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AUTHOR Fanelli, Beverly H.; Tracy, Dyanne M.
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ABSTRACT

Young children often have difficulty with understanding money in a formal school setting, yet most mathematics textbooks are virtually identical in how they teach second graders about money and do not take into account the cognitive stages of children's development. This research examined the effectiveness of traditional and alternative classroom procedures for use with this topic. Four instruments, all specifically designed for this study, were used: (a) a pretest, (b) a posttest, (c) student posttest task interviews, and (d) written teacher questionnaires. Three second-grade classrooms from one suburban school district comprised a control, an experimental, and a no-treatment group. The control classroom used traditional textbook procedures. The experimental classroom used an alternative curriculum that included a lesson on bartering, instruction on the dollar, and lessons using proportional manipulatives to represent relative coin values. The no-treatment classroom received no formal instruction on money between the pretest and posttest. The experimental group scores revealed a significant difference over the control group scores. The results indicate that the experimental curriculum for money may offer some advantages for second-grade students. Teachers and curriculum writers should incorporate bartering, proportional manipulatives, and a variety of classroom activities to promote student understanding of money. Specific recommendations for teachers, curriculum developers, and parents are given. (Author)

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Learning About Money: Effects of a Cognitively Appropriate Curriculum on Second-Grade Students and Teachers

Beverly H. Fanelli

Dyanne M. Tracy

Department of Curriculum, Instruction, & Leadership

Oakland University

Abstract

Young children often have difficulty with understanding money in a formal school setting, yet most mathematics textbooks are virtually identical in how they teach second graders about money and do not take into account the cognitive stages of children's development. This research examined the effectiveness of traditional and alternative classroom procedures for use with this topic. Four instruments, all specifically designed for this study, were used: (a) a pretest, (b) a postest, (c) student posttest task interviews, and (d) written teacher questionnaires. Three second-grade classrooms from one suburban school district comprised a control, an experimental, and a no-treatment group. The control classroom used traditional textbook procedures. The experimental classroom used an alternative curriculum that included a lesson on bartering, instruction on the dollar, and lessons using proportional manipulatives to represent relative coin values. The no-treatment classroom received no formal instruction on money between the pretest and posttest. The experimental group scores revealed a significant difference over the control group scores. The results indicate that the experimental curriculum for money may offer some advantages for second-grade students. Teachers and curriculum writers should incorporate bartering, proportional manipulatives, and a variety of classroom activities to promote student understanding of money. Specific recommendations for teachers, curriculum developers, and parents are given.

Learning About Money: Effects of a Cognitively Appropriate Curriculum on Second-Grade Students and Teachers

Money and the quest for more of it seems almost an obsession in the American society of the 1990s. This apparent obsession is also passed on to children who begin learning informally about money at very young ages. Their day-to-day experiences with grocery stores, fast-food restaurants, local ice-cream trucks, and their allowances set the stage for a lifetime of handling greenish paper and gray and brown coins. Yet, in spite of children's familiarity with money, many of them have difficulties with it in a formal school setting. First, young children are often confused by the U.S. monetary system, because relative coin sizes do not correlate with relative values (Bradford, 1980; Garland, 1990; Stevenson, 1990). Second, the school curriculum usually concentrates on coins during the time that children's real-world experiences focus on dollars (Brenner, 1989). Third, acceptable practices with money in the real world often do not correspond with usual practices suggested in the symbolically-based math curriculum (Brenner, 1989; Carraher, Carraher & Schliemann, 1985). Fourth, children do poorly on standardized tests when word problems, or math stories, involve money, especially when they are required to make change (Pettit, 1986).

Most district and state curricula suggest that students be exposed to formal instruction about coins during kindergarten through second grade. Additionally, the National Council of Teachers of Mathematics (NCTM) agrees that students need to know how money operates in our society (NCTM, 1989). Thus, our purpose was to investigate how we can most effectively teach about money as it relates to students' real-world experiences while simultaneously using learning activities that remain within students' cognitive abilities. It was hypothesized that students who

(a) learn that money is a measuring process beginning with the concepts of barter, (b) use additional proportional manipulatives, and (c) begin with the dollar bill will show no significant difference in achievement as measured by posttest scores that students who learn about money with a traditional textbook unit.

Literature Review

As defined in the American Heritage Dictionary of the English Language, money is "a commodity, such as gold, or an officially issued coin or paper note that is established as an exchangeable equivalent of all other commodities, such as goods and services, and is used as a measure of their comparative values on the market" (1992, p. 1166). Additionally, the dictionary identifies the basic unit of United States currency as the dollar (p. 461). These definitions indicate that U.S. money is (a) a part of a larger market system, (b) a legally established medium of exchange, (c) a means of measurement, and (d) based on the dollar.

