = 29.69$). The feedback main effect was further analyzed via Scheffe follow-up comparisons of the three overall treatment means. Results indicated the elaborative feedback (EF) conditions ($M = 32.50$) was higher than the KOR and KCR feedback conditions ($M = 29.28$ and $M = 31.11$). However, there were no significant differences between KOR(spoken only) and KCR feedback(spoken with text) condition. The interaction between level of ability and type of feedback was not significant.

Table 1.
Means and Standard Deviations for Retention Test Scores.

		FEEDBACK			
		KOR	KCR	EF	Total
Ability					
High	Mean	29.25	33.00	32.20	31.53
	SD	3.41	2.88	2.25	3.15
	N	8	8	10	26
Low	Mean	29.30	29.11	32.80	29.69
	SD	3.95	2.80	2.59	3.14
	N	10	9	10	29
Combined					
	Mean	29.28	31.11	32.50	30.61
	SD	3.68	2.84	2.42	3.15
	N	18	17	20	55

Attitude Measure

Means and standard deviations for attitude scores are presented in Table 2. Generally speaking, no matter which ability levels and what treatment conditions the subjects were categorized, they rated the instructional program closer to the positive direction. The average rating based on all of the subjects across all questions was 3.32 (SD=.53). The mean attitude score for low ability students was higher (M = 3.34) than the mean attitude score for high ability students (M = 3.28). Similarity, the KOR feedback condition (M = 3.48) resulted in highest mean attitude score than the other two feedback conditions (KCR, M = 3.34; EF, M = 3.14, respectively).

Table 2.
Means and Standard Deviations for Attitude Scores.

		FEEDBACK			
		KOR	KCR	EF	Total
Ability					
High	Mean	3.43	3.60	2.92	3.28
	SD	.68	.57	.34	.53
	N	8	8	10	26
Low	Mean	3.54	3.11	3.36	3.34
	SD	.55	.45	.34	.45
	N	10	9	10	29
Combined					
	Mean	3.48	3.34	3.14	3.32
	SD	.59	.55	.39	.53
	N	18	17	20	55

Discussion

The purpose of this study was to investigate the effect of different types of computer-delivered feedback at different learner ability levels in cognitive areas of psychomotor skill performance. Students' attitudes toward computer-based instruction with an interactive video were also assessed. At the end of the lesson, the students completed an attitude questionnaire and a 14-day retention test.

As suggested from the results, the anticipated interaction between ability and feedback was not confirmed. The study revealed that the elaborative feedback was most beneficial for cognitive areas of psychomotor skill learning. One plausible explanation for the results obtained is that the elaborative feedback facilitated the acquisition of skill by viewing an ideal/prototypical performance of interactive videodisc-delivered instruction. As Schwier (1987) suggested, the marrying of computer instruction and television provides a potentially powerful training medium. Instructional video may also reinforce learning in understanding the role of observation/perception in the acquisition of motor skills.

The results of the study revealed that no matter which ability levels or treatment conditions the subjects were categorized, they rated the instructional program closer to the positive direction. The difference is particularly noticeable for low ability students in the KOR feedback group which recorded the highest attitude scores of the groups. On the other hand, high ability students in the elaborative feedback group reported the lowest attitude scores. Perhaps, low-ability students feel more comfortable and confident after simple feedback responses, while high-ability students received too much information which may have interfered with learning.

Feedback is an essential construct for many theories of learning and instruction. Frequent and consistent use of feedback is also strongly promoted in today's theoretical development, instructional practice, and educational psychology. However, while the benefits of feedback in general might be taken for granted, uncertainty still exists as to how to select and optimize uses of different forms of feedback depending on myriad psychosocial characteristics of students and the learning situation. Further research is needed to clarify this uncertainty and provide the learner with the most effective and efficient type of learning environment.

Additional research is needed to determine whether higher cognitive tasks may impact the learner's prior knowledge to process feedback effectively. Higher order cognitive tasks involve a more complex variety of skills, thus usually making learner more difficult to attain. The use of simple feedback may not be enough to guide the student through the complex components of such a task. Therefore, the use of extra-instructional feedback should be examined further. "That is, containing additional information from outside the immediate lesson environment "(e.g., new examples, analogies, or new information to clarify meaning). Also, of particular relevance for the current study, motor skill acquisition, in which changes in bodily movements are required for mastery, is an important domain as yet largely unexamined in the literature on feedback in technology-assisted instruction.

Additionally, emerging interactive technologies are gradually taking an important role in schools, educators are still facing a serious dilemma. They are either to find more effective ways of using these technologies in the classroom or to limit the access by large groups of students. Researchers should also investigate the nature and strategies of promotive interaction within group learning.

Finally, researchers should examine the effects of varieties of feedback in varied new and emerging technological instructional environments. Environments are becoming increasingly available which offers an increasing range of feedback types (for example digital images, high-speed animation, video, audio, and speech). Also, technologies utilizing digitized full-motion video and virtual reality will be widely available as instructional environments in the near future, bringing with them opportunities for multi-sensory forms of feedback. Understanding how to match learners with feedback appropriate to achieve desired learning outcomes in these sophisticated instructional technology systems will certainly deserve increasing attention in the near future.

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