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Source: *The Journal of the Learning Sciences*, Vol. 2, No. 2 (1992), pp. 215-234
Published by: Taylor & Francis, Ltd.
Stable URL: https://www.jstor.org/stable/1466839
Accessed: 22-12-2019 16:39 UTC

THE JOURNAL OF THE LEARNING SCIENCES, *2*(2), 215–234

Studying Children's Learning in Context: Problems and Prospects

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In this article, I present a framework for the study of children's learning in cultural practices and educational activities. The framework consists of three analytic components, each of which is grounded in a constructivist treatment of cognitive development: (a) a model for the analysis of emergent cognitive goals in practices, (b) a model for the analysis of cognitive developments linked to emergent goals, and (c) a model for the analysis of the interplay between cognitive developments linked to one practice or activity to accomplish emergent goals in another. The article describes the early history of the framework and its current application to the design and analysis of a classroom practice in the United States involving arithmetical problem solving in third and fourth grade inner-city classrooms. I close with a discussion of the framework with reference to Schoenfeld's (1992) standards for methodological innovations.

Late on a June day in the summer of 1978, I was a newcomer to Papua New Guinea, trudging through mud, alone on a remote highlands trail, off to conduct research on the development of numerical understandings in cultural groups that differed radically from my own. My immediate concern was to locate two anthropologist friends who were residents in a community of people, the Oksapmin, known to use a 27-body part numeration system in which body parts were used as numerical symbols and in which no base structure was used. Excited, lost, and worried, I was discovered on the trail by naked boys carrying bows and arrows. They were as eager to make friends as I, and they eventually led me to their village and my colleagues. My visits to this remote area then, and again in 1980, lead to a turning point in my own thinking and research about cognitive development.

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Schooled in the structural–developmental traditions of Jean Piaget and Heinz Werner, I had conducted my dissertation research on the emergence of numerical cognition in middle-class children in the United States. In subsequent studies of atypical development during a postdoctoral traineeship, I had struggled with a tension between Piagetian normative developmental formulations and the uniqueness of the cognitive functioning of brain-damaged adults and learning-disabled children. Now in Oksapmin I was concerned again with explaining paths of development that were not well represented by standard Western norms. Although I appreciated the elegance of the Piagetian developmental formulation of epigenetic shifts in the child's construction of new understandings, my readings of Piagetian-based cross-cultural research left me uneasy by what I perceived as grossly reductive analyses. Ignored in most accounts was the interplay between unique sociocultural histories and the constructive cognitive activities of individuals; indeed, in the cross-cultural literature on cognitive development, analyses were largely restricted to reports of relative accelerations or retardations of the development of universal cognitive structures.

In Oksapmin, I was committed to representing the dynamics of cognitive development in a unique community in ways that went beyond the traditional approach. Once engaged in field work, I found that to capture the dynamics of development required an analysis of culture-specific symbolic forms like the indigenous numeration system, patterns of economic exchange in a newly emerging money economy, and patterns of social interaction, like arithmetical negotiations between traditional adults and store owners during a purchase. Although sometimes standard constructs used by cognitive and developmental psychologists were indeed useful in explaining Oksapmins' practices, much of the dynamics and the blending of cognitive developmental processes and social history was lost in such reductions.

My most rewarding research effort in Oksapmin was a study of the sociogenesis of arithmetic (Saxe, 1982). In my field observations and interviews, I had found that the Oksapmin in traditional life were not engaged in activities in which arithmetical problems emerged, but with the introduction of a Western-style economy and small trade posts, the situation was changing. I interviewed Oksapmin who had varying levels of experience with the new money economy as they attempted arithmetic tasks that I had designed as exemplars of problems I had observed in the emerging economic transactions. Through analysis of problem-solving strategies, I was able to trace the cognitive developmental progression of Oksapmin's newly emerging arithmetic.

I found that with increasing experience in the money economy, Oksapmin fashioned new ways of using their indigenous system to accomplish novel arithmetical functions. Oksapmin who participated little in the money economy treated arithmetical problems like simple counting problems and

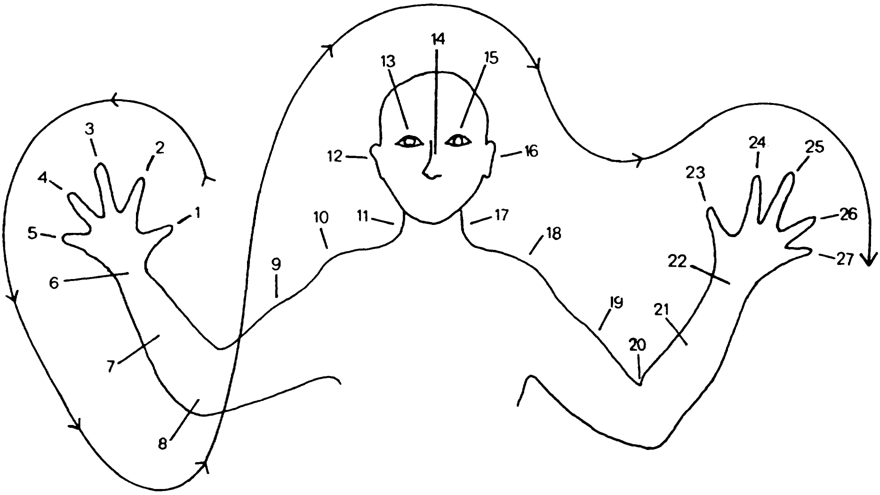

FIGURE 1 Oksapmin body counting system.

they typically did not achieve appropriate solutions. For instance, to solve 9 + 7 coins, individuals might begin by enumerating one term of the problem (thumb [1] to forearm [7]) and then continue to count the second term [9] from the elbow [8] (see Figure 1 for a schema of the Oksapmin system). Because the problem of 9 coins plus 7 coins was understood as an enumeration rather than an addition, individuals did not recognize the need to keep track of the addition of the second term onto the first term, and they typically produced an incorrect count of body parts. Oksapmin with greater experience in the money economy showed increasingly more adequate solution strategies, using body parts to keep track of the addition of one term onto another. For instance, to solve the same problem, 9 + 7 coins, individuals with greater participation in the economy again enumerate one term (thumb [1] to forearm [7]), but now, as they enumerate the second, they make efforts to keep track of their enumeration: Thus, the elbow (8) is paired with the thumb (1), the biceps (9) is paired with the index finger (2), and so forth, until the ear-on-the-other-side (16) is paired with the biceps (9), yielding the answer (ear-on-the-other-side, or 16). Individuals with still greater experience showed even more sophisticated strategic body part approaches. Thus, in Oksapmins' solutions, I found a developmental progression that could not be understood apart from cultural-specific symbolic forms and practices.