Many curriculum guides and teacher ideas for instruction on money are based on professional opinions, but very few studies describe either how students in the early years learn about our monetary system or which instructional procedures are effective. Therefore, this literature review analyzes research related to relevant components underlying an understanding of money as determined by the definition above.

These many elements are detailed in the concept map developed by the researchers (see Figure 1). Therefore, this article analyzes research on children's (a) cognitive development, (b) economic understanding, (c) understanding of abstract concepts, (d) knowledge of measurement processes, and (e) conception of rational decimal numbers. Finally, the article inspects common textbook suggestions for teaching about money.

These sources provide the best available knowledge base on which to assess appropriate instructional methods for teaching the concept of money.

Cognitive Development

The research on children's cognitive development by learning theorists Jean Piaget, Jerome Bruner, and Zoltan Dienes strongly suggests that children proceed through stages as they try to make sense of their environment. Those learning theories have influenced the teaching of mathematics by showing that children need hands-on experiences that clearly represent mathematical concepts before they advance to symbolic representation (Bruner, 1966a; Dienes, 1963; Piaget, 1947/1950; Sund, 1976). Children's hands-on experiences in the early years also should involve proportional materials that are based on a one-to-one counting correspondence (Kennedy & Tipps, 1994). Dienes also maintained that children should experience concepts in a number of different situations and perceive their purely structural properties (Dienes, 1963); he identified this condition as the Perceptual Variability Principle. This principle indicates that students need many different representations to convey one concept. Thus, lessons teaching about money not only need to include student involvement with concrete manipulatives, lessons also need to include many different representations of these concepts. This allows more students to construct meaning of new concepts more of the time.

Economic Understanding

Researchers who have examined economic understanding found that children begin thinking about economic values at an early age (Schug, 1987). Around age five, they also understand that money is used to buy things; but, as Piaget and Dienes might have predicted, children often equate value with size (Strauss, 1952). Due to the size of an object, some young children

believe that televisions cost more than diamonds, that nickels are worth more than dimes, and that five pennies are more valuable than three dimes. These misconceptions begin to lessen at approximately ages seven or eight when children gain an understanding about coins, their values, and the function of change (Furth, 1978). Thus, formal instruction in money should coincide generally with these known stages of economic understanding, which is approximately during second grade.

Understanding of Abstract Concepts

The nature of money is inherently abstract as is demonstrated by the wide variety of items which have been used for money (see Figure 1). Governments, or legal officials, can implement any commodity to serve as money, or the measure of all other commodities. Because monetary systems change in response to governmental policies, teachers and curriculum planners need to treat money as the abstract concept it is. Yet, because K-2 students are not cognitively ready to understand abstract concepts, teachers must provide students with appropriate concrete representations of money. Several researchers have found that manipulatives bridge the gap from concrete reasoning to abstract mathematical understanding (Driscoll, 1981; Fennema, 1972; Suydam, 1986) when teaching concepts such as counting, place value, and geometry. It then follows that using appropriate manipulatives when instructing youngsters about money would also enhance their understanding.

Measurement

The definition of money also identifies money as the relative measure of value in a given society. These authors believe the process of measuring value should be taught as other measurement processes such as length, area, and weight. Most recent research related to teaching measurement suggests

introducing non-standard units before proceeding to the use of standard measures (Driscoll, 1981; Garland, 1990; Hiebert, 1984; Horak & Horak, 1982; Post, 1992; Steffe, 1971). When measuring value, non-standard units can be taught through the bartering process. It causes children to understand why standard units are needed.

Rational Decimal Numbers

Underlying the U.S. monetary system is the notion of decimals and fractions. Because of the close relationship between money, decimals, and fractions, teachers should create or use a cognitively appropriate curriculum that parallels what we know about children's understanding of these concepts. Basic to developing the concept of fraction is the notion of partitioning. Partitioning refers to either dividing a region into equal parts or separating discrete objects into equal groups. Subsequent to partitioning, teachers should build concepts that convey (a) whole and part, (b) equal parts, (c) oral names for fractions, such as half or fourth, and (d) symbols for common fractions, such as 1/2 or 1/4 (Payne, 1984). Some studies have indicated that even very young children understand the whole-part concept; clearly children know the difference between a whole cookie or only a part of a cookie (Hunting & Sharpley, 1988; Payne, 1984). In the early elementary grades most children have some understanding of the meaning of half and the basic partitioning process (Behr & Post, 1992; Gunderson & Gunderson, 1957).

