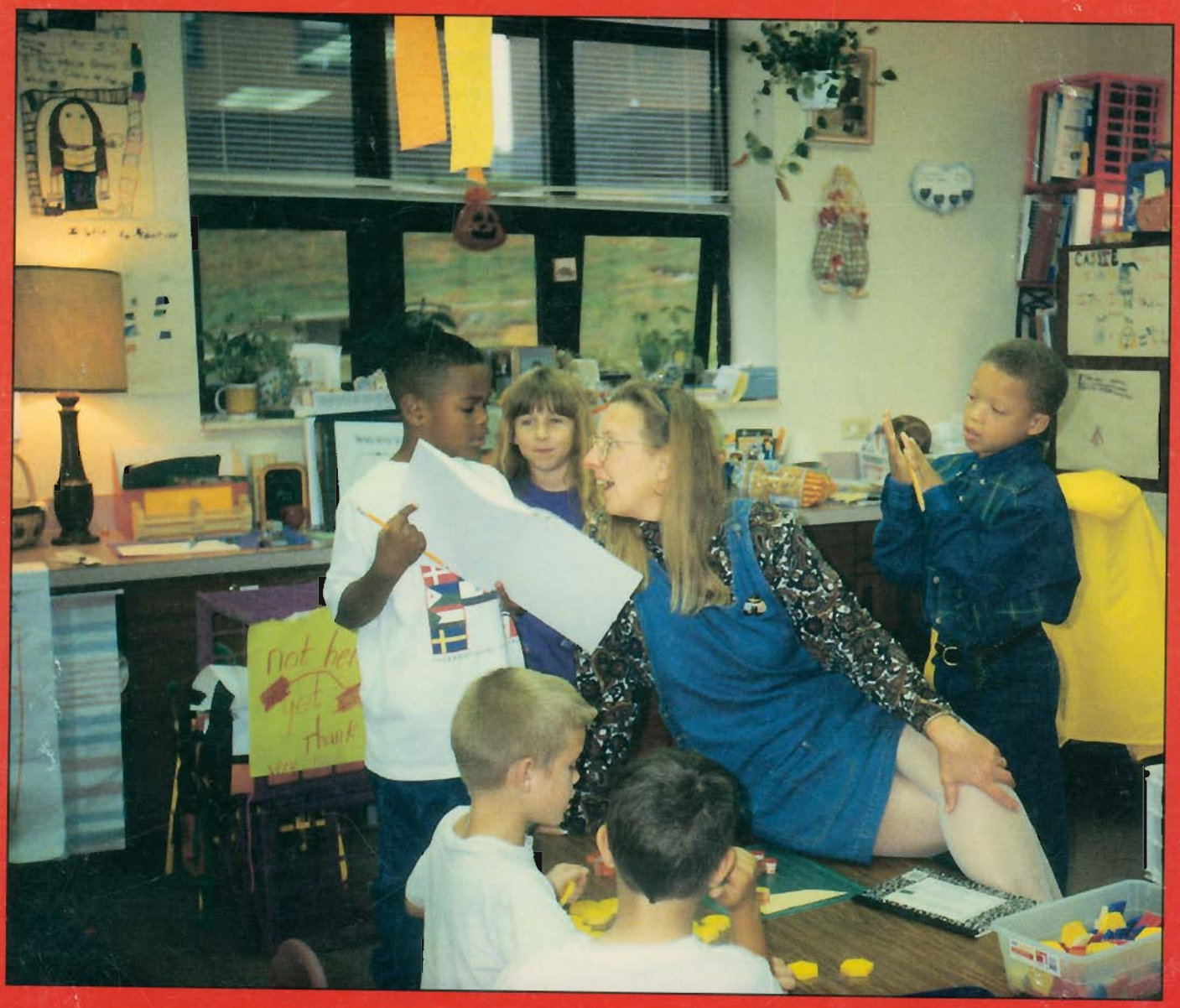
THE CONSTRUCTIVIST

Magazine of the Association for Constructivist Teaching

Volume 11, Number 2

Fall 1996

ASSOCIATION for CONSTRUCTIVIST TEACHING



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July 21–24	Columbia, Missouri

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Contents

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The Constructivist is intended for preschool, elementary, secondary, and post-secondary educators who are striving to apply constructivism to the teaching process. Subscriptions are available to nonmembers and institutions at $30 a year.

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A Letter from the President of the Association for

Good memories from our November meeting in St. Louis continue to reverberate. So much of that meeting was memorable for me—our wonderful keynote speakers, the teacher-led workshops I attended, and the very pleasant happy hour that many of us enjoyed, to mention just a few of the highlights. Thanks, again, to Brenda Fyfe and Sharon Schattgen and to all those who worked with them to make the St. Louis meeting such a success.

For me, there was a very clear theme in St. Louis, and it had to do with the social side of constructivism. In our efforts to explain how constructivism is different from other theories of knowing, we often emphasize the idea that everyone must construct his or her own knowledge. I know I have been fond of saying that nobody else can understand something for us. But, while this thought captures an essential aspect of constructivism, it can also be dangerously misleading. Consequently, I have always hastened to add that, of course, others can *help* us understand and that this is what teachers do. Now, though, the St. Louis meeting has helped me to better understand the many ways in which others can help and to see how central their assistance is in the knowledge-construction process.

Each of our keynoters spoke directly to this theme. Drawing on Piaget's recently translated "Sociological Studies" and her own very extensive work with young children, Rheta DeVries helped us understand the parallels and interplays between the development of mental operations and the development of co-operations among peers. In a speech chock full of wonderful images, Lucy Calkins spoke of teachers "getting behind" what children are doing and helping them realize the possibilities. Jim Wertsch gave us a beautifully clear overview of Vygotsky's thinking and emphasized the centrality of cultural tools in cognitive development. And Carol Gilles helped us appreciate the richness of the give-and-take in classroom talk as a vehicle for enhancing the development of students and teachers alike.