12 YEARS LATER

My current research focuses on mathematics learning in an inner-city school in Los Angeles. Like the Oksapmin, in their daily lives, these Western children participate in a multiplicity of cultural practices in which conceptual problems arise. For Western children, some occur out of school, such as selling lemonade, trading baseball cards, or helping their mothers with purchases at the store. Others occur in school, such as learning about fractions in cooperative groups, exploring ways to use a spread-sheet to create a graph with a peer, or participating in teacher-led drill and practice lesson on arithmetic. In their efforts to accomplish problems that emerge in such daily practices, Western children, like the Oksapmin, often develop new knowledge that is interwoven with practice-linked artifacts, social interactions, and activity structures.

How do we approach and analyze the cognitive work and developments that are constitutive of practices, whether in a remote part of Papua New Guinea or the inner city? The solution is not straightforward and, as I indicated earlier, I believe that the problem has not been handled well with traditional approaches. The crux the problem is that the framing questions of traditional approaches have typically led either to outcome studies that neglect fine-grained analyses of the conduct of practices or to process-oriented studies in which analyses of conduct are not driven by well-articulated conceptual frameworks of either cognitive development or sociocultural practices.

In the remainder of this article, I sketch a framework that has taken form over the last 12 years as I have tried to understand the interplay between sociocultural and cognitive developmental processes in practices in various Papua New Guinea groups (Saxe, 1982; Saxe, 1991a; Saxe & Moylan, 1982; Saxe & Posner, 1982), number play in mother–child dyads in working- and middle-class families in New York (Saxe, Guberman, & Gearhart, 1987), and straw weaving (Saxe & Gearhart, 1990) and candy selling (Saxe, 1991a) in Brazil. My concern is to sketch broad outlines of the framework and, for illustrative purposes, present some preliminary analyses of my current work with third and fourth graders in the urban classrooms.

A Quick Sketch of the Framework[1]

The framework consists of three components, each linked to the same underlying thesis: As an inherent part of their daily activities, children construct and address problem-solving goals; in their efforts to accomplish these goals, children generate new understandings.

The first component targets for analysis the goals that emerge in cultural practices. Goals are understood to be emergent in the sense that they take form and shift in practices. Goals often shift as individuals participate in

[1]I present a full treatment of the framework in G. B. Saxe, (1991a), *Culture and cognitive development: Studies in mathematical understanding.*

practice-linked social interactions (as when a child is helped by a peer in reconceptualizing a computational problem during cooperative seat work), as individuals appropriate artifacts in their efforts to conceptualize and solve practice-linked problems (as when the child conceptualizes a subtraction problem in terms of the Western computational system), and as individuals develop new understandings (as when a student's new insight into place value leads to new goals and subgoals in solving a subtraction problem). Thus, in this formulation, emergent goals are a blend of sociocultural processes and the cognizing activities of the individual, and the first component is concerned with an analysis of the nature of this interpenetration in processes of goal formation.

The second component targets the relation between children's goal-directed activities and novel cognitive developments. In attempting to accomplish socially textured goals, individuals often appropriate cultural forms, specializing them as symbolic vehicles to serve particular cognitive functions. The Oksapmin research provides an example: Although Oksapmin traditionally used their system to accomplish primarily counting functions, with increasing engagement in the money economy, Oksapmin began to adapt and transform their indigenous system to accomplish the newly emerging arithmetical function, leading to a developmental progression of progressively more adequate strategic forms. The second component is concerned with this interplay between practice-linked cognitive forms and functions in development.

Finally, the third component targets the interplay among cognitive developments across cultural practices. Children are engaged in a multiplicity of practices in their daily lives; some of these may be linked to school whereas others are not. In each, goals emerge and means for accomplishing goals are generated. The third component is concerned with the way cognitive developments linked to children's participation in one practice (economic exchange, school-based math activities) may be appropriated and specialized in children's efforts to accomplish emergent goals in another.

Treasure Hunt: An Illustration of the Approach

In my inner city work, students and I have designed an educational practice—Treasure Hunt. Treasure Hunt is a game that is based on research linked to the 3-component framework and at same time is designed to afford an analysis of children's mathematics learning from the perspective of the framework.

The development of Treasure Hunt. In developing Treasure Hunt, students and I revisited the cultural practice work to consider features that supported math learning, features of practices that might serve as design elements for our classroom game.[2] In the work with Oksapmin and other groups, I was struck by the fact that often individuals with little or no schooling generated a rich and flexible mathematics in practices that contrasts markedly with the low levels of math performance that we often find in urban schools. Now, our concern was to glean insights from this work to support our development effort.

Among the features we noted was that in economic practices—whether in Oksapmin stores or my more recent research on candy sellers, individuals' motives for math learning were contexted within their larger concerns for making a profit or acquiring needed goods. Indeed, math was not an end in itself, but was instrumental to individuals for achieving larger profit-related goals. Further, in their economic practices, individuals' mathematical goals were often interwoven with and supported by artifacts and representational systems, like currency and indigenous number systems, which afforded multiple ways of conceptualizing mathematical relations. Finally, individuals, often in interaction with others, were involved in generating problems at a range of complexity levels (many-to-one exchanges of candy for bills, addition and subtraction in change making, mark-up computations), and individuals' solutions were valued for their sensibleness rather than the correct use of rigidly prescribed procedures (see Saxe, 1991b, for a more extended treatment).