Pothier and Sawada (1983) studied children's partitioning skills in Grades K-3 and concluded that children progress through stages in their understanding of fractions. The first two stages are marked by (a) learning the notion of half and (b) making equal sets of powers of two (e.g., 4, 8, 16). Second-grade students should be able to apply these stages to concepts

about money; they should be able to partition dollars into the half-dollar, quarter-dollar, and the subsequent even amounts (one-tenth, one-twentieth, one-hundredth). Unfortunately, the connection between money and fractions is rarely part of the mathematics curriculum. Zawojewski (1983) discovered that children rarely think of coins as fractional parts of a dollar. However, the National Council of Teachers of Mathematics (NCTM) vigorously advocates making such connections among mathematical concepts (NCTM, 1989 and 1991). These mathematical connections can be made in two ways: (a) from real-life to text and in-class learning, and (b) among mathematical topics (e.g., decimals, fractions, and money). Clearly, teachers need to convey the connection between dollars, coins, whole numbers, and fractions during instruction on money.

Once students understand the fractional relationship of money, instruction should then make the connection between fractions and decimals to enhance understanding (O'Brien, 1968). Since it is known that children learn computation skills better when decimals and fractions are taught in parallel fashion (Payne, 1984), a cognitively appropriate unit on money should include connections between dollars and coins, wholes and fractional parts, and their decimal equivalents.

The first researcher's analysis of textbook practices shows a variety of discrepancies between children's natural cognitive development and how they normally are taught about money (see Table 1). First, textbooks identify money as a measurement skill only in the scope and sequence chart, but they do not develop it as measurement in instructional practice. Secondly, textbooks fail to begin instruction with non-standard units. Thirdly, they suggest beginning with play coins and bills as manipulatives; thus, they do not view money as an abstract concept nor do they offer appropriate

representations for the concept. Finally, they initiate instruction with the penny rather than the dollar, the basis of our monetary system.

Methodology

This action research used a control-group pretest-posttest experimental design to investigate two approaches to teaching second-grade students about money. The experiment was conducted in two suburban elementary schools in southeastern Michigan. The study had originally included an urban school. However, due to historically severe weather, planned school vacations, and curriculum adaptations, the treatment was severely abbreviated and was characteristic of a pilot study. Thus, the data is not reported here.

Sample

The sample consisted of three second-grade classes, whose teachers volunteered to participate in the study, from one public school district in southeastern Michigan. The classes contained predominantly Caucasian, middle-income students. Two classes from one school comprised the control group and experimental group, respectively. A third class from a different school received no treatment. The classes ranged in size from 26 to 28 students. As shown in Table 2, the number of students in the sample is lower due to (a) absences during test dates and during instruction and (b) post-hoc analysis.

Procedure

At the beginning of the study (January and February, 1994) all students completed a written 12-item, 46-point pretest to assess their knowledge of the names of coins, the value of coins, addition algorithms with money, and subtraction algorithms with money. Students in the control group received instruction using standard textbook procedures for teaching about money.

The experimental group used an alternative curriculum on money that included a lesson on bartering, followed by instruction on the dollar and subsequent lessons on coins using proportional dollars to represent relative coin values (see Figures 2 and 3). The experimental group also used a money number line to display relative coin values (see Figure 4). Students completed the posttests, which were parallel to the pretest, after approximately 12 instructional days. The pretest and posttest raw scores were analyzed for differences between the means. Additionally, five randomly selected students from each class participated in posttest interviews, and the teachers completed written questionnaires. These were analyzed for qualitative differences.

Instrumentation

This research used four instruments created by the researchers. Pretest and posttest items and total points were based on assessment practices recommended by the National Council for Teachers of Mathematics' (NCTM) Assessment Standards for School Mathematics: Working Draft (1993). The tests allowed for transfer of knowledge and asked questions not specifically taught in the classroom (NCTM, 1993). For example, the test asked children to solve the algorithm $1.00 - $0.65, even though students had not yet learned to regroup. Further, to adequately interpret student responses, questions were assigned values depending on complexity of tasks.

The instruments also sought to convey a sense of money as it is used in the real world. The item prices used in the pretest, posttest, and student interviews were reasonable prices for 1994. The coins and dollars pictured in the tests were copied actual size with their true silver and copper colors. These efforts increased the face validity of the instruments to make them

acceptable as "valid measure[s] in the everyday sense of the word" (Isaac & Michael, 1981, p. 119).

Pretest. The pretest consisted of 12 questions with 46 possible points, based on the components listed in Table 3. The teachers of each class gave this written test to their students and read the test orally to insure that all students could understand the instructions. Teachers also encouraged students with responses such as, "Take your best guess," and "You'll have to do some figuring."

Posttest. The posttest was a criterion-referenced test consisting of 22 questions with 46 possible points. Fifteen questions exactly paralleled the pretest; seven additional questions evaluated students' abilities with dollars and were used for qualitative data collection and interpretation. Only the parallel items were included in the statistical analysis. The seven questions used to evaluate students' abilities with dollars included (a) identifying one-, five-, and ten-dollar bills, (b) determining the number of coins (quarters, nickels, and pennies) needed to equal a dollar, and (c) deciding if items shown with price tags in dollar-sign-and-decimal notation could be purchased with a given amount of money.

