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ABSTRACT

This study applied brain lateralization research and a model of generative teaching and learning to economic education. The purpose of this study was to determine the effect of verbal-only, imagery-only, and integrated (verbal-to-imaginal) strategies on fifth graders' proclivity to use economic reasoning (i.e. cost-benefit analysis) in personal decision-making situations. The study involved 66 fifth-graders, each randomly assigned to 3 treatment conditions, namely, instruction on cost-benefit analysis using: (1) a verbal-only strategy; (2) an imagery-only strategy; and (3) an integrated (verbal-to-imaginal) strategy. All treatment groups received imagery training prior to economics instruction. At pretest, immediate posttest, and delayed posttest (6 weeks after instruction), students were asked to respond in writing to a hypothetical decision-making situation not seen during instruction. Each response was scored by two expert judges in terms of a three-level hierarchy of economic reasoning. A one-way ANOVA revealed no statistically significant differences among the three treatment group means at pretest. All groups showed statistically significant increases in economic reasoning scores from pretest to immediate posttest, and these increases were maintained across all groups at delayed posttest. A set of planned comparisons showed no statistically significant differences between the three treatment group means at immediate or delayed posttest, but results were in the expected direction. At immediate and delayed posttest, the mean economic reasoning scores of the integrated (verbal-to-imaginal) strategy groups was slightly more than the mean score of the verbal strategy group. In addition, the mean economic reasoning score of the verbal-only strategy group exceeded the mean economic reasoning score of the imagery-only strategy group. The results of the study were consistent with generative learning theory. They suggested that teacher elaborations and student generations of all kinds (verbal-only, imagery-only, and integrated--verbal-to-imaginal) can be used to enhance and maintain fifth-graders' economic reasoning in personal decision-making situations. A list of references and a number of tables of statistical data are included. (Author/DB)

THE EFFECT OF ECONOMICS INSTRUCTION ON ECONOMIC REASONING: A COMPARISON OF VERBAL, IMAGINAL, AND INTEGRATED TEACHING-LEARNING STRATEGIES

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Abstract

The study described in this paper applied brain lateralization research and a model of generative teaching and learning to economic education. The purpose of the study was to determine the effect of verbal-only, imagery-only, and integrated (verbal-to-imaginal) strategies on fifth graders' proclivity to use economic reasoning (i.e. cost-benefit analysis) in personal decision-making situations.

The experiment involved 66 fifth graders, each randomly assigned to three treatment conditions: instruction on cost-benefit analysis using (1) a verbal-only strategy, (2) an imagery-only strategy, and (3) an integrated (verbal-to-imaginal) strategy. All treatment groups received imagery training prior to economics instruction.

At pretest, immediate posttest, and delayed posttest (six weeks after instruction), students were asked to respond in writing to a hypothetical decision-making situation not seen during instruction. Each response was scored by two expert judges in terms of a three-level hierarchy of economic reasoning.

A one-way ANOVA revealed no statistically significant differences between the three treatment group means at pretest. All groups showed statistically significant increases in economic reasoning scores from pretest to immediate posttest, and these increases were maintained across all groups at delayed posttest. A set of planned comparisons showed no statistically significant differences between the three treatment group means at immediate or

delayed posttest, but results were in the expected direction. At immediate and delayed posttests, the mean economic reasoning score of the integrated (verbal-to-imaginal) strategy group was slightly more than the mean score of the verbal strategy group; in addition, the mean economic reasoning score of the verbal-only strategy group exceeded the mean economic reasoning score of the imagery-only strategy group.

The results are consistent with generative learning theory. They suggest that teacher elaborations and student generations of all kinds (verbal-only, imagery-only, and integrated--verbal-to-imaginal) can be used to enhance and maintain fifth graders' economic reasoning in personal decision-making situations.

THE EFFECT OF ECONOMICS INSTRUCTION ON ECONOMIC REASONING: A COMPARISON OF VERBAL, IMAGINAL, AND INTEGRATED TEACHING-LEARNING STRATEGIES

M. L. Kourilsky (1987) suggests that economic education can be improved through the application of learning theory, including learning theory based on brain lateralization research. This research indicates that the left and right hemispheres of the human brain engage in different types of information processing. For most people, the left hemisphere specializes in verbal processes and is more analytic and sequential in handling data, while the right hemisphere specializes in imaginal (imagery-related) processes and is more synthetic and holistic in handling data (Bogen, 1977). Theoretically, learning is enhanced when both hemispheres of the brain are called upon to process information, as when two symbol systems (verbal and imaginal) are used to present new concepts. This statement applies to both left-brain dominant and right-brain dominant learners (Bogen, 1977; Kourilsky, 1987; and Wittrock, 1981).

