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ABSTRACT

While research concerning feedback and cooperative learning is prevalent in educational literature, there has been little systematic research to support whether various types of feedback in cooperative learning situations can affect student performance. This study examines possible interactions among different types of computer-delivered feedback on cognitive learning outcomes and attitudes during computer-based cooperative condition. The achievement of high and low-prior knowledge students was compared among different feedback treatments; the subjects were 120 university students enrolled in six sections of beginning weight training at the University of Minnesota. The computer-based instructional module was designed to help the beginners build their basic cognitive foundation in weight training; a retention test and an attitude questionnaire were administered to the students. Results indicated significant interaction between types of feedback and prior knowledge level; results on attitude measure revealed that low-prior knowledge students had more positive attitudes than high-prior knowledge students. (Contains 13 references.) (AEF)

Title:

Effects of Types of Feedback on Achievement and Attitudes during Computer-Based Cooperative Condition

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Introduction

A principal concern of instructional technologists is the development of generalizable mechanisms which enhance the acquisition of specific learning outcomes that are compatible with both the learner and learning environment. While research concerning feedback and cooperative learning are prevalent in educational literature, there has been little systematic research to support whether various types of feedback in cooperative learning situations can affect student performance outcomes and attitudes. Computer-based instruction (CBI) opens new avenues for increasing the variety of possible feedback strategies that a teacher may employ to optimize learner performance, but it is not clear which type of feedback is most beneficial under different learner characteristics (e.g., high- or low-prior knowledge) during computer-based cooperative condition.

Various types of feedback can be grouped according to their characteristics and on their functions (Dempsey & Sales, 1993). No feedback (NF) allows the learners to progress through the instructional sequence without receiving any external indication of the degree to which they understand the content. Knowledge of correct response feedback (KCR) includes a statement that a response is "right" or "wrong" and a comment identifying the correct response. Elaborative feedback consists of all substantive information contained in the feedback message. It appears that elaborative feedback seems to encourage the construction of a richer network of pathways to the desired information.

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.

Substantial evidence exists to suggest that cooperative learning structures can promote positive relationships and efforts to achieve that are key to maximizing the potential of the technology (Hooper & Hannafin, 1988, 1991; Johnson & Johnson, 1989). Cooperative learning also appears to foster higher level cognitive reasoning, increased achievement and retention, and higher level conceptual understanding (Johnson & Johnson, 1989). Students who explain lesson material to a partner appear to generate elaborative connections between new and existing information, resulting in deeper processing of lesson content (Webb, 1982). To date, however, very little research has been conducted which looks at the effects of feedback under different learner characteristics (e.g., high- or low-prior knowledge) during computer-based cooperative environment.

The purpose of the study was to examine possible interactions among different types of computer-delivered feedback on cognitive learning outcomes and attitudes during computer-based cooperative condition. The achievement of high and low-prior knowledge students was compared among different types of feedback treatments.

Method

Subjects

Subjects were 120 university students enrolled in six sections of beginning weight training at the University of Minnesota. Students were classified as high-or low-prior knowledge according to performance on the pretest of pre-existing knowledge of weight training. The students were randomly assigned within prior-knowledge groups to one of three types of feedback treatments. 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. For the purpose of creating heterogeneous pairs of students for cooperative learning and as a way of reducing the classification error, the middle 10% of the students (those falling between 45th and 55th percentile) were not included in data analysis.

Materials

The CBI lesson. The computer-based instructional module used in the study was designed to help the beginners build their basic cognitive foundation in weight training. During the lesson, students received immediate feedback in specific skill areas and questions posed in the style of the computer-delivered practice test. This unit is designed for self-instruction and group learning. The unit can be integrated with the basic level of curriculum presented in typical weight training classes and used in conjunction with already existing materials and standard texts such as Hatfield and Krotee' Personalized Weight Training (1984).

