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Cultural–Historical Theory and Mathematics

Education

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Mathematics education in the United States is currently undergoing an attempt at reform. In this chapter an alternative in the form of a Vygotskianbased approach to mathematics pedagogy is explored. While embracing

teaching methods similar to those advocated within the reform movement,

the Vygotskian-based curriculum, in its genetic analysis of mathematics concepts, their derivation from measurement, and representation by

schematic modeling, differs substantively from both historical and current

U.S. reform efforts. The teaching and curricular similarities and differences

of reform practices and Vygotskian-based pedagogy reflect their respective grounding in divergent theoretical perspectives – the former in constructivism and the latter in cultural–historical theory. Here the cultural–

historical approach is addressed, and some of the effects of these two pedagogical approaches on the adequacy of mathematical understanding is

explored. It is necessary, however, to begin with a summary consideration

of the antecedents of the current reform effort.

Mathematics education throughout the past century has come under

the dominance of several learning paradigms. First was the early period

of behaviorist pedagogy, succeeded by the formalism of the “new math,”

then the rapid reversion to “basics,” and finally the emergence of constructivism, which continues to maintain its pedagogical hegemony to the

present day. It is curious that throughout these periods of changing pedagogical approaches, all grounded in different philosophies of mathematics

(Schmittau, 1991), a single practice persisted unchallenged. This was the

practice of building children’s understanding of the real number system,

which Davydov (1990) asserts is the dominant subject matter of school

mathematics, on the activity of counting.

The continuance of this practice is partly the result of a certain ambivalence with respect to concept development that has characterized the

history of mathematics education in the United States. Behaviorism, after all, was not concerned with concept development, and the “back to

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basics” movement that reverted to it characteristically focused on procedural rather than conceptual competence. The “vulgar formalism” (Browder

& MacLane, 1979, p. 344; cited in Hanna, 1983, p. 88) of the “new math”

virtually reduced mathematics to a syntactic system, and formalist mathematics, in which the “new math” was grounded, actually generates the

real numbers from the positive integers through an axiomatic system. So

it is obvious why formalism not only failed to question, but actually ratified an approach to number centered on the counting numbers. The final

and present period in mathematics education, unlike previous periods in

which procedural competence or logical deduction was emphasized, is

marked by an awareness of the importance of concepts. When clinical interviewing, a research method of choice by the mid-1980s, revealed that

the direct transmission of mathematical understanding from teacher to

student was not occurring despite clear explanations of mathematical content, the notion that students must “construct their own knowledge” took

center stage in mathematics education. It is perhaps significant that it did

so in the absence of any competing paradigm. The pendulum swing from

the transmission model with its grounding in behaviorism (with some

surviving formalist contaminants) was, to all appearances, extreme. Yet

constructivism, as did its pedagogical predecessors, continues to ground

number in counting. The fact that children typically enter school with some

more or less valid knowledge of counting is doubtless a consequence of

the fact that we live in a world of “stuff,” most of it eminently countable. And since constructivism posits that children must construct their

own concepts, what better basis could there be on which to build future

mathematical understanding than children’s own spontaneous counting

concepts?

Unlike the mathematics teacher, the science teacher realizes that it is

dangerous to assume that children’s spontaneous concepts constitute an

adequate basis on which to develop further understandings. When she asks

these same children why a cork floats in a tub of water and a nail sinks, she

may hear that it is because the nail is long and thin and the cork is more

round. Now disconfirming evidence is called for, and the teacher may place

a wooden matchstick and a steel ball bearing in the water, clearly challenging the children’s na¨ ıve concepts by the fact that the match floats and the

bearing sinks. At this point, however, the children are still very far from

an understanding of density, which is a concept that cannot be grasped

empirically but requires a theoretical mode of thinking for its appropriation (cf. Davydov, 1990). It is one of the concepts Vygotsky calledscientific

to distinguish them from the spontaneous concepts children form through

their interactions within their everyday environment. Scientific concepts

(which are not limited to the field of science) require pedagogical mediation for their appropriation. It is important to mention that only scientific

concepts were considered to be true concepts by Vygotsky (Kozulin, 1990),

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and that virtually all mathematics concepts fit this designation (Schmittau,

1993a).