Along with the literature on brain lateralization, M. C. Wittrock's (1974, 1987) model of generative teaching and learning provides a promising starting point for those interested in pursuing Kourilsky's suggestion for improving economics instruction. According to Wittrock, comprehension and knowledge acquisition occur (a) as the learner constructs relations among the parts of the new information to be learned and/or (b) as the learner constructs relations between the new information and

his/her knowledge base and experience. Teacher-produced "elaborations" (both verbal and imaginal) and student-produced "generations" (both verbal and imaginal) facilitate comprehension and knowledge acquisition by providing the necessary connections or relations. Learning increases as the frequency and quality of the elaborations and generations increase. In accordance with learning theory based on brain lateralization research, learning is also enhanced when both verbal and imaginal representations are constructed, for the integrated use of verbal and imaginal representations requires both the left and right hemispheres of the brain to engage in information processing.

Wittrock (1983) indicates that there is a developmental progression in children's ability to generate and profit from verbal and imaginal representations. At about age eight, children develop the ability to generate and profit from images. The ability to generate and profit from verbal representations (e.g., sentences) occurs earlier.

A study by Kourilsky and Wittrock (1987) relates to the teaching and learning of economic concepts and provides evidence in support of learning theory arising from brain lateralization research and Wittrock's model of generative instruction. Specifically, this research supports the notion that concept learning is enhanced when both verbal and imaginal symbol systems are employed (or when both verbal and imaginal representations are constructed). In addition, this research indicates that the sequence in which verbal and imaginal symbol systems are used (or

the sequence in which verbal and imaginal representations are constructed) is important.

In Kourilsky and Wittrock's study, high school students in an introductory economics course were taught the economic concepts of supply, demand, and equilibrium (market) price using three different instructional sequences: verbal-to-imaginal, imaginal-to-verbal, and verbal-only. The purpose of the study was to determine the effect of the three instructional sequences on student's understanding of the three economic concepts. The verbal-to-imaginal sequence of presentation proved to be superior to the imaginal-to-verbal sequence of presentation, and the use of two symbol systems (regardless of their ordering) was more effective than the use of a single symbol system (the verbal-only sequence). Kourilsky and Wittrock attributed these results to (a) the familiarity of the verbal mode of presentation versus the unfamiliarity of the imaginal (graphic) mode of presentation and (b) the frequency and accuracy of imaginal representations (graphs) constructed by students within their respective treatment groups.

A study by Laney (1990) also relates to the teaching and learning of economic concepts but only partially supports learning theory arising from brain lateralization research and Wittrock's model of generative instruction. Laney hypothesized that generative teaching-learning strategies could be used to help students internalize the steps in the process of cost-benefit analysis, thereby increasing students' proclivity to use cost-benefit analysis in their everyday decision making. This

internalization was hypothesized to occur through the instructional use of hypothetical decision making situations and teacher- and student-produced verbal and imaginal representations for each step of the cost-benefit analysis process. According to Laney, these representations serve to connect (a) the parts or steps of the cost-benefit analysis process and (b) the cost-benefit analysis process to one's own life experiences and background knowledge. Specifically, Laney's study explored the effect of verbal-only, imagery-only, and integrated (verbal-to-imaginal) strategies for teaching the cost-benefit analysis way of thinking on third graders' economic reasoning (use or non-use of cost-benefit analysis) in personal decision making situations.

The results of Laney's study indicated that verbal strategies (verbal-only and integrated--verbal-to-imaginal) were superior to an imagery-only strategy for increasing third graders' proclivity to use cost-benefit analysis. Third graders did not profit as much from imaginal representations (stick figures) as they did from verbal representations (sentences). Integration of verbal and imaginal strategies had no apparent advantage over a verbal-only strategy in increasing third-graders' level of economic reasoning. Thus, the study demonstrated the superiority of familiar verbal strategies over unfamiliar imaginal strategies, but failed to establish the superiority of a strategy characterized by (a) the integrated use of verbal and imaginal representations and (b) a greater number of teacher-produced elaborations and student-produced generations (because of the use of both verbal and

imaginal representations in conjunction with each step of the cost-benefit analysis process).

Because all treatment groups in Laney's study had very low economic reasoning scores at posttest (less than one point on a three-point economic reasoning scale), Laney suggested that third-graders might not be developmentally ready for economics instruction (a) aimed at teaching the cost-benefit analysis way of thinking and (b) featuring relatively unfamiliar imagery strategies. He called into question the practice of teaching economic decision making in the primary grades (as early as first grade in some curriculums) and stated that it might be best to delay this instruction until the intermediate elementary grades or later.