Guided by such reflections on the learning environments that emerged in practices, we engineered Treasure Hunt. In our design of the activity, we made sure that mathematics would be richly woven into play but that math learning was not an end in itself. Our game was to be a thematic one, one in which mathematics emerged as intrinsic to play, and one in which we expected many children with or without prior interest in math might become readily engaged. Further, we made efforts to include artifacts and representational forms woven into the game that would support children's construction of interesting mathematical ideas that included arithmetical problem solving, place value, and ratio comparison. Finally, we built into the game a structure in which children were involved in both generating mathematical problems as well as accomplishing them, and in these activities, we designed ways that supported social interactional negotiations in both problem formations and problem solutions. Thus, children would be able to participate in the game successfully at a range of ability levels and children of similar and different ability levels could be active participants at the same time.

[2]The research group has included Joseph Becker, Teresita Bermudez, Tine Falk, Steven Guberman, Marta Laupa, Scott Lewis, David Niemi, Mary Note, Pamela Paduano, Rachelle Seelinger, and Christine Starczak.

It was our expectation that children's participation in Treasure Hunt would lead them to construct interesting mathematical environments, ones that we could conduct a careful analysis through videotape records of play. Our plan was to engineer data collection in such a way that we could organize analyses in terms of each of our three components. Some of the goals that we hoped would emerge (Component 1) involved the representation of large values in both base-10 blocks and the standard number orthography (artifacts used in the game); the translation of quantity constructed in one symbolic form into another; the addition, subtraction, and multiplication of quantities across symbolic forms; and the comparison of ratios. In structuring and accomplishing their goals, we expected to see children making use of prior cognitive forms to accomplish cognitive functions linked to play, and in turn, specializing forms to accomplish prior functions (Component 2). Finally, we expected to see children's appropriation of forms linked to one phase of the game (or to math learning in the classroom) to accomplish emergent goals in another (Component 3). We are currently using the 3-component approach to study the way children's formation and accomplishment of mathematical goals is woven into the play of Treasure Hunt.

An analysis of children's Treasure Hunt play using the Three-component model. Treasure Hunt is a board game. In the game, children assume the roles of treasure hunters in search of gold doubloons that consist of gold-painted base-10 blocks (in denominations of 1, 10, 100, and 1000). In their search to acquire gold, children sail small ships around six islands situated on the board through rolls of a die. Children collect their gold in treasure chests that consist of long rectangular cards organized into thousands, hundreds, tens, and ones columns, and they report their quantity of gold on their gold register with the number orthography (see Figure 2).

Children (third and fourth graders) play Treasure Hunt in dyads. In our study, play occurred in their classrooms twice weekly over a 2½ month period for about ½ hr per session; we videotaped the first and last session of play for each dyad, and the preliminary analyses that are sketched in the following text are based on these video tape records.

Analyses of emergent goals in play (Component 1). We analyzed processes of goal formation with reference to a four-parameter model. The parameters consist of the structure of the activity, artifacts and conventions used in the activity, patterns of social interaction that emerge in the activity, and the prior understandings that children bring to bear on the activity (see Figure 3). Although each of these parameters is interwoven with the others

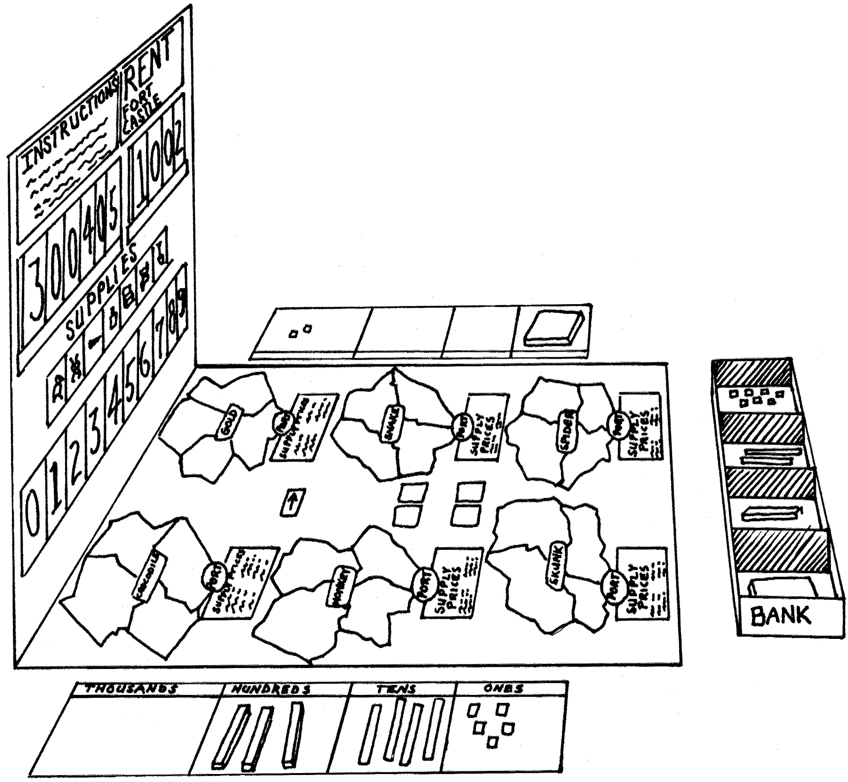

FIGURE 2 Treasure Hunt with identification of critical props.

when we consider children's goal-directed activities, the parameters are separable for analytic purposes.