Individual Posttest Task Interviews. One-on-one interviews with five randomly selected students from the three classes were audio taped and compared for qualitative differences. During the interview real money, play money, proportional dollars, scrap paper, pencils, scissors, a one-hundred chart, and calculators were within arm's length and available for student use. The tasks included separating coins to equal a dollar and counting out three combinations of coins orally. Students also were asked to compute the combined price of two items and then figure the correct change due after

purchasing the two items. Each student completed three sets of this type in increasing amounts ranging from totals of $0.50 to $5.00.

Post-Instruction Teacher Questionnaire. The teachers of the control-group and experimental-group classes responded to written questions about the strengths and weaknesses of their instruction about money. They were asked five questions in which they identified any concepts and activities that their students found too hard or too easy, and they suggested changes that might improve the curriculum.

Limitations

This experimental action research used a control-group pretest posttest design. The classrooms selected for the study were not randomly chosen. Instead, they consisted of rooms in which volunteer teachers were (a) familiar with the sponsoring university and (b) reasonably accessible to the researcher.

To maximize internal validity, student absences were carefully tracked, and students from both the experimental and control group with more than two absences from the curricula activities had their test scores deleted. Additionally, the control and experimental groups had two teachers in each room. The control group had assistance from a resource teacher during mathematics instruction; the experimental group had assistance from the first researcher during math instruction.

Analyses and Results

Pretest and Posttest

Pretest results indicated that the control and experimental groups displayed equivalent abilities in their knowledge of money prior to formal instruction at the second-grade level. The no treatment (NT) group scored

similar to the experimental group, but significantly lower than the control group. Table 4 contains the comparison of groups on the pretest.

The NT group showed a significant drop in scores from the pretest to the posttest. This indicates that students did not learn from the pretest, nor did they acquire knowledge due to an increased awareness of the topic. Therefore, one could assume that any subsequent changes in the other groups' posttest scores would more likely be attributed to instruction than to learning from the test.

The groups receiving instruction showed a significant increase in their scores and a decrease in their standard deviations. The means, standard deviations, and differences between means for pretest and posttest scores are listed in Table 5.

After the posttests were scored, post-hoc analysis revealed that one student in the control group was three standard deviations from the mean and one student in the experimental group was four standard deviations from the mean. The researchers eliminated these outliers from both the pretest and posttest data analysis.

The difference between pretest and posttest means of the control and experimental groups was +4.49 (Control: $\bar{X}$ = 29.57, $\bar{X}$ = 37.04; Experimental: $\bar{X}$ = 26.91, $\bar{X}$ = 38.87). If the groups had been randomly selected, the one-tailed t test would have revealed a value of .03. These differences reject the null hypothesis.

Individual Posttest Task Interviews

Student answers and behaviors for the individual posttest tasks were coded. Students from the different groups exhibited similar behaviors for determining the number of specific coins needed to equal one dollar and deciding the amount of coins needed to purchase two items. Large

discrepancies between control and experimental groups were exhibited in the use of half-dollars and the ability to make change from one dollar. These differences are displayed in Table 6.

Teacher questionnaires

Teachers using the experimental unit liked using manipulatives to convey the dollar and coin concepts, but they were frustrated by the quantity and small size of the pieces. These teachers also agreed that second-grade students can understand dollars. This is a change from the expectations of most textbook authors as inferred from their published curricula.

Conclusions

Posttest

The control group's pretest score was 2.66 points higher than the experimental group's pretest score. After instruction, the experimental group scored 1.83 points more than the control group on the posttest. Because this is a meaningful difference in means (a 10% increase), the null hypothesis is rejected. The 4.49 point experimental group increase over the control group from pretest to posttest may be accounted for by advantages in the experimental curriculum.

Bartering. Several children benefited from the bartering activity as evidenced in four students' definitions of money and uses of money included in their posttest responses. The control group responses from pretest to posttest remained fairly constant: Most indicated money was to buy or spend, but they did not add to their original definition.

Instruction with real dollars. A second advantage to the experimental group's instruction may have been their use of legal tender and proportional dollars. The curriculum included examining real dollars, using the dollar sign and decimal notation, and adding dollars.

Instruction with proportional dollars. Third, students may have benefited from using proportional dollars. For students who had difficulty understanding the relationships among coins to dollars and coins to coins, the proportional dollars may have helped to clarify misunderstandings. Observations of a small group verified that the proportional dollar increased students' confidence when students numbered the squares on the proportional dollar and laid proportional coins (25 cm , etc.) on top (see Figure 6). This small-group activity supplemented a textbook worksheet and helped the students see that determining the value for a group of coins in a picture required students to add coins to one another, or to gain facilitation with the "counting on" strategy (Kennedy & Tipps, 1994; Post, 1992).