Research Questions

The study described in this paper was designed to extend Laney's (1990) research. The purpose of the study was to determine the effect of verbal-only, imagery-only, and integrated (verbal-to-imaginal) strategies for teaching cost-benefit analysis on fifth graders' proclivity to use economic reasoning in personal decision-making situations. Fifth graders were chosen as the population of interest because of their ability to generate and profit from images (Wittrock, 1983). In order to insure these fifth graders' readiness for imagery-related instructional strategies, all treatment conditions included metacognitive training in the generation of images and the use of images as

mnemonic devices. Research questions for the study were as follows:

1. After receiving imagery training and instruction in the cost-benefit analysis way of thinking using a generative learning strategy (verbal-only, imagery-only, or integrated--verbal-to-imaginal), do fifth graders demonstrate a greater proclivity to use economic reasoning in their personal decision making than they did before instruction?

2. In their personal decision making, do fifth graders who have received imagery training and who have been taught the cost-benefit analysis way of thinking using a verbal strategy (verbal-only or verbal-to-imaginal) demonstrate a greater proclivity to use economic reasoning (at posttest and delayed posttest) than fifth graders who have received imagery training and who have been taught the cost-benefit analysis way of thinking using an imagery-only strategy?

3. In their personal decision making, do fifth graders who have received imagery training and who have been taught the cost-benefit analysis way of thinking using an integrated (verbal-to-imaginal) strategy demonstrate a greater proclivity to use economic reasoning (at posttest and delayed posttest) than fifth graders who have received imagery training and have been taught the cost-benefit analysis way of thinking using a verbal-only strategy?

Methodology and Procedure

The study was limited to fifth graders in two elementary schools in north central Texas. Sixty-six students, including 40 boys and 26 girls, participated in the experiment. Fifteen to 20% of these students were members of a minority group, and the majority were from families of middle or low socioeconomic status. None of the students had received prior instruction in cost-benefit analysis.

Within each school, the fifth-grade students were randomly assigned to three treatment groups, using sex, classroom membership, and general academic ability as stratification variables. As a rough indicator of general academic ability, each fifth-grader was rated by his/her regular classroom teacher as being low, medium, or high in general academic ability. Before rating their students, the teachers met and agreed upon the criteria to be employed.

Students were pretested using a measure of economic reasoning. All three instructional treatments began in the same way. After the pretest and prior to instruction in cost-benefit analysis, each treatment group received training in how to construct imaginal representations and use them as mnemonic devices. The imagery training consisted of one 45-minute lesson divided into three parts. The purpose of the three-part lesson was to teach students (a) to generate simple stick figures to represent increasingly difficult ideas and (b) to use a visual framework to relate ideas

in a meaningful, memorable way. The three parts of the imagery training lesson are described in detail below.

In part 1, "A Walk Around My Neighborhood," the teacher modeled the drawing of four pictures to represent things s/he sees when walking around his/her neighborhood block. Students then drew their own set of pictures. In order to relate these ideas and indicate the location of these neighborhood points of interest, each student was asked to place his/her pictures on a previously prepared drawing of a birds-eye-view, rectangular configuration of city streets. Next, students were asked to close their eyes and mentally view their pictures in sequential order.

In part 2, "My Typical Saturday," the teacher modeled the drawing of four pictures to represent things s/he typically does on Saturday. Students then drew their own set of pictures. In order to relate these ideas and indicate the time-of-day at which these activities occur, each student was asked to place his/her pictures on a previously prepared drawing of a clock face. Next, students were asked to mentally view their pictures as done previously.

In part 3, "How to Make a _____," the teacher modeled the drawing of four pictures to represent major steps in a process (making a kite). Students then drew their own set of pictures for a process of their own choosing. In order to relate these ideas and indicate their ordering, each student was asked to place his/her pictures on a previously prepared drawing of a staircase. Next, students were asked to mentally view their pictures as before.

Three college professors with elementary school teaching experience and backgrounds in economic education served as the instructors for the three treatment conditions. In order to minimize differences between instructors, the instructors implemented scripted lesson plans differing from one treatment condition to the next only in terms of the instructional strategy used--verbal-only, imagery-only, and integrated (verbal-to-imaginal).

The three treatment conditions are described in the next three paragraphs. The label for each treatment group reflects (a) the type of representations provided to students by the teacher during instruction and (b) the type of representations that students were asked to make during instruction.