In Treasure Hunt, the *structure* of the activity (Parameter 1) entails the game's prescribed objectives and rules that have implications for children's emergent goals. The game's prescribed objective is to acquire gold, and the objective is accomplished within a turn-taking rule structure that consists of five principal phases: Challenge, Rent, Purchase, Region, and Check Phase (see Figure 4). In the Purchase Phase, for instance, players buy supplies at island trading posts, often attempting to add or multiply supply values and then subtract the sum from their gold, and perhaps even attempt to accomplish price comparisons. In the Region Phase, players draw island cards that send them to particular island areas where, depending on the particular region, they must add gold to their chests in exchange for certain supplies, or they must pay for gold if they lack certain supplies. Later, in the Check Phase, children compare their gold and gold registers to make sure that their gold registers adequately represent their quantities of gold, a

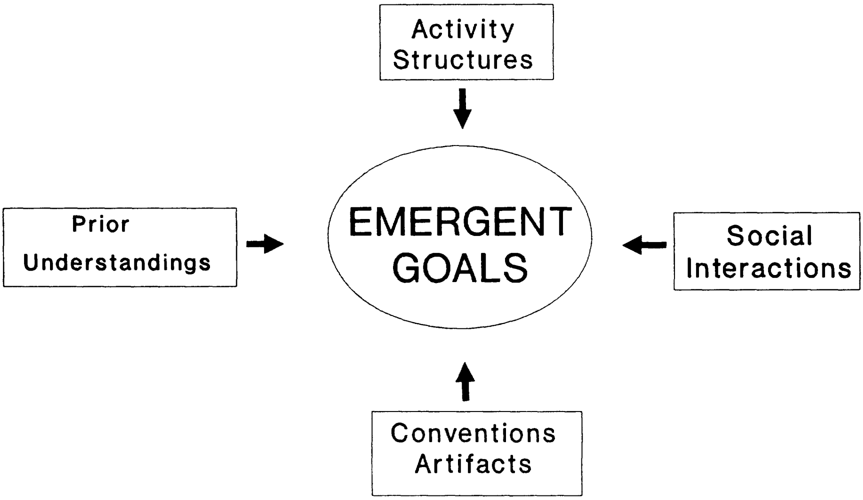

FIGURE 3 Four-parameter model.

cross-representation comparison goal that is supported by their partners' license to challenge. Thus, in the various phases of the game, problems emerge that favor children's construction of particular kinds of mathematical goals.

There are several *artifacts and conventions* (Parameter 2) that are intrinsic to play which influence the character of children's mathematical goals. To illustrate, consider the Purchase Phase. During the Purchase Phase, players can buy supplies at the trading posts (they later can trade these supplies for greater doubloon values in the Region Phase); in their purchases, children's math is interwoven with properties of the gold doubloon base-10 blocks (a principal artifact of the game). For instance, to perform a subtraction of 1,004 − 27 requires the construction of subgoals and operations that differ when the problem is presented in gold (e.g., 1 1000-block and four 1-blocks, take away a value of 27) versus when it is presented in the form of the standard orthography (1,004 − 27 in vertical format). In the case of the blocks, children may generate goals and subgoals involving equivalence trades of larger blocks for smaller blocks in order to accomplish the subtraction; in contrast, with the orthography, children may apply the school-linked column subtraction procedure with borrowing.

The particular *social interactions* (Parameter 3) intrinsic to play occasion the emergence of or modify mathematical goals. For instance, in the players' efforts to pay 27 doubloons for treasure chests and maps from the gold in his or her treasure chest totaling 1004 (1[1000] 4[1]), he or she may get stuck, not being able to obtain the needed 27 doubloons from either the 1000-block or the four 1-blocks. At this point the nonplayer may suggest