Multi-modal instructional activities. Finally, a wide variety of activities in the experimental classroom may have played a part in the increased posttest scores. These included a classroom store with goods priced up to $8.00, rubber coin stamps and ink pads, play coins, real coins, a money number line, computer software that concentrated on counting money up to $5.00, and carefully selected workbook pages from the textbook. The variety in activities provided opportunity to reach students who learn through different styles (Kolb, 1984; McCarthy, 1980).

Individual Posttest Task Interviews

During these individual interviews, which were accompanied by task performance, students revealed their understanding about money using real coins and dollars. Students (N = 15) from the different groups exhibited similar behaviors for (a) determining amount of dimes, half-dollars, and quarters that equal one dollar, (b) selecting combinations of coins needed to purchase two items, and (c) making correct change from a $5 bill. Observed

behavioral differences between the control and experimental groups emerged as follows.

1. Control-group students tended to pay for items with coins, and they overrelied on the half-dollar. Ten out of 15 control-group responses used half-dollars to make amounts of 83c, $1.40, and 75c; only 2 out of 15 responses in the experimental group used the half dollar. This overuse of half-dollars is unfortunate, since half dollars are only used in approximately 2% of coin transactions (National Bank of Detroit Clerk, personal communication, March 29, 1994). Students using the alternative curriculum were more likely to use dollars or quarters, which parallels real-world behaviors.

2. The experimental group displayed a greater ability to make change. Students were given a used children's book priced at 65 cents, told to buy it with a one-dollar bill, and asked what their change would be. Four of the five experimental students successfully accomplished the task, but no one in the control group did. In all likelihood, the difference was due to the experimental curriculum. It required students to make change regularly in ranges of 60¢ (i.e., between 5¢ and 65¢) whereas the control group's curriculum more often ranged around 15¢. The control group also relied on using their fingers to count the difference between purchase price and amount tendered. Students who used this strategy lost count on their fingers when the difference exceeded 15-20¢. The experimental group spontaneously used the hundred chart, which was available to all children, to determine their change. The chart provided a more concrete experience rather than a pictorial or symbolic experience (Bruner, 1966; Dienes, 1963; Piaget, 1947/1950). It also mirrors the real-life strategy of cashiers who

actually put the coins and the bills into the purchaser's hand as they "count on" from the purchase price to the amount that was originally given.

3. Several students from all groups overrelied on dimes. Even with a variety of coins available, some used dimes exclusively to show 83¢ (e.g., 8 dimes and 3 pennies). Others mixed dimes with quarters or half dollars. For example, students grouped a half dollar with three dimes and three pennies for 83¢ instead of using a half-dollar, quarter, dime, and three pennies. Some students used seven dimes when making 75 cents, while their more confident peers used three quarters. It may be that the practice of counting by tens causes students to prefer dimes to quarters. It also should be noted that all teachers in the study used the 10 x 10 hundred chart to teach place value. This may encourage a student preference for dimes, which is an acceptable real-world practice, and reflects student transition from the iconic chart to the symbolic dime (del Regato & Gilfeather, 1990).

Recommendations

Curriculum

The results of this study support curricular changes for teachers and curriculum developers.

1. Lessons on money need to (a) include the concept of barter and (b) explain why we use money to exchange goods in our society. This gives children a conceptual foundation from which to understand the very abstract nature of coins and dollars.

2. Second-grade instruction with dollars, not merely coins, is appropriate. On the pretest, 73% of the students in the study identified and attempted to write some form of dollars when shown dollar bills and coins. On the posttest, the correct responses rose to 82%. Children of the 1990s

regularly use or see dollars bills and are not confused by instruction involving dollars.

3. Proportional manipulatives enhance understanding of coin values in contrast to punch-out play coins used in many textbooks. Play coins are merely a cheaper device than real money. Neither real nor play money provide learners with "clear representations of mathematical ideas [that are] natural and easily understood" (Hynes, 1986, p. 11). Thus by definition, coins are not concrete representations of their values, and dependence on textbook punch- out play coins as manipulatives is educationally unsound. The concept of coin values can be more clearly conveyed through proportional manipulatives.

4. Instruction needs to take advantage of children's informal knowledge of quarters by providing students with more practice with quarters and counting by 25s. Brenner (1989) discovered that children entering school are more familiar with dollars and quarters rather than pennies, nickels, and dimes. This study suggests that after formal instruction, children are more likely to use dimes and are less confident with quarters.

