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ABSTRACT

Examined were the effects on children's learning and motivation of the embedding of instructional materials in various fantasy contexts. Students in the third grade worked with graphics commands from the LOGO programming language under one of three conditions. In a control condition, students were given a series of abstract problems characteristic of traditional instructional methods. In two fantasy conditions, identical problems were presented within a fantasy problem-solving context. In one group, children were given their choice of three alternative fantasy contexts; in the other, children were assigned fantasies yoked to the choices of the other group. Students were tested on their knowledge of LOGO and several underlying geometric concepts before, immediately after, and 2 weeks after the experimental sessions. Both fantasy groups showed significantly greater knowledge of LOGO, but not of underlying concepts, than their no-fantasy counterparts. There were no differences between the two fantasy groups. Unexpectedly, girls outperformed boys on both tests. Implications regarding the use of motivational embellishments to enhance interest and promote learning are discussed. (Author/RH)

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Abstract

This study examined the effects of embedding instructional materials in various fantasy contexts. Third-grade children worked with graphics commands from the LOGO programming language, under one of three conditions. In a control condition, students were given a series of abstract problems, characteristic of traditional instructional methods. In two fantasy conditions, identical problems were presented within a fantasy problem-solving context. In one group, children were given their choice of three alternative fantasy contexts; in the other, children were assigned fantasies yoked to the choices of the other group. Students were tested on their knowledge of LOGO and several underlying geometric concepts before, immediately after, and two weeks following the experimental sessions. Both fantasy groups showed significantly greater knowledge of LOGO, but not underlying concepts, than their no-fantasy counterparts. There were no differences between the two fantasy groups. Unexpectedly, girls also outperformed boys on both tests. Implications regarding the use of motivational embellishments to enhance interest and promote learning are discussed.

For many years, master teachers have attempted to embed educational material into fantasy contexts. For example, walk into the third grade classroom of one teacher and enter the shop of a "crooked" store keeper who cajoles delighted students to add, subtract, and divide least they find themselves "short changed". Or, sit in on the class of a European history teacher who has students prepare a Renaissance banquet complete with music, food, costume, and a fireworks display. Despite very different contexts, the underlying assumption in these two examples is identical. It is assumed that such procedures may enhance students' motivation and perhaps their learning.

Based upon theoretical and empirical work from the imaginative play (e.g. Fein, 1981; Singer, 1977) and mental imagery (e.g. Bower, 1972; Paivio, 1970) literatures, it is proposed that the introduction of fantasy into the instructional material can enhance learning in two ways. First, it may enhance intrinsic motivation (Deci, 1975; Malone & Lepper, 1987). It has been observed that many highly intrinsically motivating activities (including reading and dramatic or pretend play) involve the elicitation of fantasy. Lepper and Malone (1987) have argued that enhanced intrinsic motivation may promote increased learning via greater attention and more mindful or deeper processing. Second, fantasy may have certain cognitive advantages, such as improving memory for material learned by providing realistic metaphors or evoking vivid images (Bower, 1972; Paivio, 1970).

Surprisingly, given the important function it may serve, fantasy has rarely been studied empirically in educational contexts. Moreover, the informal manner in which fantasy has been added into lessons has made it difficult to study in any controlled fashion. One interesting and unexpected concomitant of the development of powerful and inexpensive microcomputers has been the ability to marry fantasy and lessons in a controlled fashion (Lepper, 1985). Taking advantage of this, the present study used computer based lessons to test the hypothesis that fantasy can be an effective instructional tool. We also tested the secondary hypothesis that fantasy will be most effective when it matches the learner's interests.

Method

Overview. This study examined the effects of embedding instructional materials in various fantasy contexts. Third-grade children worked with graphics commands from the LOGO programming language, under one of three conditions. In a control condition, students were given a series of abstract problems. In two fantasy conditions, identical problems were presented within a fantasy problem-solving context. In one group, children were given their choice of three alternative fantasy contexts; in the other, children were assigned fantasies yoked to the choices of the other group. Students were tested on their knowledge of LOGO and several underlying geometric concepts.