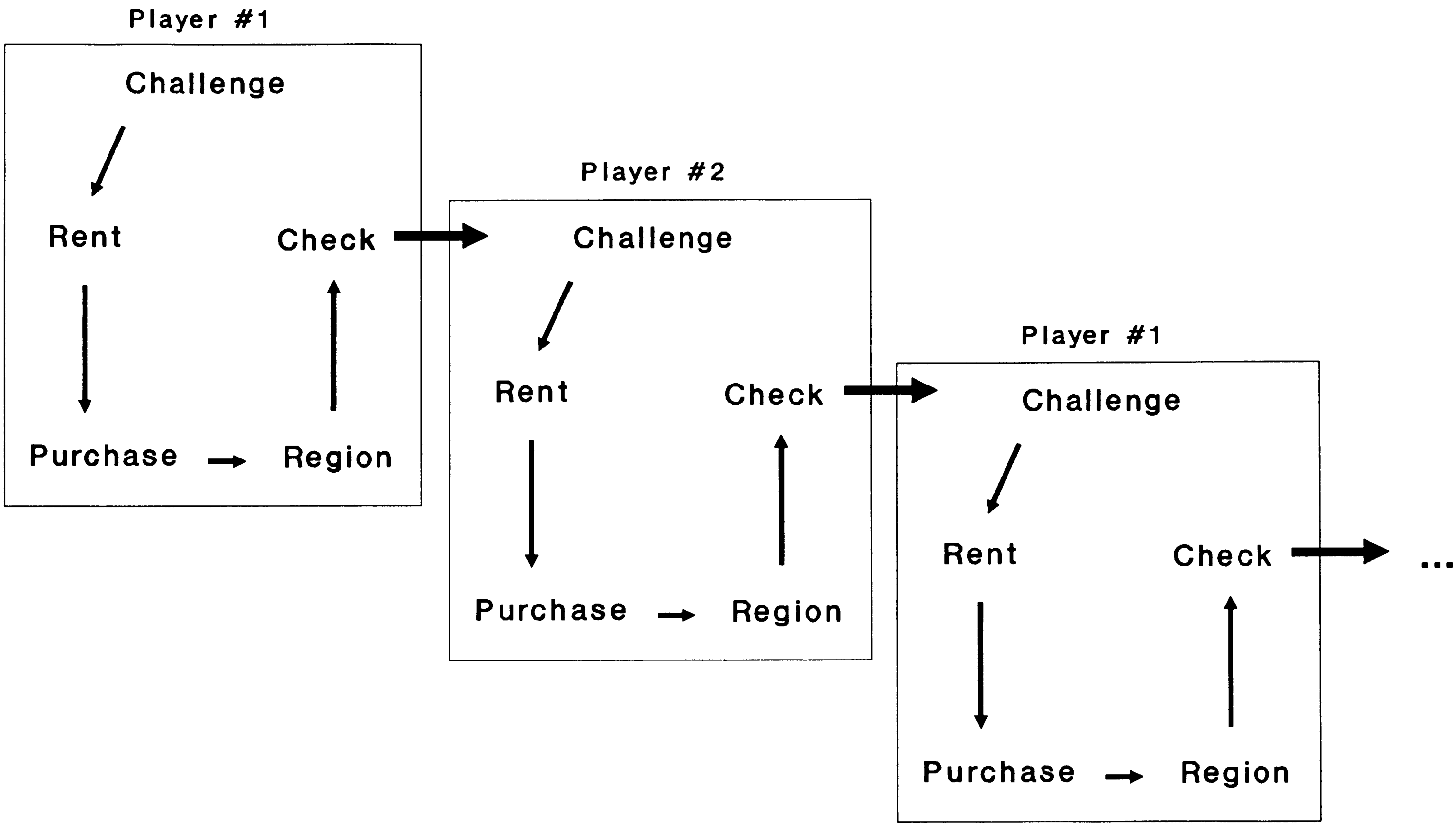

FIGURE 4 Five-phase structure of Treasure Hunt.

trading the 1000-block for 100-blocks, and the player may use this prod as a basis to structure the goal of the trade, and, by analogy, work out successive trades leading to the appropriate denominational form for payment. Here, the mathematical goals and subgoals of the player are interwoven with the social interaction that occurs in play.

Finally, the *prior understandings* (Parameter 4) that children bring to the activity have implications for the mathematical goals that emerge in play. For instance, children who have difficulty understanding the denominational structure of blocks may treat all blocks with a value of unity; others may seek assistance when accomplishing gold problems, relying on their partners to help them structure the sequence of goals that would lead to an adequate exchange. Regardless, goals are rooted in children's conceptual constructions, and analyses of processes of goal formation must be grounded in a treatment of children's understandings.

Analyses of children's developing understandings linked to their emergent goals (Component 2). The second component is concerned with the cognitive development of the individual. In Treasure Hunt, we focus specifically on the development of arithmetical problem solving. In one ongoing analysis, we target a game-linked form—gold doubloons—and the interplay in development between this form and emerging cognitive functions.

In their play of the game, children necessarily use gold doubloons as a medium of exchange. Gold doubloons are interwoven with various recurring problems: Children buy supplies with gold, they pay rent with gold, they challenge with the aim of acquiring more gold, and they report their quantity of gold on their register. In attempting to accomplish the emergent gold problems of play, children turn the game-linked form of doubloons into cognitive forms, and in this transformation we observe a complex developmental process in which the sense-making cognitive activities of the child and the external structure of the doubloons (e.g., 1 1000-block is equivalent to 10 100-block) are interwoven with one another.

To produce a payment of 14 doubloons, some novices appropriate prior cognitive forms like counting to serve game-linked enumerative functions—for instance, counting out 14 pieces of gold regardless of the doubloon denomination (Figure 5a). Other children specialize their counting strategy to accomplish more adequately the payment—for instance, respecting the denominational structure of the doubloons in their problem solutions, yet limiting themselves to paying only 1-blocks (Figure 5b). In both examples, children are organizing doubloon-linked strategic forms to accomplish strictly enumerative functions.

More specialized game-linked cognitive forms reflect a differentiated treatment of the doubloons, serving a function that is shifting from

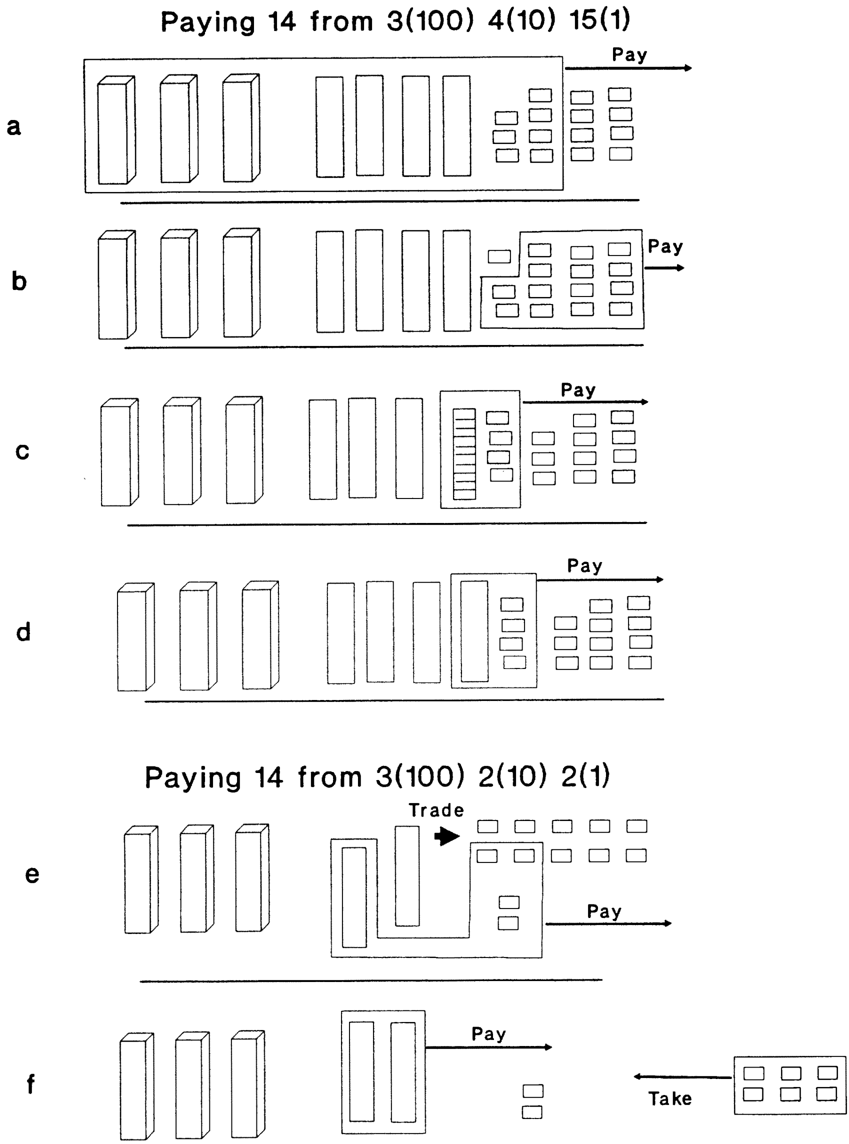

FIGURE 5 Six strategies for paying 14 doubloons.