It is clearer to me now more than ever that simply standing back to let learners understand things for themselves is, at best, an incomplete way of teaching. If we think of all the disciplines that we teach in school as very powerful tools for understanding things—tools created and made available to us by our cultures—then it is easy to see the potential contributions of countless "others" to each individual's development. In

stressing the importance of learning the disciplines that have been handed down to us, I don't think we are disregarding Piaget's admonitions about educating people who simply repeat what has been done before. After all, each discipline can be understood as an open-ended and still evolving system, with many possibilities remaining to be explored. Perhaps our main job as educators is to help students understand the disciplines in this way.

As for the discipline of education, it seems most important for us to keep talking with one another, to get behind one another, to co-operate with one another, to explore together the tools of our trade, and thereby to gain better understandings of constructivism and its implications for teaching.

—Paul Ammon

A Letter from the Executive Editor of *The Constructivist*

Dear Readers,

The staff at Project Construct National Center and I hope that you enjoy reading the articles in this, the second issue of *The Constructivist*. The articles are diverse, ranging from an interview with James Wertsch on the theory of constructivism to articles from the field by a teacher educator and a classroom teacher. We are trying in our choice of articles to provide you with breadth across disciplines as well as various perspectives on theory and practice. We encourage you, our readers, to respond with your reflections, critiques, and observations. We would like our Letters-to-the-Editors section of the magazine to be a place where rich dialogue occurs. In the true spirit of constructivism, we are all interpreting the theory (assimilating) and constructing our practice in relation to that understanding. The process of reading others' interpretations and examples of practice and then reflecting and engaging in discourse with them is beneficial to the process of accommodation, as we continue to evolve our understanding of constructivist-based practice.

We also continue to seek fresh, new manuscripts for publication. Articles should be approximately ten pages in length and written in a colloquial style, with references cited in APA style. We especially seek articles that speak to practice. Teachers who are attempting to apply their understandings of constructivism to their classroom activities are particularly encouraged to submit articles with color photos (with written permission from parents/guardians) of their classroom and students' work. Administrators and teachers at schools engaged in reform are encouraged to describe how they are going about it. Upcoming thematic issues will be on the role of affect and developing a classroom community; teacher education; and on the perspectives from the disciplines (e.g., mathematics, literacy, science).

We also intend to include a Job Market section in the classified ads. Please contact Sharon Schattgen at the Project Construct National Center (800-335-PCNC) for information on placing a classified advertisement.

Please send articles for publication as well as letters to the editors to: Catherine Twomey Fosnot, The City College of New York, NAC 3/209a, 138th Street and Convent Avenue, New York, New York 10031.

—Catherine Twomey Fosnot

ACT Annual Conference

November 14–15, 1997
The City College of New York
New York, New York

The board members of the Association for Constructivist Teaching are pleased to announce that a site has been chosen for the 1997 conference. It will be held November 14–15 in New York City at The City College of New York. Please note the call for proposals below. For more information, contact Catherine Fosnot or Herbert Seignoret at The City College of New York, ACT, NAC 3/209a 138th Street and Convent Avenue, New York, New York 10031, phone: (212) 650-6346, fax: (212) 650-7530. E-mail: ctfcc@cunyvm.cuny.edu

We are delighted that The City College of New York will be the venue for the 1997 conference. City, as it is popularly called, is celebrating its 150th anniversary and has a long tradition of excellence, which is highlighted by its list of distinguished alumni (eight of whom have won the Nobel Prize). The institution is home to many programs that base their work on constructivism, including the Workshop Center, City Science Workshop, and Mathematics in the City. You will have the opportunity to visit these programs on City's campus and in participating public schools.

While in New York City, you may take advantage of its many sites and attractions, including Broadway theatres, Central Park, Museum Mile, and many diverse restaurants.

This year's conference promises to be one of our biggest! You can't afford to miss it!

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Call For Proposals

APPLICATIONS OF CONSTRUCTIVISM TO CLASSROOM PRACTICE

The Association invites proposals for workshops (1 1/2 hours in length) for the 1997 conference. We seek presentations regarding applications of Piaget's theory of constructivism in schools and classrooms for both general and special needs populations. Research papers and symposia regarding implications for educational practice are also welcomed.

Please write a descriptive statement of purposes, activities, and intended audience. Presenters should include a brief overview of their current position and previous experience in education. Send your proposal to Catherine Fosnot, The City College of New York, ACT, NAC 3/209a, 138th Street and Convent Avenue, New York, New York 10031.

Proposals must be postmarked by July 31, 1997.

http://www.columbia.edu/~vdn1/ACT.html

A Conversation with James V. Wertsch:

Brenda Fyfe

ACT Board Member Brenda Fyfe talks with James V. Wertsch, a keynote speaker at the Association's 1996 conference. Wertsch has spent much of his career studying the work of Lev Vygotsky. In Part I of their conversation, Wertsch explains how he became interested in Vygotsky and compares Vygotskian and Piagetian theories.

Most of us know you as an acclaimed scholar of the theoretical perspectives and research of Russian psychologist Lev Vygotsky. Could you tell us a little about your professional background and interests that led to this work?

Since childhood, I always had an interest in Russian or Soviet things, for no particular reason. I'm not from a Russian family. A psychiatrist might say I was traumatized by Sputnik. I took Russian as an undergraduate at the University of Illinois and actually toured Russia on a 10-day trip when I was in college. While working on my Ph.D. at the University of Chicago, I experienced one of those rare happenings that comes along once in a while. I saw on a bulletin board that an organization was looking for social scientists interested in the Soviet Union, but who were not Soviet-area specialists. So, I applied through an organization called the International Research and Exchange Board. They supported me during my last year of graduate school with some intensive courses in Russian at Middlebury College and Indiana University. After finishing my Ph.D., I spent the 1975–76 academic year in Moscow and traveled to a lot of other places in the Soviet Union as well. I was very fortunate because I was able to work with a generation of Vygotsky's students, especially Luria and Leont'ev. I actually worked with two Leont'evs, Aleksei Nikolaevich and his son, Aleksei Alekseevich, a Soviet psycholinguist. I worked with many others who had been Vygotsky's colleagues and students, but I guess my experience with Luria and A. N. Leont'ev was most important, because they continued to be very anxious to get out the Vygotsky message. It's almost as if I went back to graduate school a second time during that post-doc year; I did a lot of things, ranging from clinical neuropsychology with Luria to a study of the philosophical underpinnings of Vygotsky's work. Out of these experiences, I gathered materials and translated two books. The first one was on Soviet psycholinguistics. But more important for me, I gathered materials for a book that really followed up on Vygotskian heritage, *The Concept of Activity in Soviet Psychology*, where I translated some articles by Vygotsky and by Leont'ev and several other contributors to the Vygotsky tradition. There were so few