The difficulty of trying to ground children’s mathematical development

in their spontaneous notions of number emanating from counting, rather

than reorienting them (as the science teacher must) to a more adequate theoretical development of the concept, is illustrated by Davydov (1991). He

cites the fact that since number becomes identified for children with the action of counting, which only generates the positive integers, and formalist

mathematics generates real numbers from these as well, a rational number

(and hence a fraction) is defined as a quotient of two integersa/bsuch that

b= 0. (This allows, for example, for 2/3, and 5/4, while properly excluding 2/0 from the realm of number.) Fractions, of course, did not evolve in

this manner any more than language evolved from the rules of grammar

(cf. Riegel, 1979; Schmittau, 1993b). This is a formalist definition and is

in keeping with the axiomatic integer genesis of real number within that

paradigm. However, since such a designation makes very little sense to

children, educators divide circles into sectors and illustrate fractions from

the ratios formed, thereby providing a visual interpretation of a formal definition. That this visual representation leads to less than an accurate grasp

of the concept of fraction is the subject of meticulous scrutiny by Davydov,

who indicts this approach on a number of counts, not the least of which is

that it separates fractions from their historical origin in measurement.

Historically fractions clearly were not developed as quotients of integers. The axiomatization and formalization of mathematics that occurred

in the 19th and early 20th centuries represented an attempt to reestablish

mathematics on a foundation that was rigorously deductive. Hence, formalism may appropriately be viewed as a cognitive reflection – occurring

very late in mathematics history – on a body of knowledge that actually

developed in a very different way over a period of several thousand years.

The fallacy of the “new math” was the assumption that formalist notions

could be directly learned by students, who could skip the development

of concepts as they had actually occurred, and instead learn mathematics by beginning at the end, so to speak, of the history of mathematical

development. The primary reason for the failure of the “new math” was

that ordinary students could not learn mathematics in this way. Rigorous

deduction and formal logic were not the paths of conceptual genesis.

Further, it is significant that the formalist reestablishment of the category

of real number as an emanation of the positive integers (or counting numbers) has the character of a generative metonymy. In his provocative book

Women, Fire, and Dangerous Things: What Categories Reveal About the Mind,

Lakoff (1987) discusses the manner in which the real numbers constitute

a generative category, that is, one characterized by its generation from a

member or subgroup of members according to rules. Lakoff observes that

the set of single-digit numbers generates all the counting numbers through

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the rules of positionality in our base 10 numeration system. The rational

numbers are then defined as quotients of these, and the irrationals as infinite nonrepeating decimals composed of the digits 0 through 9. Lakoff

further notes that generative categories tend toward metonymy, as the

generative subcategory becomes representative of the category as a whole.

Our research (Schmittau, 1994) indicates that this development of the

real numbers as a generative category is not confined to formalism, but

occurs whenever the counting numbers are taken as primary, that is, when

the concept of number is allowed to develop from the action of counting.

Consequently the entire category of real numbers may be interpreted by

students in terms of the counting numbers, and the smaller the representatives, the better. There are, moreover, other far-reaching consequences of

the acceptance of the counting numbers as a basis for the development of

the concept of number. Since fractions and irrational numbers cannot be

generated through counting, not only do many students – and even adults –

fail to see fractions and irrationals as numbers (Skemp, 1987; Schmittau,

1994), but they may inadequately conceptualize the so-called fundamental operations (i.e., addition, subtraction, multiplication, and division) on

these numbers as well. By way of illustration, we shall focus on one of

these, the operation (or more properly theaction) of multiplication.