In treatment condition 1, students were taught cost-benefit analysis in two 45-minute lessons based on a verbal-only strategy (a strategy in which only verbal elaborations and generations were constructed). Students experienced two hypothetical decision-making situations. In the first, the teacher modeled, step by step, the cost-benefit analysis way of thinking. During this demonstration, one or more teacher-composed summary sentences served as verbal elaborations for each step of the process. Next, students practiced thinking in terms of cost-benefit analysis as they resolved the second hypothetical dilemma. One or more student-composed summary sentences for each step of the process served as verbal generations. After the students completed their

sentences, the teacher showed the students a set of teacher-generated sentences for the same dilemma.

In treatment condition 2, students were taught cost-benefit analysis in two 45-minute lessons based on an imagery-only strategy (a strategy in which only imaginal elaborations and generations were constructed). Students experienced two hypothetical decision-making situations. In the first, the teacher modeled, step by step, the cost-benefit analysis way of thinking. During this demonstration, a decision-making tree and teacher-drawn stick figures (one or more images for each step of the process), served as imaginal elaborations. Next, students practiced thinking in the cost-benefit analysis way as they resolved the remaining hypothetical dilemma. Student-drawn stick figures (one or more images for each step of the process) served as imaginal generations. After the students completed their stick figures, the teacher showed the students a set of teacher-generated stick figures for the same dilemma.

In treatment condition 3, students were taught cost-benefit analysis in two 45-minute lessons based on an integrated (verbal-to-imaginal) strategy (a strategy in which verbal elaborations and generations were constructed, followed by the construction of imaginal elaborations and generations). Students experienced two hypothetical decision-making situations. In the first, the teacher modeled, step by step, the cost-benefit analysis way of thinking. During this demonstration, one or more teacher-composed summary sentences served as verbal elaborations for each step of the

process, and a decision-making tree and teacher-drawn stick figures (one or more images for each step of the process) served as imaginal elaborations. Next, students practiced the cost-benefit analysis way of thinking as they resolved the second hypothetical dilemma. Student-composed summary sentences (one or more sentences for each step of the process) served as verbal generations, and student-drawn stick figures (one or more images for each step of the process) served as imaginal generations. After the students completed their sentences and stick figures, the teacher showed the students a set of teacher-generated sentences and stick figures for the same dilemma.

As shown in Table 1, the treatment conditions within each experiment differed in terms of the number of verbal and imaginal representations constructed by teacher and students. Compared to students in the verbal-only and imagery-only strategy groups, students in the integrated (verbal-to-imaginal) strategy group produced twice as many generations and were presented with twice as many teacher-produced elaborations.

All three treatment conditions experienced the same two hypothetical dilemmas during instruction. Each dilemma was set in a shopping mall environment. The vast majority of fifth-grade subjects expressed familiarity with this environment, but, in order to insure familiarity, each treatment group was asked to brainstorm a list of "places to eat", "places to shop", and "places for entertainment/recreation" during a discussion about shopping malls

that took place prior to the introduction of the dilemmas. The two dilemmas used during instruction were as follows:

Dilemma 1: "Pretend you are at the shopping mall. It is lunch time, and you are hungry. Most eating places at the mall serve medium-sized lunches. You happen to have room in your stomach for one medium-sized lunch. Where will you eat lunch?"

Dilemma 2: "Pretend you are at the shopping mall. You want to do some shopping. It typically takes 30 minutes to browse through one store at the mall. You happen to have 30 minutes at the mall before you must go home. Where will you browse during that 30-minute period?"

Figures 1, 2, and 3 provide examples of the verbal and imaginal representations generated by (and provided to) students within the various treatment conditions. These verbal and imaginal representations are appropriate responses to the first hypothetical dilemma described above. The sentences in Figures 1 and 2 are representative of the summary sentences used in conjunction with the verbal-only and integrated (verbal-to-imaginal) strategies respectively. Note that the decision tree framework shown in Figure 2 was used with the integrated (verbal-to-imaginal) treatment group, but not with the verbal-only treatment group. The images in Figure 3 are representative of the stick figures used in conjunction with the imagery-only and integrated (verbal-to-imaginal) strategies.

As a test of their economic reasoning, all fifth-grade subjects were given fifteen minutes to construct a written response

to a hypothetical dilemma not employed during instruction. The assessment dilemma, used at pretest, immediate posttest, and delayed posttest (six weeks after instruction), was as follows:

Assessment Dilemma: "Pretend you are at the shopping mall. You want to do something fun. It usually takes two hours to do one entertainment/ recreational activity at the mall. You happen to have two hours at the mall before you must go home. What will you do during that two-hour period? Write down everything you are thinking about as you make your decision. What things are you thinking about to help you decide?"