The content presented in the module consists of four sections: 1) Terminology related to resistance training. 2) Safety in the weight room. 3) Warm up and cool down protocols. 4) Correct lifting technique. In pilot studies, the instructional lesson was reviewed and revised by two content experts and four weight training instructors. The instructional lesson was formatively evaluated using students of the target group, and was revised into its final form. In addition, data from the pilot study indicated its effectiveness in helping students learn concepts. That is, students who completed the module learned the material to a higher degree of competency than did those who did not go through the unit.

Retention test. Two weeks after completing the computer-based instruction, all students received a paper-and-pencil retention test. This multiple-choice test contained 40-items , based on knowledge and application of learning outcomes to test students' factual recall and conceptual understanding of the lesson. These items were previously chosen from the pilot study involving the same content and a similar population. Cronbach's alpha method was used to calculate the reliability of the retention test, and was found to have a value of .82. The mean of the 40 item retention test was 28.2 with a standard deviation of 4.50.

Attitude questionnaire. Following the lesson, students responded to a Likert-type questionnaire developed by Simsek & Tsai (1992). This instrument was designed to measure students' reactions to cooperative learning. It included 27 items containing a 5 point scale ranging from "Strongly Agree" to " Strongly Disagree". The items were equally divided among three categories: attitudes toward delivery system, attitudes toward subject matter, and attitudes toward group work.

The Coefficient alpha reliability for the questionnaire was reported to be .91 (Simsek & Tsai, 1992). Although those authors used the questionnaire with sixth grade students, the current study still found a high reliability (.86) for the instrument, even though the subjects here were adults. The purpose of the scale assessing attitudes of students was to determine students' liking to the delivery system, the subject matter, and of working with a partner. An example item for each category was: "I enjoyed working with the computer" (delivery system); "I would like to learn more about weight training" (subject matter); and "I feel more comfortable working in a small group than working alone" (group work).

Procedures

The study was implemented during a six-week period. The pretest was administered during the first week. The basic cooperative skills training was completed by all students and occurred during the second week. During the third week, each student completed two computer-based instructional units. Each student spent about 40 to 50 minutes each day to finish two units of content. During the fourth and fifth weeks, nothing related to the study happened for the students. The retention test was delivered in the sixth week of the study.

Subjects were assigned to treatments using stratified-random sampling. Initially, high- and low-prior knowledge students were randomly assigned to paired. Next, within each class, subjects in the paired treatment were ranked within each ability group. Partners were assigned by combining students with identical ranks. The most able high- and low-prior knowledge students were paired, as were the second most able and so on. Thus, equivalent heterogeneity among group members was established. Each group contained two subjects.

The study was conducted in the weight room of the kinesiology department. Sixteen Macintosh SE computers were set up before each class. Specific directions for implementing individual versus cooperative strategies were provided for each condition. Subjects were assigned to a computer and completed one of three types of feedback version of the CBI lesson. Upon completion of the lesson, each subject individually completed the attitude questionnaire. Two weeks after the above activities, all subjects were individually administered the delayed retention test.

The basic cooperative skills training was adapted from procedures recommended by Johnson and Johnson (1984). Students were presented with a 50 minute instructional module development by the researcher for use with the four weight training instructors intended to guide students toward better use of cooperative behaviors. Two activities were given to the cooperative learning groups' instructors to help reinforce those behaviors students need in order to work cooperatively.

Design and Data Analysis

The study employed a 3 x 2 factorial design. The first factor was Types of feedback with three levels (no feedback-NF, knowledge of correct response-KCR, and elaborative feedback-EF), and the second was Ability had two levels (high and low-prior knowledge). In analyzing data, two-way ANOVA was used. Dependent variables of the study were achievement on the retention posttest, and attitudes toward computer-based instruction, weight training, and learning in pairs. The alpha level was set at .05, unless otherwise indicated.

Results

Achievement

Achievement was operationalized as an individual's score on the retention posttest. Mean scores and standard deviations for retention posttest scores can be found in Table 1. Results of the ANOVA showed significant main effects for feedback type $F(2, 114) = 5.95$, $p < .01$, and for ability $F(1, 114) = 17.57$, $p < .001$. A two-way interaction was found between Feedback and Ability $F(1, 114) = 13.99$, $p < .001$. The feedback main effect was further analyzed via Scheffe follow-up comparisons of the three overall treatment means. Results indicated the EF mean (M= 33.00) and the KCR mean (M= 31.63) were both significantly higher than NF mean (M= 27.00). However, there were no significant differences between KCR and EF conditions. A simple inspection of the means shows students in the high-prior knowledge (M= 31.95) outperforming those in the low-prior knowledge treatment (M= 29.13).