Conventional pedagogical practice in the United States (by which we

shall mean common textbook approaches that in practice become the

basis for curriculum) define multiplication as repeated addition. Hence,

5×4 means 5+5+5+5. This is, of course, an extension of the generative metonymic, since one can repeat an action such as adding 5 to itself

only an integral (but not a fractional or irrational) number of times. Textbooks sometimes present other “models” of multiplication, such as arrays

in which circles, squares, or other symbols appear in equal groups. It is

generally unclear whether these constitute the same notion – that is, one

is just repeatedly adding the same number of objects in each group – or

whether they represent disparate concepts (in which case one might well

wonder why they are both calledmultiplication). Increasingly, rectangular

models are finding their way into textbooks as well and often prove helpful

in providing meaning to the operation, but again absent the requisite conceptual connections, it is unclear whether in and of themselves they will

be sufficient to transform the learning of multiplication from instrumental

(a collection of rules) to relational (an integrated system of knowledge)

(Skemp, 1978).

a vygotskian learning paradigm for number

and multiplication

However, in the curriculum developed and researched by V. V. Davydov

and his colleagues in Russia for more than 40 years and grounded in

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Vygotskian cultural–historical psychology, a very different approach to the

genesis of both number and fundamental actions such as multiplication is

taken. Number is developed out of the action of measurement rather than

counting.

Generation of Number from Measurement

Preparatory activities for the development of measurement in Davydov’s

curriculum reflect the essence of mathematics as the science of quantity and

relation. The first-grade course (Davydov, Gorbov, Mikulina, & Saveleva,

1999) begins with the comparison of two quantities (length, area, volume,

or weight), which differ sufficiently to permit a visual determination of

their equality or inequality without placing them in spatial proximity. In

the case of weights, merely hefting them in the hands is sufficient to determine which is greater. Next children are presented with quantities that

do not differ so significantly and therefore require alignment to effect a

determination as to which is greater. They may be asked to compare the

length of a pencil and a pen, for example, or the area of a textbook and

a notebook, or the volume of liquid in two identically shaped containers. Two weights may be so close that a balance is necessary to make a

determination about which of them is greater. No sooner have students

mastered these requisite alignments than they are confronted with a task

requiring them to compare quantities that cannot be aligned. They might be

asked to compare the height of a bookcase and the length of the teacher’s

desk, the area of the classroom door and that of the overhead projector

screen, or the volume of liquid in two containers having very different

shapes. Now the children must find an intermediary, such as a piece of

rope to compare the lengths, or a third container into which to pour the

original liquids to determine which of them has greater volume.

Once children have become comfortable with these methods, they will

then be confronted with the task of comparing two long line segments

with only an intermediary unit such as a short strip of paper to use for this

purpose. They must now lay off the strip on each of the segments as many

times as required: That is, they mustmeasureeach one. The measure is then

expressed as a ratio of the length of the original segment to the length of the

unit. For example, if the length of the original segment is designatedAand

the length of the strip of paper is designatedU, then A/Uis the required

measure. This measure may be a whole number or a fraction, or even an

irrational number. Measurements resulting in fractions (or irrationals) are

not encountered in the first grade, of course, but occur later in the child’s

education and significantly do not require a reconceptualization of number

when they do occur. In curricula where number develops from the action

of counting, however, successive reconceptualizations of both the concept

of number and the various operations performed on numbers are required

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each time a new type of number is introduced. Thus the genesis of number

from measure gives greater coherence to the category of real number and

spares the student such successive conceptual upheavals, which as Skemp

(1987) attests and our own research (Schmittau, 1994) shows, are rarely

accomplished.

Progressive Task Difficulty

The first-grade curriculum of Davydov not only is grounded in cultural–

historical theory, following the anthropological and historical development

of mathematics and framing significant moments in this development in

ways psychologically accessible to children, but accomplishes this through

a stream of progressively more difficult problems, without demarcation

into chapters or sections. The teaching methods employed greatly resemble those advocated by constructivism, but with very different theoretical

foundations. Vygotsky and Luria (1993) carried out an extensive investigation of the development of primates, traditional peoples, and children and

concluded that cognitive development occurs only when members of these

groups are confronted with a problem for which previous solution methods

are inadequate. Hence, the progressively more difficult problems of comparison of quantity in the first-grade curriculum described above reflect

this view. No sooner do children master one solution method than they are

confronted with a problem for which this method is no longer adequate.