At pretest, immediate posttest, and delayed posttest, students' written responses were evaluated by two expert judges in terms of a three-level hierarchy of economic reasoning. The judges scored subjects' responses independently and blindly. A response to the dilemma was worth between zero and three points, and judges scored each response at the highest level of economic reasoning exhibited. The arithmetic mean of the two judges' scores served as the indicator of a student's level of economic reasoning. Decision consistency for the two judges was 94%; thus, interjudge reliability was high. The point allocation criteria for the students' essays are given below, along with sample responses to the assessment dilemma--deciding what to do for entertainment/recreation during a two-hour period at the shopping mall.

0 = No recognition or use of economic reasoning: "Go to a movie. I like movies."

1 = Recognition of the existence of scarce resources and identification of scarcity as a relevant decision-making issue: "Go to a movie. A movie lasts about two hours, and I only have two hours."

2 = Ability to identify specific alternative uses for scarce resources: "I could see a movie, play video games, or go ice skating. There are many fun things from which to choose."

3 = Ability to identify those alternative uses that are realistically within one's consideration set and prioritize them in terms of anticipated benefits: "I could see a movie, which I like to do. I also like to play video games, but I think I would choose to go ice skating because I like it more. Ice skating combines fun and exercise, and I find that kind of activity relaxing."

This economic reasoning scale, consisting of three levels of explicitness in the application of cost-benefit analysis to personal decision making, was developed by Kourilsky and Murray (1981) and has been employed in connection with several previous studies on economic reasoning (Kourilsky, 1985; Kourilsky and Graff, 1986; Kourilsky and Kehret-Ward, 1983; Kourilsky and O'Neill, 1985; Laney, 1988; Laney, 1990). Measures of students' thought processes, even in the form of self-report data, have proven to be useful and accurate in predicting achievement at a statistically significant level (Wittrock, 1986); thus, there is good reason to believe that students are aware of and can accurately recall or describe their cognitive processes.

Results

Table 2 shows the results of the one-way analysis of variance for the pretest. No significant differences between means were revealed, indicating that the treatment groups were initially comparable in terms of economic reasoning.

Table 3 contains the economic reasoning score means and standard deviations at pretest, immediate posttest, and delayed posttest. Results were in the expected direction. Means for the immediate posttest ranged from .95 for the imagery-only strategy group to 1.36 for the integrated (verbal-to-imaginal) strategy group. The mean score for the verbal-only strategy group was slightly less than that of the integrated (verbal-to-imaginal) strategy group. From immediate posttest to delayed posttest, mean scores for all three groups rose slightly. Delayed posttest means ranged from 1.28 for the imagery-only strategy group to 1.41 for the integrated (verbal-to-imaginal) group. It is possible to attribute these score increases to a number of factors as follows: (a) the imperfection of the economic reasoning measure, (b) students learning from the immediate posttest (although no corrective feedback was given), and/or (c) longer student responses at delayed posttest as compared to immediate posttest.

Economic reasoning score gains from pretest to delayed posttest ranged from 1.04 for the imagery-only strategy group to 1.27 for the integrated (verbal-to-imaginal) strategy group. Such gains are in line with treatment-control group differences obtained in studies of the effects of introductory economics courses on high

school and college students' economic reasoning (Kourilsky, 1985; Kourilsky and Kehret-Ward, 1983; Kourilsky and O'Neill, 1985). Although immediate and delayed posttest means ranging from .95 to 1.41 may seem low to one unfamiliar with previous research on economic reasoning, one must remember that the measure utilized in this study does not test simple understanding of cost-benefit analysis; instead, it measures the actual use of cost-benefit analysis in a hypothetical personal decision-making situation.

Pretest and immediate posttest means were compared using a series of t tests for nonindependent samples, and Table 4 contains the results of these t tests. For each treatment group, there was a significant increase in mean economic reasoning score from pretest to immediate posttest. Level of significance ranged from $p < .05$ for the imagery-only group to $p < .01$ for the verbal-only group to $p < .001$ for the integrated (verbal-to-imaginal) group.

As shown in Table 5, pretest and delayed posttest means were also compared using a series of t tests for nonindependent samples. Again, with respect to each treatment group, there was a significant increase in mean economic reasoning score from pretest to delayed posttest. Level of significance ranged from $p < .01$ for the imagery-only strategy to $p < .001$ for the verbal-only and integrated (verbal-to-imaginal) strategies.