The significant interaction between Feedback and Ability was further analyzed by comparing the six feedback means, using a Scheffe's procedure to analyze the 15 possible pair-wise comparisons. The results of this analysis are shown in Table 3. Findings, although not significant, indicated that for low-prior knowledge students the KCR condition mean was higher than that for the elaborative feedback (EF) condition. However, for high-prior knowledge students, the elaborative feedback (EF) condition mean was a significantly higher than the KCR condition mean. This proved to be significant level. That is, high-prior knowledge students performed better under the EF feedback condition. However, the assumption that KCR feedback condition is better than EF feedback condition for low-prior knowledge students was not confirmed. The interaction is graphically displayed in Figure 1.

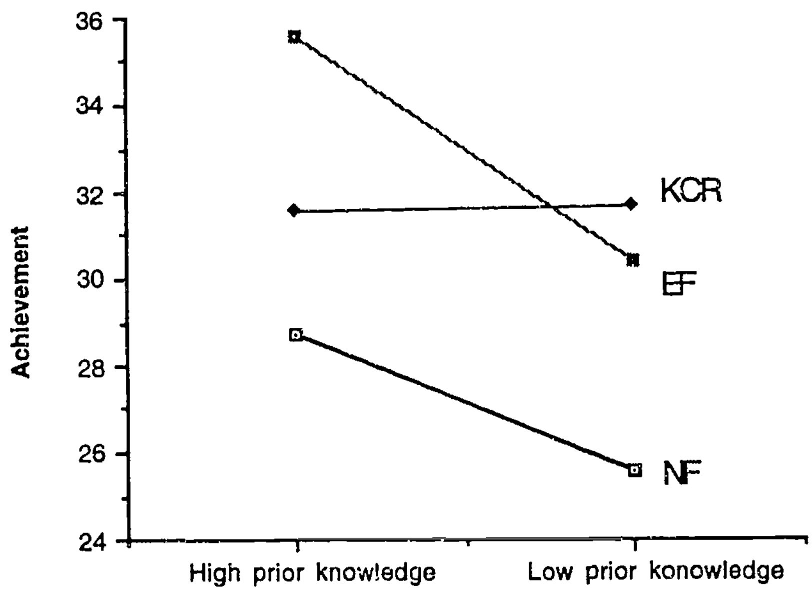

Figure 1.
Graph of the Interaction of Feedback and Ability (prior knowledge) by Retention Posttest.

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

		FEEDBACK			
		NF	KCR	EF	Total
High	M	28.75	31.55	35.55	31.95
	SD	2.05	1.86	1.79	3.43
	n	20	20	20	60
Low	M	25.25	31.70	30.45	29.13
	SD	3.09	2.66	1.77	3.84
	n	20	20	20	60
Combined					
	M	27.00	31.63	33.00	30.54
	SD	2.57	2.26	1.78	3.64
	n	40	40	40	120

Attitudes

Student attitudes toward the delivery system, subject matter, and group work were measured with the attitude questionnaire. Attitudinal data for 108 out of the original 120 subjects were included in the analyses of the results because scores on one or more measures were unavailable for the remaining 12 subjects (For random reasons: illness, transportation problem, etc.). Means and standard deviations for overall attitude scores are contained in Table 2.

Table 2.
Means and Standard Deviations for Attitude Scores.