The following classroom episode described by Lee (2002) is illustrative.

The first graders have just learned that ifA>B, they can conclude that

B<Awithout reverting to concrete objects. The teacher cuts a paper plate

into three parts labeledA,B, andC(with areasA>B>C) and places them

into an envelope out of sight of the students. She then presents the task:

If A>B, then B C. All children write B<Cand cite their previous

conclusion fromA>B(viz.,B<A) as the reason. They have drawn a false

conclusion based on syntactic similarity. The teacher points out thatCdoes

not appear in the initial inequality, but the children are unmoved. They see

their error when presented with the plate pieces, but the teacher’s attempts

to elicit a correct conclusion without such concrete aids are unsuccessful.

So the teacher tries another approach.

She asks the children to compare the height of classmates Mike (T) and

Sue (C), elicitingT>C. She then inquires as to how Tcompares with the

height of an unknown first grader, Ellen (E). Mike promptly writesT>E,

explaining that this must be true since he is the tallest first grader! Having

made an obviously ineffective choice of students, the teacher then asks

the children to compare Mike’s height with the height Bof another child,

Bobby, whom they do not know. A flurry of questions about Bobby’s grade,

age, and so on, ensues, to which the teacher responds that she either does

not know or cannot tell. The children finally agree that the correct answer

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is T?B, since they do not know Bobby and cannot conclude anything

about the relationship between the heights of the two boys. And the fact

thatT>Cwas of no importance to their argument.

Clearly Davydov’s curriculum is anything but didactic. At this writing,

we have completed the implementation of the first 3 years of his program

in a school setting in the Northeast (to our knowledge a first in the United

States), and we have found the problem solving–inquiry focus challenging

for both students and teacher. It has typically taken our American children

a year to develop the intense focus and sustained concentration required

consistently and productively to engage with the problems, which appear

to continuously expand their zones of proximal development (Vygotsky,

1934/1986). The problems themselves are very interesting to the children,

but the challenge is unrelenting, and there is never a day when they can

simply “kick back” and do “fun stuff” or drill on “facts.” After Vygotsky,

for whom learning leads development, Davydov’s program, in both curriculum and teaching methodology, has as its intended goal not only a

deep understanding of mathematics but cognitive development itself.

Genetic Analysis of Concepts

In his Types of Generalization in Instruction: Logical and Psychological Problems in the Structuring of School Curricula, Davydov (1990) explains this

orientation toward cognitive development. He cites a study of Krutetskii

in which students unfamiliar with the square of a sum were presented

with the basic example (a+b)

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and taught its meaning. They were then

presented with another square of a sum, (C+D+E)(E+C+D), whose

surface features were very different from those of the original example.

Many students, whom Krutetskii identified as average, had to be given intermediate examples such as (3x−6y)

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and 51

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before they were able to discern the conceptual structure of (C+D+E)(E+C+D) as the square of

a sum (i.e., [(C+D)+E][(C+D)+E], which, ifC+D=K,is(K+E)

2

).

A few students immediately grasped thetheoretical essenceof the first example (a+b)

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and easily discerned it in (C+D+E)(E+C+D), which was

judged to be the most syntactically different example in the series (there

were eight examples in all). Rather than labeling these students “gifted,”

Davydov noted that their mental activity was qualitatively different from

that of the less capable students.