Part I

people in the U.S. in the business of studying Russian and Soviet psychology that I became very busy with this. At the same time, there was a growing interest in Vygotsky's ideas in the United States and in Western Europe. I think there was a kind of pendulum swing back to the social dimension of children's development. It was partly a critique of Chomsky and partly an extension of the very powerful impact Piaget was having on ideas about development at the time. I studied a lot of Piaget in graduate school, much more Piaget than Vygotsky, because Piaget was the major figure at the time. But people were searching for ways to complement and extend Piaget's approach, and so there was kind of a ready reception out there for Vygotsky's ideas at that time—in the late 1970s and early '80s. In 1980, while I was in the Linguistics Department at Northwestern University, I helped to organize the first international conference on Vygotsky at the Center for Psychosocial Studies in Chicago. The papers that grew out of this conference were published in 1985 in an edited volume, *Culture, Communication, and Cognition: Vygotskian Perspectives*. At the same time, my own writings on Vygotsky were coming out, which included my first book on Vygotsky and a lot of different articles and chapters.

You mention that you studied more Piaget than Vygotsky in graduate school. How would you relate Vygotsky's ideas about learning and development to those of Piaget?

One of the first comments I'd make is that at the level of philosophical inclination there are certain points where they had very much the same agenda. In particular, I think both figures were trying to avoid the horns of the dilemma of being either a strict empiricist or a strict rationalist; they both rejected the notion of strong nativism, which in its modern incarnation you can still find in Chomsky and his followers. At the same time, they both wanted to reject a kind of radical empiricism that manifested itself in behavioristic approaches of their time. The way they saw to avoid both horns of this dilemma between radical empiricism, or radical behaviorism, on the one hand, and rationalism, on the other, was to focus on human action as their unit of analysis. That's where I take both Vygotsky and Piaget to be on the same track. Piaget focused on human action and talked about things like the schema, which is the generalized pattern of action. It's really essential, in my mind anyway, to remember that Piaget's unit was the schema, not the individual. Assimilation and accommodation are terms that apply to schemas, not individuals.

On Vygotsky's side, there was also a strong tendency to look at action, especially in the form of speech. For example, Vygotsky looked at speech in the context of problem-solving actions, although a term like "schema" did not play a central role for him (as it did for Piaget). Furthermore, like Piaget, he moved very strongly into developmental analysis, thinking that basically all psychology should be developmental, that the privileged mode of explanation was a kind of genetic explanation or genetic epistemology. Yet another parallel with Piaget for Vygotsky was that he did not take development or genesis to be something that applied only to ontogenesis (development over the life span); rather, he saw it as a much broader framework having to do with phylogenesis (evolution of the species), and sociocultural history. In some ways, it's no accident. Vygotsky borrowed

from Piaget in this respect. Vygotsky was also influenced by people like Heinz Werner, who was very powerful in his formulation of developmental analysis.

There are a lot of parallels between Vygotsky and Piaget, but a couple of things distinguish them and make them complementary. First of all, as a general observation you could say, in my view, that Piaget is stronger in talking about earlier stages of ontogenesis and that Vygotsky is very weak on that point. Vygotsky has nothing really concrete to say about infancy and early phases of ontogenesis. I think Vygotsky gets stronger as you go up the developmental pathway of ontogenesis and has more to offer there, especially as it relates to the impact of schooling of children. But I think this is just a reflection of a more basic for Vygotsky, namely that cognitive development is largely a process of mastering cultural tools, especially language. Tools are things like levers and hammers. Today we might speak of cars, computers, and other technological things in this respect. Among sign systems, language played a central role for Vygotsky. He became very interested in signs, especially language and communication, in their role of reshaping individual mental functions. For Vygotsky, *any* form of human action involves signs and/or tools. In a way that often escapes our attention, cultural tools, especially language, shape how action gets carried out. For Vygotsky, language fundamentally shapes human action, both outward-communicative and inward-thinking action. This notion of mediation is a central tenet in Vygotsky's approach, and he nominated it as such. People often say that the difference between Piaget and Vygotsky is that Vygotsky was interested in the social and Piaget was interested in the individual. I think this view gives short shrift to both of them—to put them in those corners. Piaget clearly was interested in the social. For him, thought, operations, and schemas and logical structures apply to both individual and social forms of action. He looked at social interaction at a lot of points in his work. Conversely, Vygotsky was clearly interested in the individual, the active constructive individual. Otherwise, there would be no way to participate in the kind of social processes that he saw.

Did Vygotsky ever speak to Piaget's concept of logical necessity?

Not that I know of directly. Of course, there is always a set of issues here having to do with what was available to Vygotsky. In the middle 1920s, the political system of the Soviet Union played a big role in this. In the late '20s, as opposed to the later Soviet era, the Soviet Union really was very open to Western European and American influence, so it was possible to read and quote all kinds of things. Vygotsky was really taken by two of Piaget's very early books, *Le Langage et la pensée chez l'enfant* and *Le Jugement et le raisonnement chez le'enfant.*

For example in Vygotsky's book, *Thinking and Speech*, there is a chapter on Piaget. Originally this chapter was a long introductory essay of the Russian translation of these two books.

When you say* Thinking and Speech*, are you referring to the book most of us know as* Thought and Language*?

Yes, *Thinking and Speech* is, however, clearly the more accurate title. Vygotsky clearly used "speech" in the title of this book. He also used "thinking" and not "thought." Each of these words are relevant for Vygotsky's interest in action and process rather than static entities. The fact that the book was translated into *Thought and Language* has led a lot of people to look at him as more interested in the static entity.