		FEEDBACK			
		NF	KCR	EF	Total
Cooperative					
High	M	113.73	111.75	111.50	112.33
	SD	2.05	2.90	4.21	3.37
	n	18	17	18	53
Low	M	116.00	114.06	114.15	114.70
	SD	2.59	4.07	2.14	3.06
	n	17	18	19	54
Combined					
	M	114.87	112.91	112.83	113.52
	SD	2.32	3.49	3.18	3.22
	n	35	35	37	107

Two-way ANOVA results revealed that the main effects were significant for Feedback, $F(2,95)= 4.52$, $p=.013$, for Ability, $F(1,95)= 14.92$, $p<.001$. However, no significant two-way interactions were found between Feedback and Ability. The feedback main effect was further analyzed via Scheffe follow-up pair-wise comparisons of the three overall treatment means (see Table 3). Results indicated no significant pairwise differences among the NF, KCR, and EF feedback conditions. The significant main effect was probably due to the pooling of the nearly-identical means of the KCR treatment (M = 112.91) and the EF treatment (M = 112.83) being substantially lower than the NF condition (M = 114.87).

Table 3.
Mean Differences for Type of Feedback by High and Low Ability (prior knowledge) Level.

	NF/H	KCR/H	EF/H	NF/L	KCR/L
NF/H(28.75)	•				
KCR/H(31.55)	2.80	•			
EF/H(35.55)	6.80*	4.00*	•		
NF/L(25.55)	3.50	6.30*	10.30*	•	
KCR/L(31.70)	2.95	0.15	3.85*	6.45*	•
EF/L(30.45)	1.70	1.10	5.10*	5.20*	1.25

*p < .05 (Scheffe)

An examination of the Ability main effect indicated that low-prior knowledge students (M= 114.85) demonstrated better attitudes than high-prior knowledge students (M= 112.13). Analyses of variance on both the attitude toward subject matter and the attitude toward group work subscales indicated no significant main or interaction effects.

Discussion

This study was to investigate the effects of type feedback and ability (high- or low-prior knowledge) in a cooperative-based instructional program. Upon completion of the lesson, students responded to a retention posttest and an attitude questionnaire.

The result of the study yielded a significant interaction between types of feedback and prior knowledge level: elaborative feedback (EF) was more effective with high-prior knowledge students. High prior knowledge students who received elaborative feedback demonstrated significantly higher in achievement than those who received KCR and NF treatment. Specifically, high-prior knowledge students seem more able to take advantage of the extra mental effort required by elaborative feedback. However, asking students to provide responses on the computer without activating greater mental effort (as in KCR or NF) might frustrate high-prior knowledge learners and result in lower performance. For low-prior knowledge students, EF and KCR treatments significantly outperformed the NF condition. However, there were no significant differences between KCR feedback and elaborative feedback for low-prior knowledge students, although the KCR mean scores were slightly higher than elaborative feedback (EF) condition.

The significant interaction of feedback type by prior knowledge in this study partially replicates the results of Dick & Latta (1970) and more recent studies by Clariana (1990), Clariana & Smith (1989), and Smith (1988) that high-prior knowledge learners benefit most from feedback that provides additional information, like elaborative feedback, but not from feedback that short-circuits additional processing, such as KCR feedback. Low-prior knowledge learners, on the other hand, should benefit most from feedback that provides less information than the elaborative feedback condition, like KCR feedback, and may be overwhelmed by feedback which requires additional processing, like elaborative feedback. In the current study, however, although KCR slightly outperformed the EF condition, there was no significant difference. This could be due to the nature of the feedback provided in the lesson: it was highly graphical, whereas, earlier studies employed textual feedback. It might be that the amount of information contained in pictorial feedback and perceived by low-prior knowledge students is more difficult to specify.

Results on the attitude measure revealed that low-prior knowledge students had more positive attitudes than high-prior knowledge students. One plausible explanation for the results obtained is that the low-prior knowledge students in heterogeneous groups feel more supported and satisfied than other students. They may also feel privileged because their high-prior knowledge partners are always available to help them. According to Deutsch (1949), interaction improves interpersonal attraction when the interaction helps individuals to achieve personal goals. Johnson & Johnson (1989) also indicated that for the college and adult studies, cooperative experiences resulted in greater interpersonal attraction than did competitive or individualistic experiences (effect sizes = 0.83 and 0.40 respectively). In cooperative learning groups, students' goals are linked. Thus, partners seek outcomes that are beneficial to everyone in their group. Such interdependence motivates partners to invest effort toward a mutual goal, which in turn helps foster a caring and supportive environment.