Confronting a specific problem they primarily tried to discover its “essence,” to

distinguish the main lines by abstracting themselves from its particular features –

from its concrete form...striving to delineate the internal connections among its

conditions (this is peculiar to theoretical generalization). (Davydov, 1990, p. 133)

Davydov observed that theoretical generalization is necessary for the

appropriation of Vygotskian scientific concepts and set about the task of

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attempting to develop in ordinary students this ability, which is generally

evidenced by only the most capable. Hence, his curriculum is a rich synergy of content and method designed not only to enable students to grasp

mathematics at a deep conceptual level, but to develop their ability to think

theoretically.

Before such a curriculum can be created, however, there must be an

epistemological analysis of the concepts in question that encompasses

both historical and conceptual analyses. This often entails a lengthy and

arduous process, but a necessary one, since symbolic forms of thought

(typical of mathematics) “absorb” the genesis of a concept, making it

“necessary to trace all of thehistoricallyavailable methods of solving the

same problems in order to see the initial forms behind the abbreviated

curtailed thought processes [represented symbolically], to find the laws

and rules for this curtailment and then to detail the complete structure

of the thought processes being analyzed” (Davydov, 1990, p. 322). This

genetic analysis is reflected in the development of number from measure

in Davydov’s curriculum, since historically it became necessary to admit

the results of measure, such as irrational numbers, into the system of real

numbers (otherwise such common quantities as the diagonal of a unit

square or the circumference of a circle could not be designated numerically). This was not accomplished without upheaval, since the Greeks

had relegated irrationals to the category of “magnitudes” while admitting

only integers as numbers. By developing the real numbers through measurement, this historically Herculean cognitive restructuring by students is

avoided.

The approach to multiplication in Davydov’s curriculum also reflects

the understanding gained from a genetic analysis of the concept. The firstgrade curriculum actually lays the groundwork for multiplication by presenting children with many tasks that require them both to build and to

measure quantities. And they use a schematic form to designate these actions. For example, the designation

U

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----→A

indicates that three units have been used to build or measure quantity A.

The symbolU

||||

----→? indicates that the student mustbuilda quantity using four units. The unit is specified and may be one or more line segments,

squares, or other shapes, which then must be combined to build the quantity. Alternately, the symbol U

?

----→Aindicates that the student must

measurequantityAusing unitU, and thereby determine the value of the ?.

The students do many varieties of such problems. Then they are confronted

in the second grade with a situation in which they must do a measurement

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of a very large quantity with a very small unit, and the process is thus a

deliberately tedious one (Davydov, 1992).

For example, following Davydov (1992), children may be told to pretend that they are working for the local animal shelter and must give each

kitten a very small paper cup of water poured from a large pitcher. They

need to know how many kittens will receive water. The process is tedious,

and there are other larger glasses on the table, but no mention is made of

them. Eventually a child will suggest that we find out how many little

paper cups of water one of the larger glasses will hold and then determine

how many of the larger glasses we can fill from the pitcher. For example, a

glass may hold five of the paper cups, and the pitcher may hold six glasses.

Now the situation must be schematized a bit differently. Since we found it

too tedious to do a straightforward measure of the volume of the pitcher

with the unit paper cup, we cannot represent our measure as we did previously, by designating the number of unitsUin quantity A. Now our

schematic must represent thechange in unit from a smaller unitU(here

the little paper cup) to a larger unitG(the glass) with which we then measured the volume of water. The children therefore indicate this action as

follows:

5 x 6

U A

G

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5 6

Multiplication is now defined as a method for taking an indirect measurement by means of a change in unit (from a smaller to a larger unit)

(Davydov, 1992). This reflects Lebesgue’s (1960; cited in Davydov, 1992)

stress on multiplication as a change in the system of units. One can see

how the need for such a process as multiplication arose historically as the

numerosity of quantities increased with cultural complexity. Here multiplication is not reduced to addition, which is a different action (of composition

rather than of measurement).