Back to your earlier question, Vygotsky read early books of Piaget's, but Piaget tended to talk much more about logical necessity in his later works. I don't know offhand that Vygotsky read that work. He did

read French, English and German. Issues of logical necessity came up more strongly for Piaget after his first work, *Play, Dreams and Imitation*.

I would like to add a comment on one additional parallel between Vygotsky and Piaget—they both were terrific dialectical thinkers. Both were unsatisfied with simple mechanistic determinations (of behavior). The world and the human mind come in many respects in the form of dialectical tensions. This is a very important thing to be studied when compared to some of the ways we do things in American psychology, where we look for computer metaphors, or something that has a nice neat, logical, or final answer or resolution to problem solving. In regard to assimilation and accommodation, for example, you can never have one in total isolation. There is always this kind of irreducible tension. That's something akin to the way Vygotsky set up problems as well.

We often hear Vygotskians speak of "social constructivism" rather than "constructivism." What is "social" about "social constructivism?"

Well, I think two things. First, Piaget tended to put more emphasis on the active, constructive individual. Vygotsky tended to focus more on the social conditions, although both of them kept the other side of the picture in mind, it seems to me.

The second point, and a point that I find more interesting, is that if you want to use the term "social constructivism," the social has to do with the cultural tools, the socioculturally situated mediational means. Vygotsky was not looking so much for universal aspects of human rationality, because for him human action, and human thinking as one form of human action, is always dependent, always shaped in fundamental ways by the cultural tools that are involved. Those tools are themselves situated in terms of cultural institutional and historical settings. In that sense, Vygotsky is a social constructivist. You cannot act without using tools, and those tools come from a sociocultural setting. So, in this connection, I think there is a difference in emphasis for the two authors.

Could you give a simple example of socioculturally situated mediational tools?

Yes, in a new book that I am publishing with Oxford University Press, I go through a few of these in much more detail. One example I give is that many people comment on the differences the word processor makes in how they write today as opposed to the time when paper and pencil or an old typewriter were the only tools available. Everybody you ask about this seems to have their own story, "Oh, when I started to write with the word processor, my writing changed completely. I tend to write more freely, or I tend to revise much more, and I end up with quite a different final product." Word processors are socioculturally situated tools. They are very complex ones. They transform human action. So, in that sense, Vygotskians are interested in what I might call "sociocultural constructivism." They would be looking for how writing is different today from when people used pencil and paper, or when they used typewriters, where once you had it down, you might as well leave it that way.

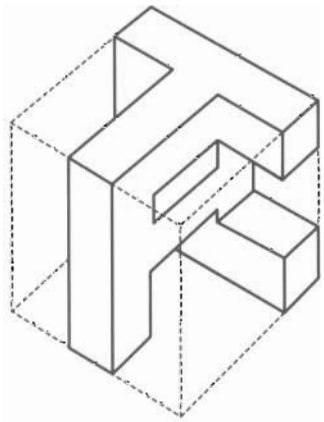
Other people—for example, Giyoo Hatano in Japan—have looked at the use of the abacus. The appearance of calculating devices like the abacus leads to a certain set of skills, a way of thinking about numbers that is different when you don't have an abacus. Today, the general debate is whether kids should use calculators in the early grades in school. What you are talking about here is the appearance of a new sociocultural tool in the form of a calculator. Some people are saying, "Given a calculator, there's no reason for kids to spend much time learning multiplication, division, subtraction, addition." Others disagree strenuously. This is an argument

that basically is about cultural tools and the way the appearance of any new cultural tool or mediational means may transform human action.

Part II of Brenda Fyfe's interview with James V. Wertsch will appear in the next issue of* The Constructivist. *In the second half of their conversation, they focus on the zone of proximal development and the role of scaffolding and mediators. ❐

James V. Wertsch is Professor and Chair of the Department of Education at Washington University in St. Louis, Missouri. **Brenda Fyfe,** Professor of Education at Webster University, is a member of the Board of Directors of the Association for Constructivist Teaching.

See pages 20–22 for 1996 ACT Conference highlights. James V. Wertsch presented one of the keynote addresses at the conference.



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Are Algorithms the Answer?

Anne Solomon

Fourth-grade teacher Anne Solomon shares her thoughts about the dangers of teaching algorithms to elementary-school students.

As a fourth-grade teacher and a student of children's thinking, I find myself in conflict over students who have previously been taught the algorithms (rules) of carrying and regrouping. I am constantly comparing Constance Kamii's research findings (Kamii, 1982, 1985, 1989a, 1989b, 1994; Kamii and DeVries, 1980) and my own observations of how students construct mathematical understandings to the responses of students who have been taught algorithms. It is frustrating to watch students come to a dead end in their thinking and/or proceed illogically as they attempt to solve math problems.

I observe eight-, nine-, and ten-year olds—students who have been taught by competent, well-meaning teachers—use the algorithm for double-column addition of adding the ones and carrying to the tens. Yet, these students have no concept of place value. They make similar errors over and over without making logical sense of the numbers with which they are actually working. In this article, I will illustrate how the introduction of an adult model of an algorithm hinders the development of the student's understanding. This view is supported by Kamii (1994), who states:

> . . . the teaching of algorithms in the primary grades is harmful for the following reasons:
>
> 1. Algorithms force children to give up their own numerical thinking.
> 2. They "unteach" place value and hinder children's development of number sense.
> 3. They make children dependent on the spatial arrangement of digits (or paper and pencil) and on other people. (p. 33)

and Marilyn Burns (1992), who states,

> With the exception of errors that result from carelessness with basic facts, the errors children make are not random. They are remarkably consistent. In most instances, children's errors are rule-bound, the result of applying an incorrect procedure in place of the correct algorithm. Often, the child has been taught the rule by a teacher but applies the rule in an inappropriate situation. (p. 9)

Math Problem

While the rest of my fourth-grade class worked in pairs using a math menu of 17 game choices taken from Kamii's books, *Young Children Continue to Reinvent Arithmetic—2nd Grade* and *Young Children Continue to Reinvent Arith-*

I must allow children to construct their mathematical knowledge for themselves.

metic—3rd Grade, I worked with a heterogeneous group of four students using an activity (described by Sally Jones Livingston in Kamii, 1994) called "throwing" numbers on the board.