enumeration to addition. For instance, when faced with insufficient 1-pieces, children pay with "mixed denominations," counting a singleton piece with ten strokes ("one, two, three, . . . ten"), and in this way incorporate both 10-blocks and 1-blocks into their solutions (Figure 5c). Here the prior form that served the earlier function of enumeration (counting by values of

1) is appropriated to accomplish the newly emerging game-linked cognitive function of addition. As children's understanding of the denominational structure of doubloons deepens, we see a further development—an abbreviation of the mixed doubloon counting procedure. Rather than counting a 10-unit block as ten ones, children treat a 10-block as a single term in a composition of multidenominational terms (Figure 5d).

With more complex problems in which the child's available doubloons will not permit an exact payment (like paying 14 doubloons when one has 8 100-blocks, 1 10-block, and 2 1-blocks), we observe children's use of earlier emerging forms to accomplish the new more complex problem. For example, to produce a payment for which exact denominations are not available, children may initially make use of their prior knowledge of equivalence relations across denominations and their counting to effect a trade of one 100-block for ten 10-blocks and then one 10-block for ten 1-blocks. With this restructuring through the use of the prior forms to accomplish the emergent goal of the trade, children now can make use of prior strategic forms of counting and addition to accomplish the larger goal of payment (Figure 5e). Finally, some children begin to abbreviate the explicit trade, and in so doing, they attempt to accomplish a new cognitive function linked to game play—subtraction. These children, for example, may offer a larger denomination and take the appropriate return of the smaller denomination, paying one 100-block and taking eight 10-blocks and six 1-blocks (Figure 5f).

Links between emergent goals and form-function shifts. The shifting relations between form and function are interwoven with cognitive and social processes of goal formation. For instance, some children may choose to buy only supplies for which 1-blocks are available or supplies that total ten, thereby limiting the complexity of the gold-linked problems and hence the complexity of strategic forms required. Further, social interactional processes may be deeply interwoven with children's gold-linked strategic forms through processes of goal formation as when, for instance, some children rely on their partner to tell them what gold denominations to pay; others may overpay, expecting the partner to take on the role of a shopkeeper and return change. It is this interdependent web of social and cognitive processes of goal formation and children's construction of cognitive forms and functions that allows multiple ability levels an opportunity for sustained engagement with Treasure Hunt (and, we suspect, with other cultural practices; see Saxe, 1991a, for a general discussion).

The interplay between knowledge generated across activities (Component 3): The treasure chest and the gold register. The third component is concerned with the interplay between form and function across activities or practices—in what way do cognitive forms elaborated in one activity become appropriated and specialized to accomplish cognitive functions in others? The question is similar to that addressed in the extensive literature on learning transfer; however, the current interpretive frameworks and language used to describe transfer are often not well-suited to analyze core processes at work in everyday practices.

In approaches to transfer, researchers often treat the process as one of a generalization of prior learning or of alignment of prior cognitive forms to new problems. In the methods associated with these conceptualizations of transfer, subjects are typically presented with some short-term learning exercises and then transfer is assessed in terms of pass–fail performances on transfer tasks.

Unlike in the laboratory, in practices such as candy selling, economic exchange, or Treasure Hunt, children are engaged with recurring problems. Further, unlike the close correspondence between problem structures characteristic of laboratory studies, the correspondence between recurring problems that emerge across everyday practices is often inexact, and requires considerable tailoring and specialization of knowledge generated in one activity to accomplish problems in others. Finally, unlike the typical laboratory study, when we make the analytic shift to the practice as a principal unit of analysis, we find there are social processes (e.g., interactions with peers, teachers, adults) that support children's use of knowledge generated in one activity to accomplish emergent problems in others. Because of both differences between the environments that emerge in the lab and in everyday practices and incongruities in conceptual thrust between laboratory- and field-based views of cognition, what we take as transfer phenomena in the laboratory and in the field differ from one another.

Our approach calls for an analysis of transfer as an interplay between knowledge generated in one activity to accomplish recurring problems in another. Consider one analytic tack that we are taking to approach the issue of "transfer."

Under Component 2 earlier, I sketched a preliminary analysis of form–function shifts linked to children's efforts to structure and accomplish the gold problems of play. In these analyses, we study children's use of gold doubloons to represent numerical values. We are engaged with a parallel analysis of children's use of the standard number orthography to express numerical values. Given these two sets of analyses, we can address the issue of interplay: Do children draw on one kind of representational system (knowledge of base-10 block forms, knowledge of the standard orthography) to help them understand the other? Some evidence for this form of transfer and its relation to social processes are documented in the extended interchange that follows, as one child, T, attempts to represent the numerical value "one thousand and thirty-one" in his gold register using the standard orthography.

T's treasure chest contains ten 100-blocks, three 10-blocks, and one 1-block (see Figure 6a). As T begins to change his gold register, T states incorrectly, "I have 100 and something" (apparently conceptualizing his 100-blocks as merely 10-blocks).