Two posttest planned comparisons and two delayed posttest planned comparisons were made. For all planned comparisons, t critical (one-tailed test, $p < .05$, $df_w = 63$) was equal to 1.67. Posttest planned comparison 1 indicated that the combined economic

reasoning score means of the integrated (verbal-to-imaginal) and verbal-only strategy groups were not significantly higher than the mean economic reasoning score of the imagery-only strategy group, with t observed equal to 1.01. Posttest planned comparison 2 indicated that the mean economic reasoning score of the integrated (verbal-to-imaginal) strategy group was not significantly higher than the mean economic reasoning score of the verbal-only strategy group, with t observed equal to .14. Results from the delayed posttest planned comparisons paralleled those from the posttest planned comparisons. For delayed posttest planned comparison 1, t observed was equal to .32; for delayed posttest planned comparison 2, t observed was equal to .05.

Discussion

The outcome of this study is consistent with generative learning theory and the findings of Kourilsky and Wittrock (1987). Although differences between the three treatment group means did not reach statistical significance at immediate or delayed posttest, results were in the expected direction. An integrated (verbal-to-imaginal) strategy with more student- and teacher-produced representations yielded somewhat better results than a single (verbal-only) strategy with less student- and teacher-produced representations, and relatively familiar verbal strategies (verbal-only and verbal-to-imaginal) yielded somewhat better results than a relatively unfamiliar imagery-only strategy.

Fifth graders in the present study, when compared to third graders in a previous study by Laney (1990), appear more developmentally ready to learn the cost-benefit analysis way of thinking and to profit from imagery-related teaching-learning strategies. The highest post-instructional economic reasoning score mean obtained by a third grade treatment group was .75, compared to 1.41 by a fifth grade treatment group. In addition to developmental readiness, imagery training may have contributed to the fifth graders' more successful performance, for the third graders' received no such training. Metacognitive training in the construction and use of images as mnemonic devices may help students profit from imaginal representations generated (or provided) during instruction. Definitive conclusions about the effectiveness of imagery training and its potential for use at different grade levels must await further research.

Perhaps the most important conclusion of this study is that teacher elaborations and student generations of all kinds (verbal-only, imagery-only, and integrated--verbal-to-imaginal) can be used to enhance and maintain fifth graders' level of economic reasoning. All groups significantly increased their economic reasoning level from pretest to immediate and delayed posttests. The findings suggest that generative teaching-learning strategies have the potential, at least in the intermediate elementary school grades, to improve students' understanding and application of many basic economic concepts.

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TABLE 1

FREQUENCY OF VERBAL AND IMAGINAL REPRESENTATIONS BY TREATMENT GROUP

	Verbal-Only Strategy	Imagery-Only Strategy	Integrated (Verbal-to-Imaginal) Strategy
Teacher-Produced Verbal Elaborations	24	0	24
Teacher-Produced Imaginal Elaborations	0	24	24
Student-Produced Verbal Generations	12	0	12
Student-Produced Imaginal Generations	0	12	12

TABLE 2

One-Way Analysis of Variance for Pretest

Source of Variation	SS	df	MS	F observed*
Between Groups	.32	2	.16	.4
Within Groups	25.27	63	.40	
Total	25.59	65		

*F critical (α = .05, df = 2, 63) = 3.14

TABLE 3

Economic Reasoning Score Means ($\bar{X}$s) and Standard Deviations (SDs)

Treatment Group	Pretest	Immediate Posttest	Delayed Posttest
Verbal-Only Strategy (n = 23)	$\bar{x}$ = .30 SD = .76	$\bar{x}$ = 1.30 SD = 1.52	$\bar{x}$ = 1.39 SD = 1.44
Imagery-Only Strategy (n = 21)	$\bar{x}$ = .24 SD = .70	$\bar{x}$ = .95 SD = 1.32	$\bar{x}$ = 1.28 SD = 1.38
Integrated (Verbal-to-Imaginal) Strategy (n = 22)	$\bar{x}$ = .14 SD = .35	$\bar{x}$ = 1.36 SD = 1.40	$\bar{x}$ = 1.41 SD = 1.44

TABLE 4

Results of t Tests for Nonindependent Samples--
Pretest vs. Immediate Posttest Means

Treatment Group	t observed	t critical (α)
Verbal-Only Strategy (n = 23; df = 22)	3.56	2.82 (.01)
Imagery-Only Strategy (n = 21; df = 20)	2.75	2.09 (.05)
Integrated (Verbal-to-Imaginal) Strategy (n = 22; df = 21)	4.08	3.82 (.001)

TABLE 5

Results of t Tests for Nonindependent Samples--
Pretest vs. Delayed Posttest Means

Treatment Group	t observed	t critical (α)
Verbal-Only Strategy (n = 23; df = 22)	4.08	3.792 (.001)
Imagery-Only Strategy (n = 21; df = 20)	3.63	2.845 (.01)
Integrated (Verbal-to-Imaginal) Strategy (n = 22; df = 21)	4.31	3.819 (.001)

FIGURE 1
SAMPLE VERBAL REPRESENTATIONS

1. THE PROBLEM

I only have room in my stomach for one lunch.