5. A variety of instructional activities and materials benefits students' learning. Teachers should attend to a variety of learning styles by implementing many approaches. Curriculum writers need to include more variety of formats among activities from which teachers can choose to best fit students' many learning styles within their classrooms.

Out-of-School Experiences

The results of this study lead to suggestions that teachers and curriculum developers could share with parents, families, and caregivers (used interchangeably here).

1. Children should examine real money on a regular basis and be familiar with the names and values of the different coins.

2. Parents should also provide children with practice counting not only by 5s and 10s but also by 25s to 200 and beyond. Such practice builds upon children's informal learning about quarters and dollars.

3. Regular shopping experiences with adults and children offer valuable opportunities for learning about money. Children should read prices and can decide if items can be purchased with $5, S20, or $100 in currency or food stamps. Children should also practice counting the money in a caregiver's wallet to predict the amount of change due from a cashier. Adults can use sales receipts to teach children to examine receipts for correct prices, and they can practice the algorithm with receipts for two, three, or four items (e.g., milk, eggs, and bread costing $1.79, .65, and .69, respectively, add up to $3.13).

Because using money is pervasive in homes and communities, the topic should have an especially strong home/school connection where families can help students connect mathematics to the real world (Leonard & Tracy, 1993).

Future Research

This study sought to determine children's knowledge of money and benefits of different instructional methods. Because this was an initial study and used volunteer teachers, future replications of this study with random groups are warranted. It also is suggested that samples from different geographical regions, from rural and urban settings, and from different socio-economic levels should be tested.

Stevenson (1990) and Bradford (1980) found benefits in their own classrooms for using proportional manipulatives, such as Cuisinaire rods and

hundred squares, to teach children to count money. Future studies also could test the use of these and other proportional manipulatives, in addition to the proportional dollars used in this study, to see if they help children learn.

Finally, future research could investigate the benefits of coordinating instruction about money with instruction about wholes, fractions, and decimals. Using money may help students learn these concepts more easily.

The authors hope that reform in mathematics education and the implementation of the NCTM's Standards will provide the necessary impetus for additional research opportunities in this vital part of the mathematics curriculum.

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Table 1

Summary Analysis of 39 Second-Grade Mathematics Textbooks, 1917-1992

Attribute	n	%
Separate chapter on time/money	24	62%
Identify money as measurement in scope/sequence chart or table of contents	17	44%
Use non-standard units	0	0%
Use play money	35	90%
Use other manipulatives	7	18%
Begin with penny	39	100%
Readily include prices over $1.00	3	8%

Note. Detailed data are available from the authors.

Table 2

Number of Students in Each Group, Days of Instruction, and Test Dates

Group	N in Class	N in Study	Days of Instruction	Administration Dates: Pretest	Posttest
Experimental	27	23	12	2/9/94	3/2/94
Control	26	23	10	2/2/94	2/18/94
No Treatment	28	22	0	1/17/94	2/4/94
		--			
Total		68			

Table 3

Concepts and Skills Included in Pretest and Posttest

No. of Items		
Pretest	Posttest	Concept/Skill
1	1	Define money and its uses
3	3	Identify coins by name[a]
0	2[b]	Identify dollars by name
1	4	Identify coin values in cents[a]
0	3[b]	Determine number of coins in $1.00
1	2	Count value of coins and dollars[a]
2	1	Combine two sets of coins and determine value
2	2	Compute addition algorithm with ¢ or $ notation
2	2	Compute subtraction algorithm with ¢ or $ notation
0	2[b]	Decide if items can be purchased with given amount of money

[a]Reproduced in copper and silver colors

[b]Not included in statistical analysis

Table 4

Pretest Means, Standard Deviations, and p-Values

Group	Mean Raw Score	SD	p-Value Between Groups NT	Control	Exp.
No Treatment	24.23	9.77	n/a	.05	.25
Control	28.79	8.69		n/a	.16
Experimental	26.17	9.16			n/a

Table 5

Means and Standard Deviations of Pretest and Posttest Scores

Group (N)	Mean Raw Score[a]	SD	Difference Between Means
No Treatment (22)			
Pretest	24.23	9.77	-2.73
Posttest	21.50	9.84	
Control (23)			
Pretest	29.57	7.99	+7.48
Posttest	37.04	2.96	
Experimental (23)			
Pretest	26.91	8.59	+11.96
Posttest	38.87	3.57	

[a]46 points possible

Table 6

Numerical Data for Student Responses on Individual Posttest Task Interviews (N = 25)

Tasks	Group Control	Experimental	NT
Correct responses[a]	15	15	7
Coins Used in Correct Responses:			
Dimes[b]	10	8	5
Half-dollars[b]	10	2	2
Made correct change from $1.00[c]	0	4	0

[a]Out of 15 possible responses (5 students with 3 responses each)

[b]for amounts of 83¢, $1.40, and 75¢

[c]for purchase of 65c item

Figure 1. Concept map of the elements involved in understanding money.