T then counts his gold and puts "131" in his register (further evidence that he is treating the 100-blocks as 10-blocks; see Figure 6b). As he places the last digit, T looks at the value that R reports in his register, 871, and now realizes that he must have considerably more than he initially determined . . . T exclaims referring to his own ten 100-blocks, "Hey, that's a thousand, boy."

Looking doubtful at T, R shakes his head "No."

T asserts, "Yes it is, yes it is!" and then recounts the 100-blocks, showing that there are ten of them, and sticks out his tongue at R.

Then both T and R recount the 100-blocks together, confirming that there are, in fact, ten. T then asks, "How do you make it 1000 (referring to the "131" in his gold register)?"

In an effort to solve T's problem, R shifts T's gold register from "131" to "1 31," and both consider the new arrangement.

T laments (only half seriously), "We don't have any commas."

R then, with some excitement, incorrectly notes, "Oh, I know, you don't have 1s" (R sees that he's wrong, shifting to the assertion), "you don't have none of these (pointing to the empty thousand column in T's treasure chest)."

This insight does not lead R to a solution, and he looks frustrated, returning the digits to the initial 131 spacing. T then breaks in, "How do we get those (referring to the thousands column in his treasure chest, apparently playing off of R's observation of the empty thousand column)?"

Silence. Then T continues, but with sudden insight, "Oh, I know, I could take all these (T's ten 100-blocks)," indicating he could trade the ten 100-blocks for a 1000-block; T makes the trade (see Figure 6c). T now looks at his gold and exclaims, "one thousand and thirty-one!"

At the same time, R is moving digits on the gold register so that they are arranged as 1 31 again. R says, "You got a zero. Put a zero right here [pointing to the blank space]."

T looks at first as though he believes R is wrong. R prods, "Go ahead, put a zero!" . . . pause. . . . "That's all, put a zero."

Then, T follows R's recommendation, placing the zero, saying (Figure 6d), with clear reflective insight, "Oh yeah, it could have been

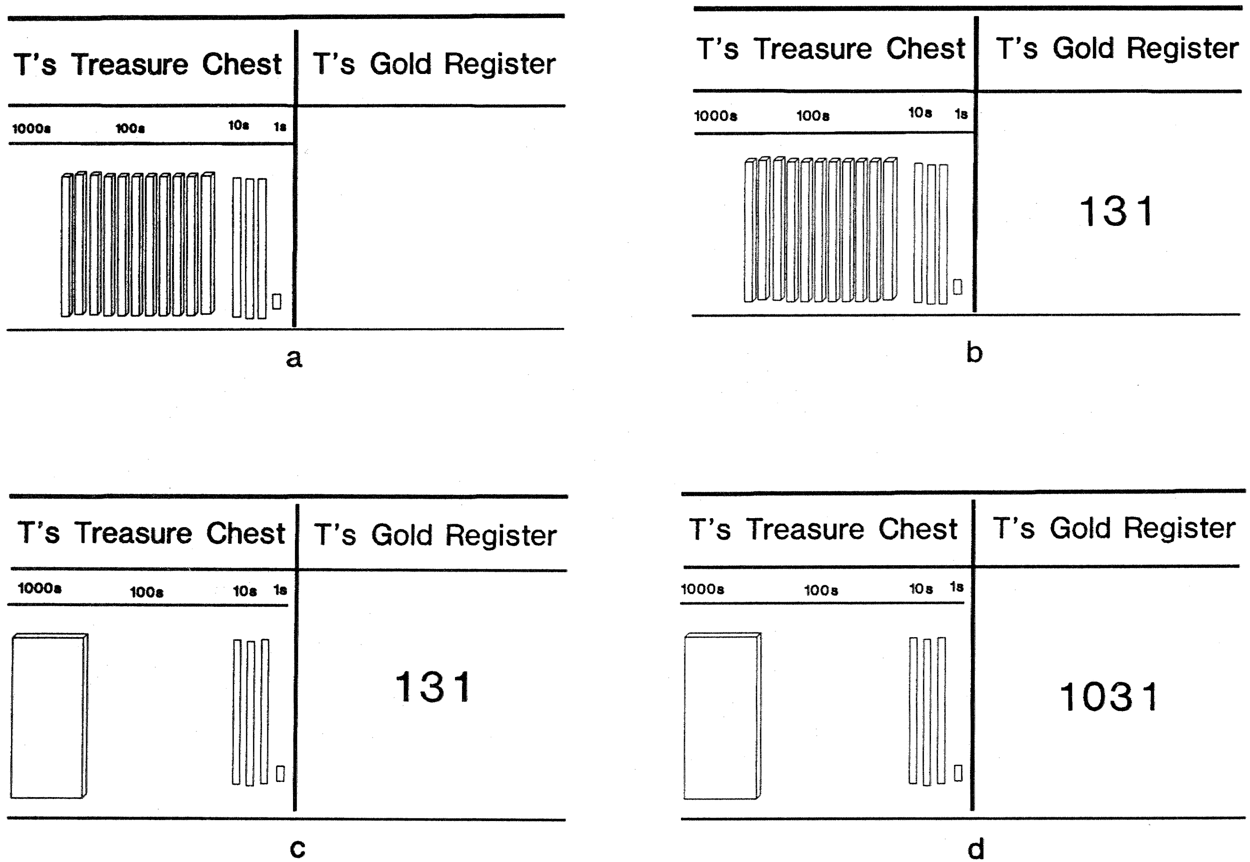

FIGURE 6 Shifts in T's treasure chest and gold register.

> ten hundred and thirty-one," referring back to the original non-canonical arrangement of gold doubloons (ten 100-blocks, three 10-blocks, and one 1-block).

In his efforts to determine and to represent the value of his gold, T finds himself stumped. Two points are noteworthy in the ensuing solution, one about transfer and the other about social processes interwoven with transfer.