It is important to note the use made of mathematical models or schematics, such as the building, measurement, and multiplication models, in

Davydov’s curriculum, which preserve in representational form the mathematical action that constitutes the essence of the concept in question. In

my research in Russia with Davydov and his colleagues, I saw the power

of such models in classrooms where I observed Davydov’s program being

taught and have now observed it even more extensively in our implementation of the program here in the United States. A particularly powerful

(albeit deceptively simple) schematic is the part–whole model from which

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first graders write three equations derived from their actions with quantities before numbers are introduced. This model suggests putting together

or taking apart a set of objects or quantities.

A

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B C

A=B+C

A−B=C

A−C=B

Since this schematic represents the essence of actions of composing and

decomposing quantities, adding and subtracting are not perceived as formally separated operations, but as complementary actions. The whole (A)

must be found from composing the parts (BandC); a part must be the

difference between the whole and the remaining part(s). Children have

no difficulty with missing addend problems as a result. Children in the

United States, however, typically find missing addend problems such as

the following difficult: “John has 14 baseball cards. Eric gave him 6 cards.

How many cards did John have originally?” The sentence representing

this problem appears to indicate addition: ?+6=14. However, it is necessary tosubtract6 from 14 to obtain the solution. No such confusion arises

if the preceding schematic is employed to analyze and represent such a

problem, as 14 is the whole, 6 is one part, and the other part is found by

subtraction.

Now that we have completed the implementation of the first 3 years

(these years constitute the 3 years of Russian elementary school) of

Davydov’s curriculum in a U.S. setting, our research has confirmed the

effects of these models firsthand. The power to analyze situations such

models afford children cannot be overstated. Neither can their ability to

connect the conceptual content of mathematics at very deep and important

levels. The function of a model is, after all, either to render hidden features

visible or to render particular (or essential) features salient. Hence, appropriately constructed models might be expected to give students the ability

to grasp conceptual structure at its most abstract level, thereby enabling

them to ascend from the abstract to the concrete, as Hegel, whose influence

on Vygotsky was considerable, advocated. In addition, these schematics

allow conceptualconnections(the sine qua non of learning) between mathematical actions previously viewed as separate operations. Finally, they

provide students with thetools of analysisrequired for problem solving.

Although with the publication of the National Council of Teachers

of Mathematics (NCTM, 1989, 2000) standards, the U.S. curriculum has

shifted in recent years from procedural and algorithmic dominance to more

work with concrete materials, it lacks the critical intermediate work with

schematic models, the genetic analysis, and the emphasis on conceptual

essencethat are so central to Davydov’s curriculum.

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a cross-cultural study of the conceptual structure

of multiplication

How does the understanding of students who experience a curriculum

designed in such a way as to foster the development of a generative

metonymic structure for the categories of real number and multiplication

differ from that of students instructed in Davydov’s curriculum, which

develops the concepts of number and multiplication very differently?

A comparative study conducted with 40 secondary and university students in the United States and 24 elementary and secondary students in

Russia addressed this question (Schmittau, 1994). The U.S. university students represented a diversity of course majors and varying backgrounds in

mathematics (high school geometry through calculus, statistics, and linear

algebra). The secondary student component consisted almost entirely of

high school students, 90% of these rated “very good” or high-achieving in

mathematics by teachers and mathematics grades. The Russian students

consisted of fourth and fifth graders and a cohort of ninth- and tenthgrade students, all of whom had experienced Davydov’s curriculum during their elementary years, the first 3 years of Russian schooling. After these

3 years, the older students had experienced a variety of mostly traditional

approaches to the teaching of mathematics. The Russian elementary students were rated either good or average by their teachers, and all Russian

secondary students were rated average.