> . . . write three to six numbers on the board, such as the following . . ., asking the class to add them without using paper and pencil:
>
> 50 50 15 49
>
> After giving plenty of "think time," I ask for and list all the answers the students got . . . I then ask for volunteers to explain the different ways in which the answers were obtained.
>
> Our rationales for this activity are that it is good for children to have to think without recourse to paper and pencil, and it is particularly important for users of conventional algorithms to have to deal with numbers that are not aligned in columns. Many users of algorithms know the rule of working from right to left and of carrying but cannot apply it when the numbers are not arranged in columns. (pp. 133–134)

This is the addition problem that I presented to Michelle, David, Justin, and Zachary, the four students in my small group:

$.50 $.75 $.99 $1.25 $.50

Each child approached this problem in his or her own way.

Children's thinking

Michelle: "$.50 + $.50 = $1.00. I made the $.99 as $1.00. Then I made the $1.25 as another dollar. $1.00 (from .50 + .50) + $1.00 (from .99) + $1.00 (from 1.25) = $3.00. Then $.75 + the $.25 from the $1.25 = $.10 . . . wait . . . one hundred equals another dollar. Take away a penny (because of previously changing the $.99 to $1.00) and that equals $4.99 . . . no, wait . . . $3.99."

David: "I started with the easier numbers first. I said $.50 + $.50 = $1.00. $.75 + the $.25 from the $1.25 = $1.00. That's $2.00. The dollar from the $1.25 = $3.00. There's $.99 left and that equals $3.99."

Justin: "$.50 + $.50 = $1.00. $1.00 + $1.00 (from $1.25) = $2.00. $.25 (from $1.25) + $.75 = another dollar. $2.00 + $1.00 = $3.00. $3.00 + $.99 = $3.99."

Zachary: "First I put the $.75 under the $1.25 and add it up. 5 + 5 = 10. Put the 1 on top of the 2. Then I said 2 + 1 = 3, 3 + 7 = 10, put the 1 on top of the 1. 1 + 1 = 2 and you have $2.75."

```
 1 1
$1.25      $1.25
+ .75      + .75
 2.00       2.75
```

(his mathematical thinking) (what he arrives at)

"Next I put the $.99 over the . . . I mean under the $2.75. You go 5 + 9 = 14, put the 4 on the bottom of the 9 and the 1 on the top of the 7. Then 1 + 7 + 9 = 17. Put the 7 under the 9 and the 1 on top of the 2. 2 + 1 = 3, it's $3.74."

```
 1 1
$2.75
+ .99
 3.74
```

"Then put the $.50 under the $3.74. 4 take away nothing is 4. 7 + 5 = 12. Put the 12 under the 5."

David: "What about the beginning?" (referring to 4 – 0 = 4)

Zachary: "What?"

David: "You subtracted 4 – 0."

Zachary: "Oh, yeah. I mean 4 + 0 = 4.

Put the 1 from the 12 on top of the 3. 3 + 1 = 4. Put the 4 down. Did I just use 50? It's $4.24."

	1
$3.74	$3.74
+ .50	+ .50
124	4.24
(what he originally said)	(what he arrives at)

"Put the $.75 under the $4.24. 4 take away 5 is 1, 2 . . . wait! Did I say take away? 4 + 5 = 9. 7 + 2 = 9. 4 take . . . 4 + nothing = 4. You have $4.99."

$4.24	$4.24
+ .75	+ .75
1	4.99
(what he originally said)	(what he arrives at)

Teacher's thinking

Zachary, though not allowed to use paper and pencil, says, "First I put the $.75 under the $1.25 and added it up. 5 + 5 = 10. Put the 1 on top of the 2 ..." Having been taught the algorithm, he continues to be dependent on the spatial arrangement of digits as well as on pencil and paper. He lines up the numbers in his mind instead of using his own numerical thinking, which Kamii (1994) identifies as one of the three harmful effects of algorithms. Zachary has just demonstrated what Kamii and Livingston say happens to users of algorithms—they know the rule of working from right to left and of carrying, but they cannot apply it when the numbers are not arranged in columns. (Kamii, 1994)

An example of "unteaching" place value is when Zachary says, "5 + 5 = 10. Put the 1 on top of the 2. Then, I said 2 + 1 = 3, 3 + 7 = 10." Kamii (1994) states that children are thinking about every column as ones, and the algorithm helps to reinforce this weakness. With an understanding of place value and without interference of an algorithm, Zachary might have figured 5 + 5 = 10, 10 + 20 = 30, 30 + 70 = 100. This example shows ones as ones, tens as tens, and hundreds as hundreds.

Zachary has also shown two examples of the incorrect thinking that Burns (1992) describes in her research on children's common arithmetic errors. When Zachary adds seven and five together and says, "Put the 12 under the 5," he is doing what Burns describes when children ". . . add the numbers in each column and write the sums under the line" (p. 9). Later, when Zachary says, "Four take away five is one," he is demonstrating another common arithmetic error that Burns describes in this way, "When you subtract, you take the smaller number from the larger" (p. 9).

The brief exchange of points of view between David and Zachary demonstrates how student dialogue facilitates logical-mathematical thinking. David clarified that Zachary had said 4 – 0 = 4, which led Zachary to realize he had subtracted when he should have added. Zachary immediately went on to solve the problem. This non-threatening exchange of points of view helps students to construct their own knowledge (meaning) and "runs" a constructivist classroom.

Reflections Over Time

Throughout the year, I have gone back and forth in my thinking about whether I am helping or hindering my students by providing them with a way to make sense of numbers. Am I actually doing a disservice and causing confusion by allowing them to construct their mathematical knowledge for themselves, rather than reinforcing the use of an adult model of an algorithm that they don't understand?