With regard to transfer, we can note that rather than an immediate insight or generalization of one symbolic form to the other, transfer was a protracted process in which children were structuring and restructuring a solution across the two partially isomorphic symbolic forms, the number orthography and the gold doubloons. The solution path was one in which the children first struggle with the value of the doubloons (T first asserting "I have 100 and something . . ." but later "Hey, that's a thousand. . . ."). T's accurate determination of the doubloon value is, however, only an early intermediate step in the construction of an appropriate orthographic representation. T knows that his orthographic representation of "131" is not an adequate reflection of the value of "one thousand and thirty-one," and he is puzzled by the mapping across that orthographic and doubloon forms. With his realization that he can obtain a 1000-doubloon piece by trading ten 100-blocks, there is progress in achieving a doubloon configuration in which the mapping across forms is more transparent; however, there is no immediate insight. Finally, with R's directive to insert the zero the mapping from doubloons to the orthography is realized, and with T's assertion, that "it could have been ten hundred and thirty-one," the mapping from the orthography to the original doubloon configuration is realized. Clearly, transfer as it occurs in this example is an extended process of construction, one in which processes of problem representation in both symbolic forms and mapping across forms are interwoven with one another in a microgenetic process.

With regard to social interactional processes in the transfer, we can ask, quite seriously, did T or R accomplish the transfer? Although certain elements of problem solution were attributable to T or R, respectively, when we consider the process as a whole, each child's contribution was dependent on the contribution of the other, and to understand the phenomenon of transfer in practices, we may find it useful to shift from analyses of the individual as a lone cognizer to understanding cognition as a dynamic process intrinsically linked to social processes (see Laboratory of Comparative Human Cognition, 1986; Saxe, 1991a). Indeed, in the case of T and R, it was R who first noted that T had no thousand pieces, and this, in turn, prompted T to effect a trade of ten 100-blocks for one 1000-blocks. T's new doubloon configuration, in turn, led R to the insight of the missing zero, and the subsequent change in the zero, in turn, led T to the realization that "1,031" could be understood as ten-hundred and thirty-one as well as one thousand and thirty-one. Clearly, for T and R the interplay between learning across symbolic forms was a joint one in which a common goal emerged. Further, in the accomplishment of the problem, though the children's activities were organized around a common concern, the subgoals that emerged in their activities differed. T conceptualized and reconceptualized the value of his 100-blocks, which eventually led to the identification and accomplishment of a trade. R was focused on the manipulation of the spacing of the digits to adequately reflect the gold doubloons; these goals and accomplishments played off one another in the solution process such that each child's efforts and accomplishments was linked with the other's.

PROMISE, PROBLEMS, AND PROSPECTS

Alan Schoenfeld (this issue) calls for standards in presenting methodological innovations in the cognitive sciences. In closing, I take stock of my general research approach, as Schoenfeld did his coding schemes, with respect to some of Schoenfeld's principal criteria.

Schoenfeld's first two concerns are with the *context* that gives rise to the need for new methods and the *rationale* for the methods. Early in this article, I argued that we lack systematic analyses of the interplay between sociocultural and cognitive developmental processes in children's learning. I offered the three-component research framework as an effort to move forward in this direction. The three-component framework provides a means of conceptualizing the dynamic interplay between social and cognitive processes in children's developing understandings. By focusing on emergent goals, we can capture the constructive activities of the individual and dimensions of sociocultural life within a single analytic frame.

Schoenfeld's next concern is with a detailed account of a method, an account that would permit readers to apply the method to the author's or another set of data. In some respects, Schoenfeld's concern is a norm for archival journal publications, and appropriately so. Consider the example of T and R presented under Component 3—is the example atypical? How was it selected? How faithful is my transcription to the real-time interaction? Clearly, in this article, I have not described the particular methods associated with the analysis of Treasure Hunt. However, I am in the process of coding children's play of Treasure Hunt with a scheme that is geared for the analysis of emergent goals linked to the three-component model, and this scheme will be published with an upcoming monograph along with the results produced from it. Further, I have detailed the framework and specific methods in analyses of other cultural practices. *Culture and Cognitive Development* (Saxe, 1991a), contains an elaborated description of the framework and associated methods used to study the mathematics of Brazilian child candy sellers; similarly, in a recent monograph, colleagues and I presented a scheme for analyzing dynamics of goal formation in studies of the daily numerical activities with which young children in New York are engaged in home contexts (Saxe, Guberman, & Gearhart, 1987).

Schoenfeld's last concern is that an author provide a critical discussion of the strengths and limits of the innovations. I close by considering three points.

First, although the framework provides a method of approach, it does not provide a recipe for investigators. Indeed, because the framework is based on the assumption that novel cognitive developments are rooted in emergent goals, the investigator must necessarily blend the particularities of any targeted practice with the construction and coordinated use of ethnographic, observational, and task-based interview techniques. The downside here is that the development of such procedures is a substantial challenge and requires creative syntheses of methods from various disciplinary perspectives.

Second, to date, research guided by the framework has focused on mathematical cognition, and whether the approach can be extended usefully to other domains is an open question. Math has been a fertile context for initial study: It is a domain that is well-delimited, amenable to formal analysis, and one in which the nature of children's problem-solving is often manifest in their actions. Mathematics allows for a relatively clear specification of what counts as mathematical cognition in children's activities as well as what counts for more and less complex forms of mathematical operations, and as a result it is particularly useful for developmental analyses.

Finally, the conceptual framework that underlies the approach is itself developing, and a hope is that new empirical efforts will lead to further differentiation of core analytic categories. Indeed, processes of goal formation, form–function shifts, and the interplay between knowledge forms across practices each constitute theoretical models. These models need further specification; I expect that fine-grained analyses of children's activities in various practices will inform further progress.

ACKNOWLEDGMENTS

This paper was presented as a part of a symposium entitled, "On paradigms and methods: What do you do when the ones you know don't do what you want them to?" (Alan Schoenfeld, Chair) at the 1991 Meetings of the

American Educational Research Association, Chicago, IL. The article was prepared while the author's research was supported by grants from the Spencer Foundation (#M890224) and the National Science Foundation (#MDR-8855643). The opinions expressed are not necessarily those of the funding agencies.

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