Participants. The sample included 19 male and 14 female third graders from a private Catholic elementary school in the San Francisco Bay area. Controlling for sex, 11 children were randomly assigned to each of the three conditions: Fantasy Choice, No-Choice Fantasy and No-Fantasy Control. Some children did not complete all four lessons; their data are not included. In the final sample, there were 10 children in the Fantasy Choice condition (six boys and four girls), 10 children in the Fantasy No-Choice condition (five boys and five girls), and eight children in the No-Fantasy condition (five boys and three girls). The 28 children in the final sample ranged in age from 8 to 10 years (mean = 8.77, SD = .65) and came from predominantly lower middle income backgrounds (as estimated by parental occupation). None had prior programming experience.

Procedure. Students participated, in small groups, in seven experimental sessions. They were taught the fundmentals of working with LOGO "turtle graphics" (Papert, 1980) on Apple II+ computers. During the first session, children were pre-tested on their knowledge of the basic geometric concepts underlying simple graphic programming in LOGO (e.g., estimation of line length and direction, and angle size). During the second through fifth sessions, children received instruction in the elementary concepts involved in using turtle graphics. Children in the No-Fantasy control condition were given a standard sequence of instruction and a standard series of exercises to undertake, all involving abstract "line drawing". Following an introduction to the five basic commands that permit the child to control the movement of a triangular cursor that draws lines on the screen, children were presented with a set of problems which included connecting objects, negotiating mazes and drawing simple geometric shapes.

Children in the Fantasy Choice condition were asked to select a fantasy context from a list of three alternatives (a space story, a pirate story, and a detective story). Children in the Fantasy No-Choice condition were assigned fantasies which were yoked to the selections of the children in the Choice condition. Students in these two fantasy conditions and the control condition received formally identical instruction. The only difference between the experimental conditions and the control condition was that material was embedded in a fantasy problem-solving context designed to increase the intrinsic motivational appeal of the activities and to foster the formation of mnemonic metaphors and images. Thus, for some students in these groups mazes became catacombs or city streets.

During a sixth session, immediately following the lessons, children were given a post-test to assess their knowledge of geometric concepts and LOGO turtle graphics. During a seventh session, which took place two weeks after the last lesson, the post-test was re-administered.

Results

Preliminary Analyses. There were no differences between the Choice and No-Choice Fantasy conditions on either the LOGO tests or the Geometric Concepts tests. Therefore data were collapsed across these two groups and further comparisons examined the differences between students in the two experimental fantasy conditions and students in the No-Fantasy control condition. It was also found that girls and boys differed on the dependent measures. Therefore the gender grouping was maintained on subsequent analyses.

Learning of turtle graphics. To assess the effects of sex and condition upon learning the turtle graphic commands in LOGO, two-way analyses of covariance controlling for the children's performance on the geometric concepts pre-test and their academic achievement as measured by the California Test of Basic Skills (CTBS) were computed[1]. As hypothesized, children in the Fantasy conditions performed significantly better on the initial LOGO post-test than children in the No-Fantasy Condition, $F\,(1, 22) = 7.19, p < .02$. On the delayed LOGO post-test, the Fantasy groups again performed better than the No-Fantasy group; this difference only approached statistical significance $F\,(1, 22) = 4.28, p = .05$. Although girls seemed to perform better than boys on the initial and delayed LOGO tests, neither difference achieve statistical significance, $F\,(1, 22) = 1.95, p = .17$ and $F\,(1, 22) = 3.18, p = .09$, respectively. There were no significant interactions. The unadjusted and adjusted means and standard deviations for the two LOGO post-tests are reported in Table 1

Insert Table 1 about here

Learning of Geometric Concepts. Similarly, to assess the effects of sex and condition upon learning the geometric concepts underlying LOGO, two-way analyses of covariance, controlling for performance on the Geometric Concepts pre-test and the CTBS, were computed. Contrary to expectations, there were no differences between the Fantasy and No-Fantasy groups on either the initial or delayed Geometric Concepts Post-Tests. Girls performed significantly better than boys on the initial Post-Test $F\,(1, 21) = 8.68, p < .01$. On the delayed post-test, girls again performed better than boys, although this latter difference only approached statistical significance $F\,(1, 22) = 2.69, p = .12$. There were no significant interactions. The unadjusted and adjusted means and standard deviations for the two Geometric Concepts post-tests are reported in Table 2