In the case of Michelle and Justin, who were taught algorithms and struggled to "remember what to do next" when approaching a math problem, one can see that their thinking has shifted and that they have developed number sense. Their transitions have occurred primarily because I have been teaching these two children for a year-and-a-half, and they have learned to explain their mathematical thinking.

David, who is new to my class this year, grew up with a mother who allowed him to construct mathematical thinking for himself. Because of this (even though his previous teachers taught the algorithms), he is comfortable with either

approach and his thinking reflects number sense.

Zachary, new to my class this year, struggles with which "recipe" to use and has lost all sense of number. Therefore, his transition is slower.

Conclusion

To summarize what is shown in research and what I have observed in my classroom, not only with Zachary, but with others as well:

> . . . many students continue to approach every addition and subtraction problem mechanically and to think about each column separately. The cognitively most advanced children came close to being unprogrammed by the end of the school year. The below-average students, however, continued to cling to algorithms and to have trouble with place value. Human beings are much harder to unprogram than computers, and children at the bottom of the class suffer the most from the damage caused by algorithms. (Kamii, 1994, pp. 45–46)

In addition:

> . . . children rely on following recipes rather than reasoning what is sensible to do. Following recipes results from learning arithmetic as a collection of specific methods used to arrive at answers.
>
> Not only is the mastery of algorithms presented as the most important goal in elementary mathematics instruction, but the algorithms taught are often presented as if they are the only way to perform a calculation. (Burns, 1992, p. 10)

After much thought on this issue, observation of my own students, and consideration of Kamii's and Burns' research, I conclude that I *must* allow children to construct their mathematical knowledge for themselves. This is important so that the Michelles and Justins of the world have the "Aha!" of discovering a real sense of what number is about; so that the Davids continue to be validated for their natural way of mathematical thinking; and so that the Zacharys will, hopefully, transition into making sense of number for themselves. For children to have number sense, algorithms are *not* the answer. ❐

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Reframing Is a Way of Teaching

Sherrie Reynolds and Kathleen Martin

Sherrie Reynolds and Kathleen Martin describe a teaching strategy that helps students think about problems in new ways.

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This article is based on a paper presented to the 1996 Symposium of the Jean Piaget Society.

Piaget helped education to shift from a mechanical model of learning to a more appropriate, biological one (Doll, 1993). Piaget and Inhelder (1969) established that understanding can not be given, shown, demonstrated, or transmitted from one person to another. Learning is a dynamic process in which the learner actively constructs his/her own intellectual life.

New models of teaching must be developed; these models must recognize that learning is an organic/dialectical process which can be cultivated but not controlled (Sigel, 1981). As Piaget (1973) said, "in order to bring education into line with the needs of society, it would be necessary to undertake a complete revision of the methods and aims of education, rather than continue to be satisfied with simple appeals to common sense" (p. 12). What is desired is that the teacher "cease being a lecturer, satisfied with transmitting ready-made solutions; his role should rather be that of a mentor stimulating initiative and research" (p. 16).

A Model of Teaching

The shift from thinking about teaching as delivering information, to thinking about teaching as providing capacity-creating conditions, is crucial. The teacher creates environments in which children's thought is engaged, provoked, and challenged; in which children are presented, in Piaget's words, "the initial devices which present useful problems to the child" (1973, p.16). Thus, one thing a teacher must do is to create a rich learning environment of sufficient depth and complexity to offer interesting and engaging possibilities. By doing this, she provides children with things to think with and about. These learning environments must be powerful enough to engage the most sophisticated learners and diverse enough to engage the least sophisticated students. Appropriate learning environments allow all students opportunities to have their current constructions of thought challenged.

Powerful learning environments alone are clearly not sufficient. The teacher is not simply a provider of experience

A teacher who reframes a problem is carefully listening to the child's current reasoning, finding a way to subtly rephrase the problem so that the limit is removed.

because understanding is not derived from observation or "hands-on" experiences. Children construct ideas, connections, and explanations from their actions and from interactions with other people.

The teacher needs to provide rich learning environments, but he also needs to have sensitivity to and interest and belief in the vital organic process of the growth of a child's intellectual life, so children can learn. A fascination with the development of the child's thought and respect for its continued unfolding are essential. This kind of caring is appropriate for a teacher; it helps her to see moments when a child is caught by something and needs to pursue it—or when it is time to move on—or when to give information or provide sources of information. The teacher will notice those important moments of disequilibrium—the teachable moments—and be able to respond to them. There are no rules, no methods, no prescriptions. This, too, is an organic process that can be cultivated but not controlled.

The teacher is able to follow children's thought in this way most effectively when the environment includes appropriate opportunities for feedback that are visible to the teacher as well as to the student. In many cases, this means that the student must be engaged in trying to do something or make something. It is the doing or making that allows the teacher to observe a child's thinking and reasoning.

The teacher cannot predict what each student will do in any given environment, but she can create conditions that will make more visible what *does* happen. Based on this information, a teacher can intervene as appropriate. Moreover, the intervention does not have to have predictable results, as long as tight feedback loops permit the teacher to again sense the result and act upon it. This dynamic response in a rich environment permits other kinds of complex systems to approach optimal solutions quickly and seems to do so in teaching as well. Waldrop (1992) describes the process in this way:

> Notice that this is not a recipe for passivity, or fatalism . . . This is a powerful approach that makes use of the natural nonlinear dynamics of the systems. You apply available force to the maximum effect. You don't waste it. . . . it's also the principle that lies behind all of Oriental martial arts. You don't try to stop your opponent, you let him come at you—and then give him a tap in just the right direction as he rushes by. The idea is to observe, to act courageously, and to pick your timing extremely well. (p. 331)

In our work with children in unstructured learning environments, we have tried to find out what the nature of these "taps in the right direction" might be. We wanted to identify ways that teachers can mentor children's understanding without undercutting the process of individual construction of knowledge. The important thing, of course, is that any tap is in response to a need in the child's spontaneous learning and not in response to some external event or notion. The occasion which seems to call for these kinds of interventions are those in which the child has gotten stuck in some way. That is not to say that the teacher should intervene the moment the child perseverates in some ineffective solution or appears a bit frustrated. It is rather that, as Piaget (1954) said, the child's current understanding is both the limit and the ground of the next understanding he constructs. When the current understanding imposes a limit which prevents further action by the child, then it also prevents further learning. The child is stuck. These are the kinds of situations in which teachers may be able to introduce new possibilities if they do so sensitively, subtly, and without insisting.