Our investigation of conceptual structure took into account the fact

that commonly held assumptions in psychology predicating the structure

of conceptual categories on genus and differentia have given way in recent years to massive evidence of family resemblance and comparison-toexemplar structures (Lakoff, 1987). Rosch (1973) was the first to establish

evidence of such category organization. She found that when subjects were

asked to rate instances of fruit on a scale of 1 to 7 for degree of membership

in the category, a prototypic instance emerged to which all other instances

were compared. An apple, for example, might receive a rating of 1, designating it as an exemplary member of the category “fruit,” and an olive

might receive a 7, indicating that the subject did not regard it as a good example of a fruit or perhaps did not consider it to be a fruit at all. The rating

for “fig” might fall somewhere between these two instances. Rosch determined that the characteristics of the apple, especially that it was juicy and

sweet, were believed by subjects to be essential to fruit. Hence, they judged

all other instances of the category on this basis, and the apple functioned as

a prototype for the category. Her work has been widely replicated, and evidence of prototypicality has been confirmed even in such highly structured

domains as science and mathematics. Armstrong, Gleitman, and Gleitman

(1983), for example, extended Rosch’s work to the categories of odd and

even numbers and found prototype effects for both.

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Subjects in our study were assigned the task of rating instances of multiplication (on a scale of 1 to 7) for degree of membership in the category. The

instances to be rated included integers, fractions, irrationals, monomial and

binomial products, and a product of length and width yielding rectangular

area. Upon completion of the rating task, subjects were asked the question

“What is multiplication?” This question emanates from the Vygotskian

method of concept definition(Luria, 1981, p. 56), in which subjects are asked,

“What is – ?” with respect to the concept of interest. After this, subjects were

asked with respect to each instance of multiplication appearing on the rating task, “In what sense do you consider this (particular instance of integer,

irrational, or binomial multiplication, for example) to be multiplication?”

A flexible clinical interview format was employed in probing subjects’ responses. This third measure was a variant of the Vygotskiancomparison and

differentiationmethod (Luria, 1981, p. 58), in which the designated instance

and the subject’s own meaning for multiplication are juxtaposed.

Results on the rating task indicated that for the American students

multiplication possessed a prototypic structure. Every U.S. student assigned the positive integer instance 4×3 a rating of 1 but rated other

instances as considerably less representative of multiplication, thereby indicating the exemplariness of the cardinal instance. Triangulation of the

data yielded confirmation from the second measure. In response to the

question “What is multiplication?” all the U.S. subjects stated that it was

repeated addition. Finally, on the third measure, in more than 90% of the

cases in which students gave evidence that an instance of multiplication

had any meaning for them, this meaning was linked to the exemplar or

prototypic instance. For example, after the cardinal instance 4×3, the

monomial productabreceived the most favorable ratings. Twenty-three

of the U.S. students found it meaningful, and all substituted small positive

integers for aandb, thereby establishing linkage to the positive integer

prototype for multiplication. Only one student noted thataandbcould

represent any real numbers, and that the substitution of positive integers

did not resolve whatever conceptual difficulties existed for the multiplication of other types of real numbers (fractions, for example). The results

were similar for the instance of binomial multiplication (2x+y)(x+3y);

only 12 of the U.S. students reported that binomial multiplication had

any meaning for them at all. Of those for whom it did, all illustrated its

meaning by substituting small whole numbers forxandy. The most popular choices among the university students were 1 and 2, which yielded a

product of 4×7 and effected a reduction to the counting number prototype. In effect, these subjects deformed the generalized algebraic product

into their limited understanding of binomial multiplication predicated on

cardinality.

Another disturbing finding was that half of the U.S. university students

and two-thirds of the secondary students indicated that they did not see

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the area of a rectangle as multiplication. These subjects were unable to

draw a grid in a rectangle that would illustrate how its area is a product

of length and width. They could not go beyond the simple substitution

of small whole numbers forbandhin the formula A=bh(area=base×

height), whereby they again effected a reduction to the cardinal number

prototype. Moreover, they accomplished this merely by substitution of

counting numbers into the formula, which they were able to do in order

to produce a value for Awithout perceiving any apparent connection to a

rectangle at all. They also gave evidence of considerable confusion between

area and perimeter.

By way of contrast, the Russian students did not give evidence of prototypicality on the ratings task. The younger students actually rated the

rectangular area instanceA=bhas more exemplary of the category than

4×3, and many commented that this counting number instance was too

easy and, therefore, uninteresting to them. Nor did they characterize the

meaning of multiplication as repeated addition; rather the essential change

in the system of units was reflected in their conceptualization of area.