GOAL

My goal is to choose the best place to have lunch.

2. ALTERNATIVE

I can eat at the hamburger place.

ALTERNATIVE

I can eat at the pizza place.

ALTERNATIVE

I can eat at the cafeteria.

3. CONSEQUENCES

(good) I can get a free toy with my lunch.
(bad) It is always crowded.

CONSEQUENCES

(good) I am allowed to eat with my fingers.
(bad) I cannot get a free toy with my lunch.

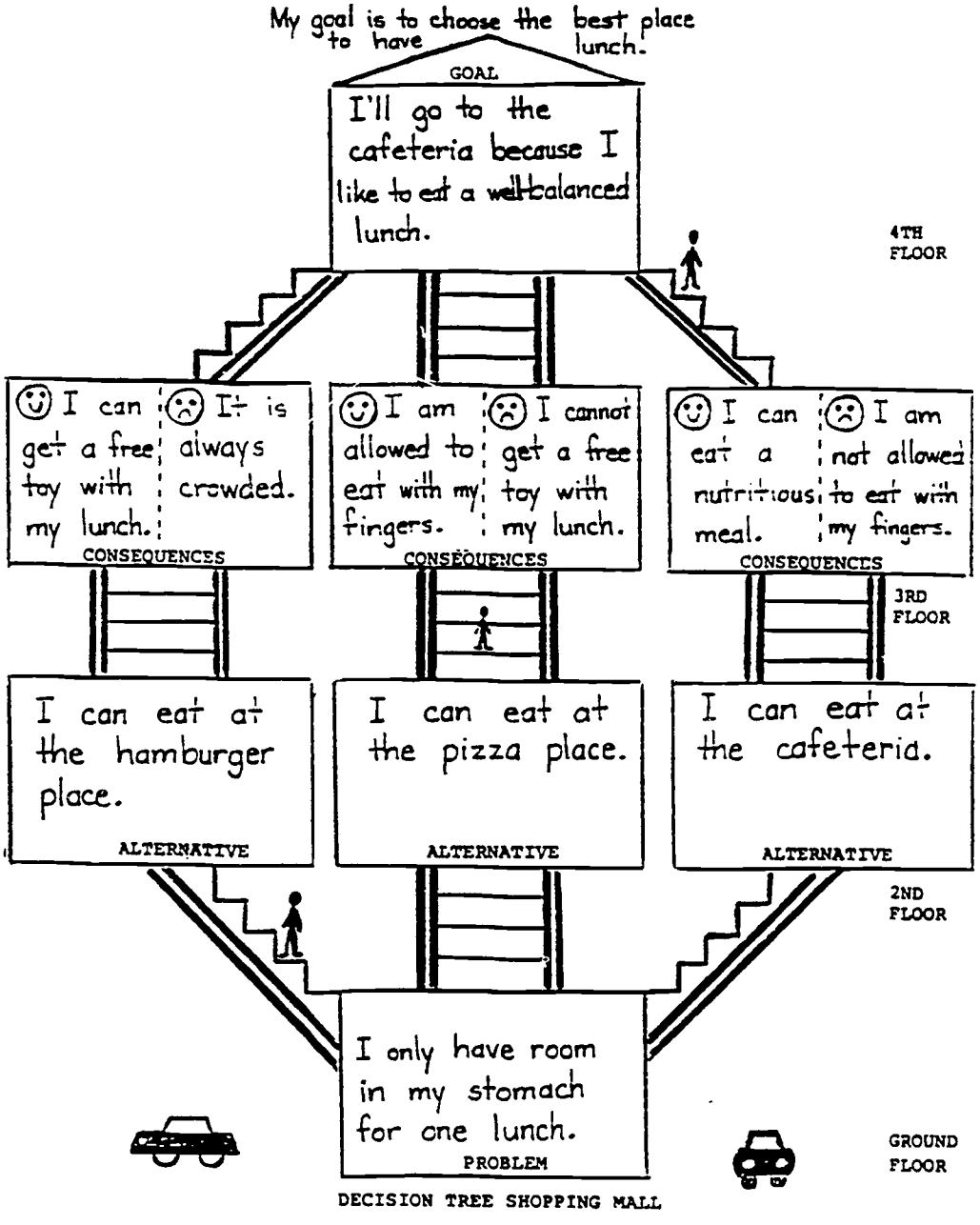
CONSEQUENCES

(good) I can eat a nutritious meal.
(bad) I am not allowed to eat with my fingers.