By understanding the conditions under which feedback is most effective during learning, we can improve both our instructional theories and our practices. Feedback serves to provide conditions that result in mutual influence between learners and their environments. For researchers and developers in the field of educational technology, the implications of effective and efficient interactions between the learner and the learning task are critical, since newer technologies are able to make optimum use of such highly interactive environments. However, while a great deal of reseaich has been conducted on the feedback and cooperative learning, the effects of types of feedback in group learning have not been adequately investigated between these instructional variables. Based upon the results of this and other relevant studies, the following recommendations are proposed for future research.

Additional research is needed to determine whether motivational factors may impact the learner's prior knowledge to process feedback effectively. For example, the learner's motivational states, attitudes about the instructional or topic, general self-perceptions, learning styles, and self-esteem levels may all play a part in their prior knowledge to successfully interact with feedback. A learner with a poor self-concept or general lack of self-confidence is likely to underestimate his or her prior knowledge in a majority of situations.

Researchers should examine other factors that influence cooperative learning. One such factor is ability-group composition. The present study investigated cooperative groups comprised of heterogeneous prior knowledge pairs and compared their performance to similar students working individually. Future research might wish to heterogeneous prior knowledge groups with homogeneous groups.

More research should be conducted to examine the relationship among the effects of various computer-delivered feedback and group size. Although interpersonal interactions generate more powerful feedback in cooperative groups, studies do not provide a clear answer regarding the ideal group size. In fact, the number of students in a group may depend largely on the tasks students involve. Researchers may wish to explore and clarify the relationship between group size and type of computer-delivered feedback to determine which can be employed most effectively and efficiently to boost students' performance.

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.

References

Clariana, R. B., & Smith, L. J. (1989). The effects of AUC and KCR feedback on learners of different ability. A paper presented at the Annual meeting of the Mid-South Educational Research Association, Little Rock, Arkansas. (ERIC Document Reproduction Service: ED 313 387)

Clariana, R. B. (1990). A comparison of answer until correct feedback and knowledge of correct response feedback under two conditions of contextualization. Journal of Computer-Based Instruction, 17(4), 125-129.

Clariana, R. B., Ross, S. L., & Morrison, G. R. (1991). The effects of different feedback strategies using computer-assisted multiple-choice questions as instruction. Educational Technology Research and Development, 39(2), 5-17.

Dempsey, J., & Sales, G. C.. (1993). Interactive instruction and feedback. Englewood Cliffs, NJ: Educational Technology Publications.

Deutsch, M. (1949). A theory of cooperation and competition. Human Relations, 2, 129-152.

Dick, W., & Latta, R. (1970). Comparative effects of ability and presentation mode in computer-assisted instruction and programmed instruction. Audio-visual Communication Review, 18(3), 34-45.

Hatfield, F., & Krotee, M. L. (1984). Personalized weight training for fitness and athletics, Dubuque, Iowa: Kendall/Hunt Company.

Hooper, S., & Hannfin, M. J. (1988). Cooperative CBI: The effects of heterogeneous versus homogeneous grouping on the learning of progressively complex concepts. Journal of Educational Computing Research, 4(4), 413-424.

Hooper, S., & Hannafin, M. J. (1991). The effects of group composition on achievement, interaction, and learning efficiency during computer-based cooperative instruction. Educational Technology Research and Development, 39(3), 27-40.

Johnson, D. W., Johnson, R. T. (1984). Cooperative in the classroom , Edina, MN: International Book Company.

Johnson, D. W., & Johnson, R. T. (1989). Cooperation and competition: Theory and research. Edina, MN: Interaction Book Company.

Simsek, A. & Tsai, B. (1992). The impact of cooperative group composition on student performance and attitudes during interactive videodisc instruction. Journal of Computer-Based Instruction, 19(3), 86-91.

Webb, N. M. (1982). Peer interaction and learning in cooperative small groups, Journal of Educational Psychology, 74(5), 642-655.