Insert Table 2 about here

Discussion

As hypothesized, embedding structured instructional materials in a fantasy context significantly enhanced children's learning of basic graphics programming in LOGO. Moreover, the children in the fantasy conditions maintained their superiority two weeks after the last lesson. These findings are particularly compelling because the manipulation was relatively subtle. Materials were instructionally identical and time on task was the same for all groups; yet, the fantasy group learned more[2]. The effect, however, was limited. Contrary to expectations, the use of fantasy did not enhance learning the geometric concepts underlying LOGO. It is possible that four lessons are not sufficient to facilitate gains in this complex material. Also, contrary to expectations, there were no differences in learning between the Fantasy Choice and No-Choice Groups. It is possible that the choice dimension was not made sufficiently salient to the children. The latter finding, however, has positive policy implications. It demonstrates that even when fantasy contexts are not precisely tailored to the individual student, they can be effective educational tools.

It was also of interest that the girls performed better than boys on both the LOGO and Geometric Concept tests. It is widely acknowledged that there are gender differences in computer usage. The ratio of males to females is quite high in elementary school and children's summer computer programs (Lepper, 1985) and remains high at the university and professional levels. We believe the sex differences found in this study should be interpreted optimistically but with caution. They suggest not that girls are necessarily better LOGO programmers than boys, but that given the right mix of instructional material and fantasy, boys are not necessarily better than girls at computer activities.

Finally, it should be noted that although we used computers, our findings have more general implications. Because computers afford a degree of control not possible with live instructors, computers are an excellent experimental tool. We do not believe that our findings are limited to a computer-based educational context. Rather, we expect that our findings could generalize to other contexts such as written materials and classroom demonstrations. Similarly, we expect that our findings are not limited to learning turtle graphics. Rather, we propose that embedding instructional materials in fantasy contexts could improve learning of many subjects including language, social studies, science, and mathematics.

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Foot Notes

[1]The composite of the reading, math, and language subtests of the CTBS were used. This is a standard measure of academic achievement.

[2]Although only one subject from each of the Fantasy conditions did not complete the lessons, three subjects from the No-Fantasy condition did not finish the lessons -- an effect consistent with the hypothesis that Fantasy Conditions enhanced motivation. Moreover, if it was the least motivated subjects who dropped out, then differences reported here are conservative estimates.

Table 1

Means and SD's of Group Performance on LOGO Turtle Graphics Tests.

Statistics By Group	Initial LOGO Test Unadjusted	Initial LOGO Test Adjusted@	Delayed LOGO Test Unadjusted	Delayed LOGO Test Adjusted@
Female Fantasy				
Mean	9.89	9.52	11.78	11.52
SD	4.34	--	4.35	--
Male Fantasy				
Mean	8.00	8.25	9.54	9.60
SD	2.58	--	4.06	--
Female No Fantasy				
Mean	7.67	7.07	9.67	9.25
SD	5.03	--	4.04	--
Male No Fantasy				
Mean	5.20	5.72	6.00	6.58
SD	1.30	--	1.58	--
Pooled Est. of Pop. SD	--	2.23	--	3.01

Highest possible score on these measures was 24 points.

@ Adjusted means are from ANCOVA controlling for knowledge of geometric concepts and composite CTBS score.

Table 2

Means and SD's of Group Performance on Geometric Post-Tests.

Statistics By Group	Measures			
	Initial Post Test		Delayed Post Test	
	Unadjusted	Adjusted@	Unadjusted	Adjusted@
Female Fantasy				
Mean	23.22	22.58	24.00	23.80
SD	6.06	--	8.41	--
Male Fantasy				
Mean	18.44	18.93	20.09	19.86
SD	5.10	--	6.04	--
Female No Fantasy				
Mean	23.33	22.50	22.33	21.50
SD	6.03	--	4.51	--
Male No Fantasy				
Mean	17.20	17.97	17.20	18.57
SD	3.63	--	6.38	--
Pooled Est. of Pop. SD	--	3.47	--	4.79

Highest possible score on these measures was 43 points.

@ Adjusted means are from ANCOVA controlling for knowledge of geometric concepts and composite CTBS score.