4. DECISION

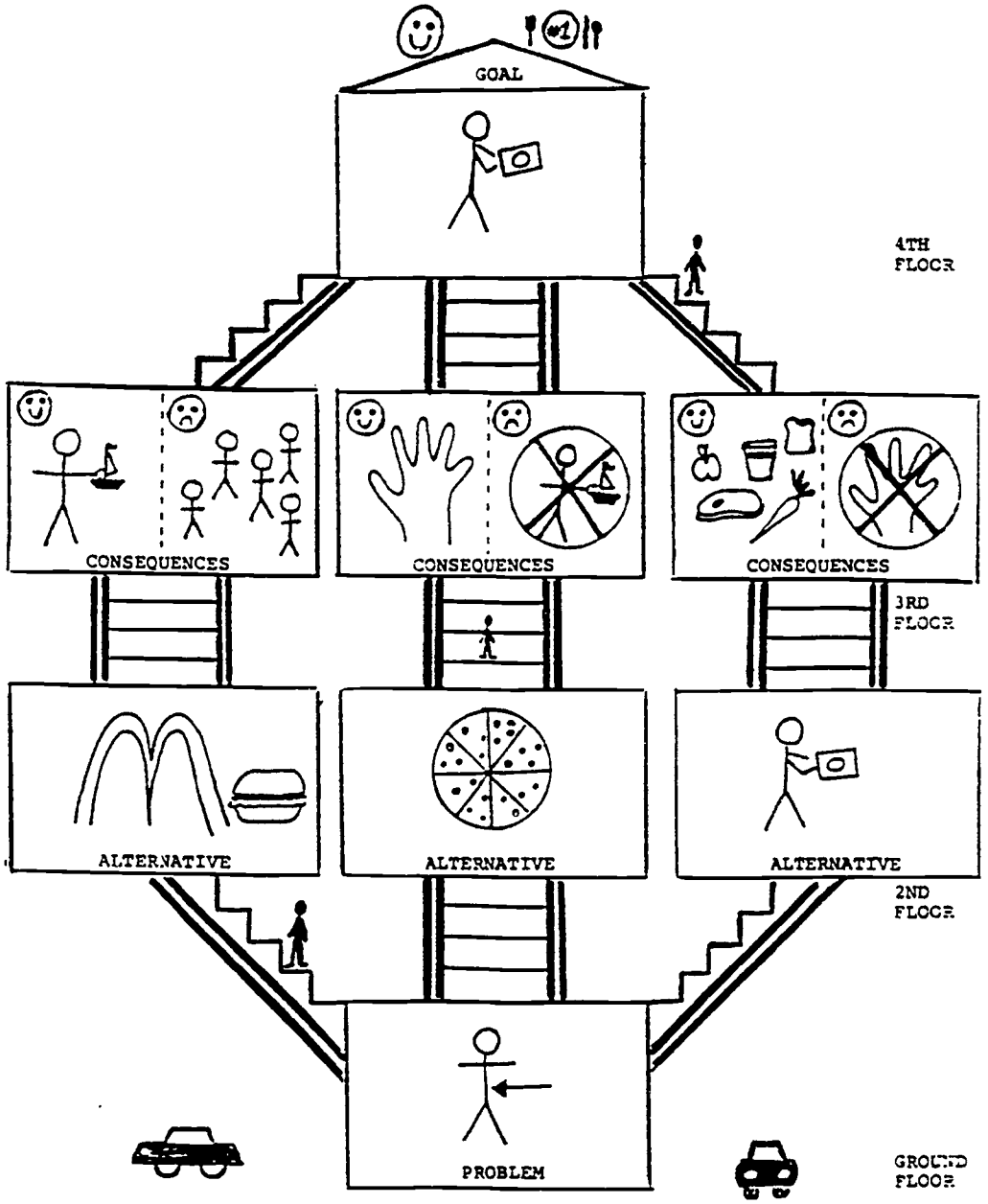
I'll go to the cafeteria because I like to eat a well-balanced lunch.

FIGURE 2
SAMPLE VERBAL REPRESENTATIONS



DECISION TREE SHOPPING MALL

FIGURE 3
SAMPLE IMAGINAL REPRESENTATIONS



DECISION TREE SHOPPING MALL