Reframing

One way to introduce new possibilities is through *reframing*. Reframing is described by Watzlawick,

Weakland, and Fisch (1974) as "to change the conceptual and/or emotional setting or viewpoint in relation to which a situation is experienced and to place it in another frame which fits the 'facts' of the same concrete situation equally well or even better, and thereby changes its entire meaning" (p. 95). Psychologists have used reframing as a therapeutic device for a long time. It doesn't change the problem; rather, it introduces a new way to think about the problem, which frees us from the boundaries of our current conceptions.

A teacher who reframes a problem or way of thinking about a problem does not demonstrate, model, or instruct. The teacher is not trying to get the child to understand something. Rather, she is carefully listening to the child's current reasoning, thinking about what is limiting her, and finding a way to subtly rephrase the problem or thought so that the limit is removed.

Reframing to remove conceptual limits

An illustration of reframing occurred when we were doing a variation of Piaget's (Piaget, Inhelder, & Szeminska, 1960) volume experiment. (See photo 1.) The child was presented with a piece of paper on which two rectangles of different sizes had been drawn. On one of the rectangles, a "house" was erected from wooden blocks, and the child was asked to make a "house" on the other one that would have just as much room. In our case, we had several papers with different sized rectangles, so that when the child finished one, she was asked to do another.

As we observed one child working on the first volume problem, we noticed that he behaved very much like the children reported in Piaget's volume experiments. He built his building the same height as the teacher's building and then compared the height of the two buildings with his hand. He decided they were the same height and concluded that they were, therefore, the same size. When questioned, he said that he thought they were the same size, but he wasn't absolutely sure. When he continued to waver and appeared frustrated, the teacher reframed the problem for him by asking, "If these were both apartment buildings, could as many people live in your building as live in mine?" He thought about it and then said, "No, more people could live in yours." She then asked him to make his so that the same number could live in both. He added more to the top of his and then said they were the same. She asked him how he could know that they were the same. He reconfigured his "building" so that it looked like the other one and added to it until it was the same. She said to him, "But yours is in the water." He took the part that was in the water and put it back on top. He looked puzzled. She said, "They don't have to look the same to be the same." He repeated that to himself and then his eyes lit up and he repeated it again. He then successfully constructed buildings on the rest of the papers (of different volumes). After each one he said, "They don't have to look the same to be the same."

When a child is transitional like this one is, the teacher can help him to make the shift by listening for the thoughts that are posing limits. In this case, the child was initially helped to re-think the problem in terms of people living in apartments. This approach helped him imagine the inside of the building rather than just the outside

Photo 1. A student works on a volume problem.

Photos courtesy of Sherrie Reynolds and Kathleen Martin

and to think of it in terms of its composition in three dimensions, which seemed to free him sufficiently so that he could solve the problem. However, he still did not fully understand, as indicated by the fact that he was puzzled when he re-configured his building. The second reframing ("they don't have to look the same to be the same") helped him to be free of the last tie to his perceptual knowledge and was the key for him to make the transition.

Reframing for discernment

Reframing is also a way of helping the child to create limits when she is drawn to too many features or fails to notice important constraints. When children approach new problems or new materials, they do so in an exploratory way, starting with their current constructions. Sometimes they get lost in the exploration. They act as if they are immobilized by the many possibilities. At times, children do not need to be freed from the limits (as in the first example), but rather need to be assisted in thinking about the problem in a way that constrains it so that it is more manageable. Reframing in this second case is for the purpose of introducing a more refined discernment.

For example, we asked children to construct a "diabolical cube" (a 3 x 3 x 3 cube) from a set of pre-constructed pieces. (See photo 2.) Many of the children took an additive approach (as described by Piaget, 1987). They did not think about the whole cube and the necessary coordination of their actions to build it. Instead, they thought of the next piece to add to their current construction. These children also did not seem to notice that a 3 x 3 x 3 cube could not be constructed if one of the sides was already larger than three cubes in any direction. One of the teachers went to the table and sat by some children who appeared to be frustrated. She simply began constructing her own cube and intentionally made it larger than three cubes and then made comments to herself like, "That won't work. It's too long. I won't be able to make a cube that way." Some of the children did not change what they were doing. Others seemed to understand for the first time that there was a necessary constraint on each side if a 3 x 3 x 3 cube was to be built. Clearly, there was no intention of forcing this view on the children; the teacher was simply suggesting an important feature to be attended to in the construction of a cube.

Photo 2. This child is constructing a diabolical cube.

Reframing to escape bias

Sometimes children will ignore an important variable because of a bias. Bias, by its nature, blinds us to certain features or possibilities. This is another situation where reframing may be helpful. In the next example, children were asked to make a top that would spin a long time. They had various materials available to them, such as paper plates, cups, wooden dowels, screws, and magnets. They were trying various combinations and moving quickly from one to another.

They consistently placed the disc symmetrically with respect to the dowel or screw about which it was to rotate. (This bias toward symmetry in children was observed in many settings and was also observed in Piaget's experiments with children.) Because the dowels were longer than the screws, tops made with the dowels and balanced halfway up the dowel were rather unstable and did not spin very well or very long. This led children to discard those tops because they "didn't

work." The teacher came by and asked if she could borrow the top made with the dowel. The children did not pay much attention and barely even acknowledged the request. She asked if she could change something. The children again rather off-handedly said, "Yes, they don't work." When she lowered the disc, the top gained stability and spun well and for a long time. The children were surprised. She did not say anything more. By the sort of invisible and instant communication that occurs in these situations, children throughout the room began rescuing their discarded tops and lowering them.