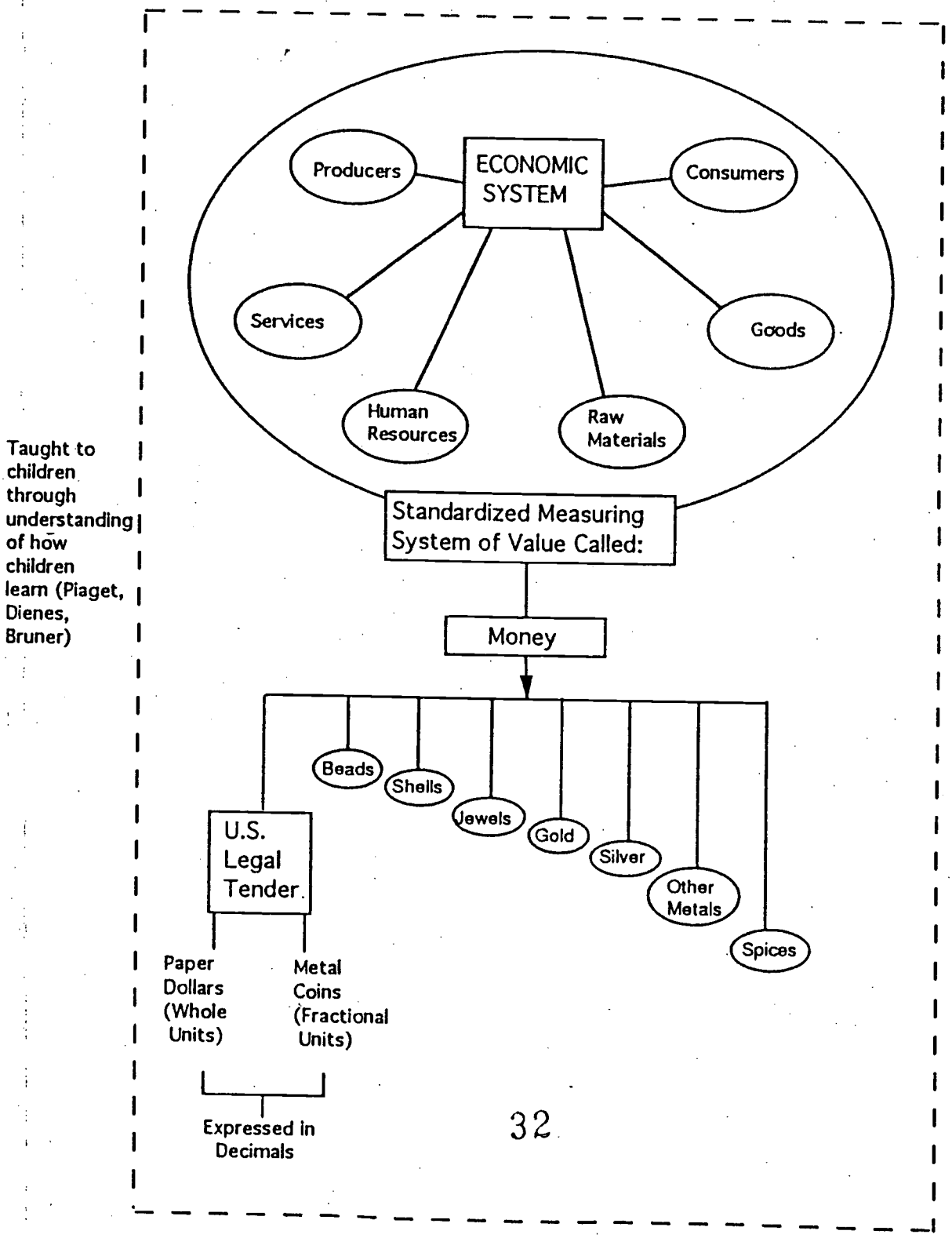
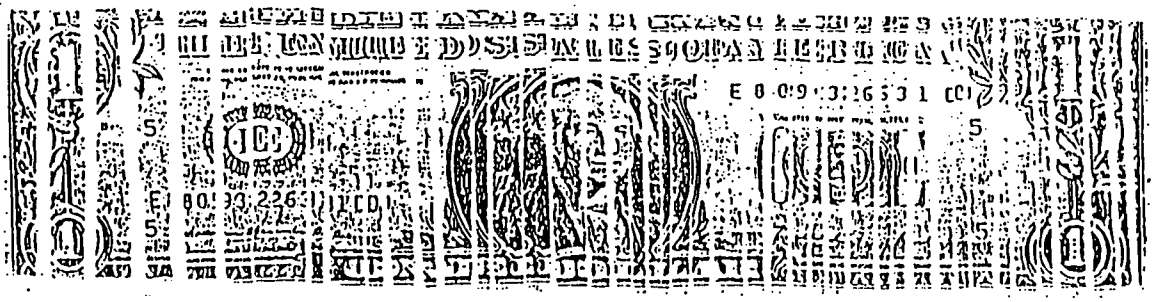
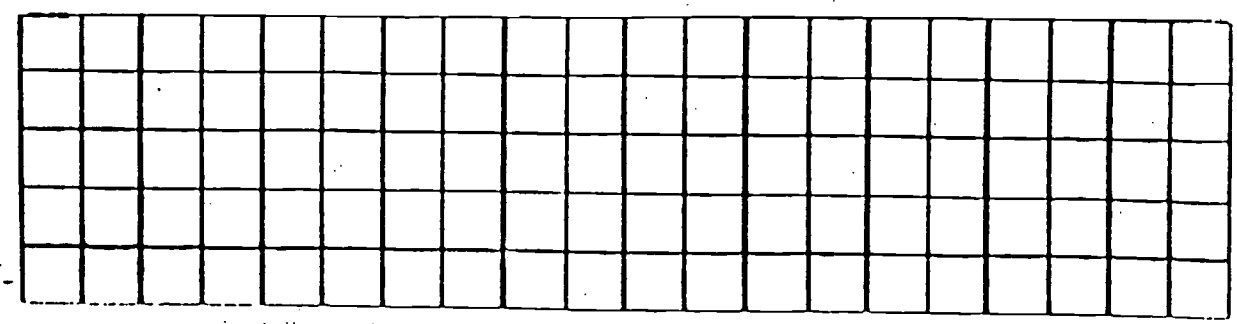