Conclusion

The way to understand children's constructions relative to "problems" is to carefully observe children's thinking and reasoning and to make judgments about appropriate responses. One of the encouraging things we have learned is that there is a lot of latitude in this process. If the children are free to follow their own learning as it unfolds, they seem to show amazing resistance to inappropriate interventions by others.

If the teacher is honoring the spontaneous unfolding of the child's thought, he will be able to learn appropriate ways to mentor by offering small, subtle feedback and watching what the children do next. When the intervention is inappropriate or the timing is wrong, children tend to ignore it.

The purpose of education is not primarily to help children know more; rather, it is to help children become better able to think, care, imagine, understand, and adapt—to become autonomous learners. Teachers can not and should not try to make children learn and think in particular ways—they can not transmit or deliver understanding. What they can do is create conditions that cultivate and nourish that which is developing in the child.

> As Doll (1993) suggested:
> The teaching role, here, is ancillary not causative. This is not to lessen teaching's role but to change it. Indeed, it is to bring to consciousness what I suspect self-reflecting teachers already know, at least tacitly: that through their interaction they fertilize certain ideas, but the development of these ideas is internal, via the reflective process. (p. 102)

It is not enough to help teachers understand what we have discovered about how children learn. We must also find the new models of teaching that best respond to these new insights and cultivate the capacities in new teachers to provide the conditions that promote the growth of children. Reframing appears to be one of those capacities. ❐

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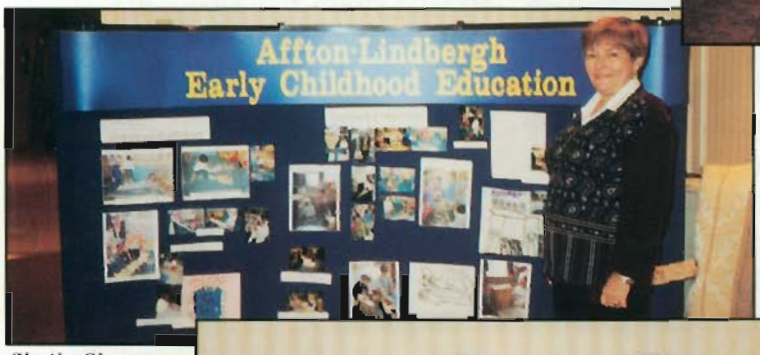
Highlights of the 1996 ACT Conferenc

ACT president Paul Ammon confers with Cathy Fosnot and Barry Wadsworth at the beginning of the conference.

Rheta DeVries talks with a participant following her keynote speech entitled "Piaget's Social Theory."

Lucy Calkins presented a keynote speech entitled "Building a World for Readers and Writers."



Sheila Sherman poses beside her school's exhibit.

Maurita McCarthy, Julie Brogno, and Tracy Jensen staffed the conference registration table.

Terry Anderson, Mary Meihaus, and Terry Bloomberg planned the Friday-night reception at Canyon Cafe.

Linda Kroll prepares for her presentation on the use of history to teach fiction writing.

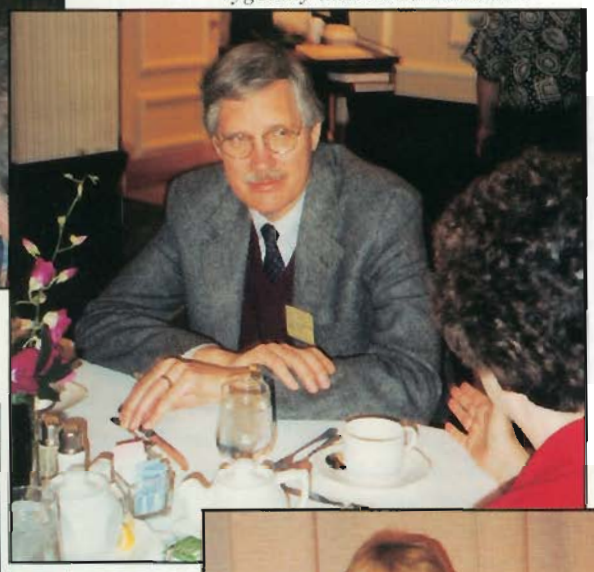
Photos courtesy of Project Construct National Center.

The 1996 ACT Conference was co-sponsored by

- Project Construct National Center
- Webster University
- Missouri Department of Elementary and Secondary Education

Brenda Fyfe, George Forman, and Cathy Fosnot chat with other conferees at the Friday-night reception.

Keynote speaker James V. Wertsch relaxes following his address, "Vygotsky and Constructivism."



Patty Anderson led a discussion on constructivist teaching practices with her colleague Sue Bryde.

Kristen Eagleburger and Wendy Watkins presented a session on math workshop.

Carol Gilles gave the final keynote speech, "Exploring Talk in the Classroom."

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Thanks to everyone who made the 1996 ACT Conference a huge success!

Keynote Speakers

Lucy Calkins, Columbia University Teachers College
Rheta DeVries, University of Northern Iowa (co-sponsored by the Jean Piaget Society)
Carol Gilles, University of Missouri-Columbia
James V. Wertsch, Washington University

Breakout-Session Presenters

Paul Ammon, University of California-Berkeley
Patty Anderson, Southwest Missouri State University
Terry Anderson, Kirkwood (MO) School District
Donna M. Bagley, University of Missouri-St. Louis
Kathleen Sullivan Brown, Educational Researcher
Sue Bryde, Southwest Missouri State University
Louise Boyd Cadwell, The College School
John Davis, Pattonville (MO) School District
Ann Denney, Columbia (MO) School District
Rheta DeVries, University of Northern Iowa
Kristen Eagleburger, Columbia (MO) School District
George Forman, University of Massachusetts-Amherst
Catherine Twomey Fosnot, The City College of New York
Brenda Fyfe, Webster University
Betty Garner, Pattonville (MO) School District
Lori Geismar-Ryan, Clayton (MO) School District
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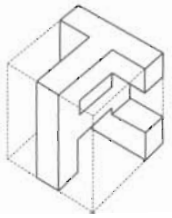

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