Figure 2. 100 cm^2 Proportional Dollar (front).



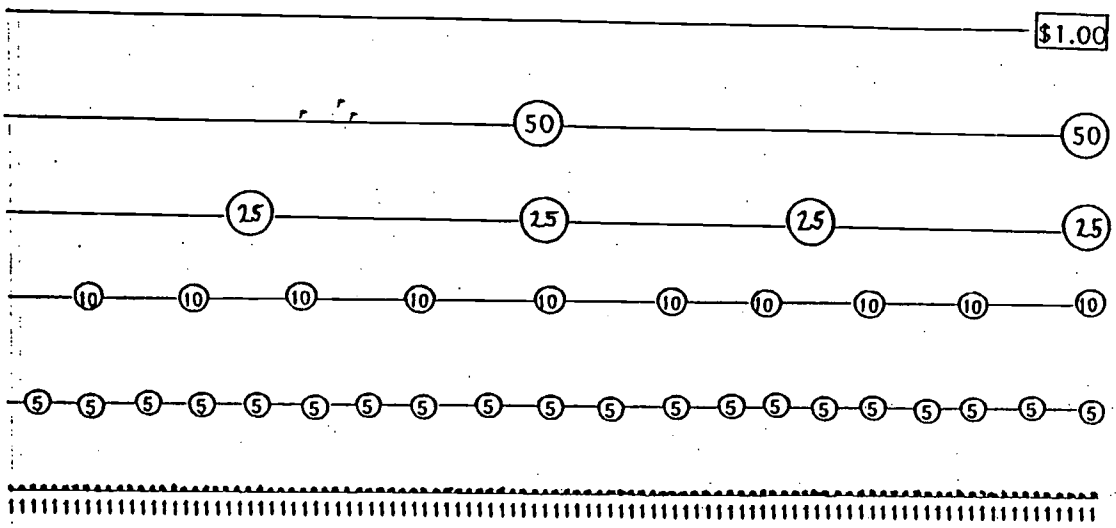
Note. The proportional dollars were printed on goldenrod, blue, yellow, red, and white paper to associate a different color with each of the five U.S. coins, half-dollar, quarter, dime, nickel, and penny, respectively.

Figure 3. 100 cm^2 Proportional Dollar (back).



Note. The proportional dollars were printed on goldenrod, blue, yellow, red, and white paper to associate a different color with each of the five U.S. coins, half-dollar, quarter, dime, nickel, and penny, respectively.

Figure 4. Money Number Line Showing Coin Values Relative to the Dollar and Other Coins.



Note. On the classroom money number line, pictures of U.S. coin fronts replaced the numeric circles.

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Signature: Beverly H. Fanelli, Dyanne M. Tracy

Position: Lecturer , Associate Professor

Printed Name: Beverly H. Fanelli & Dyanne M. Tracy

Organization: Oakland University

Address: 502 O'Dowd, Rochester, MI 48309-4494

Telephone Number: (248) 370 3064

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