None of the Russian students confused area with perimeter, and even

the youngest students were very explicit about the conceptual transitions

necessary to establish rectangular area as multiplication. All were explicit

about the change of unit, from a small square to a row of such squares,

which then must be repeated to form the rectangle. This is the essence of

rectangular area, and it emanates directly from the conceptual essence of

multiplication. None of the U.S. students had this understanding. The protocols of virtually all of the Russian students, however, even the youngest,

consistently identified first the change in quantity from the baseb(or height

h) of the rectangle to the area of a rectangular strip having dimensions

b×1 (orh×1). They also explicitly noted the change in unit from a single unit square within the rectangle to a rectangular strip of such squares

(Fig. 11.1).

Similarly,every Russian student, including beginning fourth graders

who had never been introduced to binomial multiplication, was able to

obtain the product of two binomials and explain in what sense it represented multiplication. Unlike the U.S. students, they did not reduce either

the monomial or the binomial factors to small whole numbers in order

to understand the action to be performed as multiplication. Instead, they

expressed this understanding at a higher level of generalization, that of

algebraic abstraction. Only later, when requested to do so, did they substitute specific numbers to obtain a product. This typifies the ascent from

the abstract to the concrete advocated by Hegel. Unlike the U.S. university

students who substituted the smallest whole numbers they could think of

forxandy, the Russian children, when asked to illustrate their abstract understandings with a concrete solution, chose numbers such as 64, 206, and

103.9 as factors. These children evidenced a confidence not found in the

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6

3

figure11.1a Model of area by a Russian student illustrating change in unit from a

single square to a rectangular strip of such squares.

b

1

h

figure11.1b Model of area by a Russian student illustrating transition from linear

dimensionbto a rectangular strip of dimensionsb×1.

American subjects, whose age and subject matter background advantages

might have been expected to result in the generalized understandings actually shown by the Russian children who were uninstructed in binomial

multiplication. Some of the Russian students explained binomial products by drawing a rectangular model with dimensions 2x+yandx+3y,

then showing a strip of dimensions 2x+yby 1 repeatingx+3ytimes.

(Fig. 11.2).

The U.S. students who converted fractions to decimals reported that

they mentally removed the decimal points (thereby effecting a reduction

to the positive integer prototype), multiplied the resulting integers, and

then invoked the “rule” to reposition the decimal point in the product.

None knew how or why the “rule” worked. A fifth-grade Russian student

made a similar transition from fractions to decimals, writing:

2

3

=

20

30

=.6 and

4

5

=

40

50

=.8 Then 0.6×0.8=.48

In contrast to his U.S. counterparts, this child, when questioned about how

he saw this as multiplication, explained without hesitation, “.08 repeats

6 times.”

The product of irrationals (and

√

2) had meaning for only one secondary and two U.S. university students, who explained it correctly by successive approximation of two nonrepeating decimals. For many students,

however, the multiplicative difficulties were compounded by the added

failure to understand the irrational numbers themselves. Some regarded

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(2

.

x +y)

.

(x +3

.

y) = (2

.

4 + 2)

.

(4 +3

.

2)

8

10

100

6

10

figure11.2a Model of binomial multiplication by a Russian fourth-grade student.

2x

x 3y

2x

2

6xy 2x

x 3y

y 3y

2

xy y

figure11.2b Model of binomial multiplication by a Russian student showing repetition of a rectangular strip of dimensions 2x+yby 1.

A = √2 . π

π

√2

1

1

figure 11.3 Russian ninth-grade student’s model of

√

2·as the area of a

rectangle.

and

√

2 as “mere symbols” to be consigned to a calculator for solution;

others insisted that 2 does not have a square root. The older Russian students used successive decimal approximation as well as area models for

this problem. One sketched

√

2·as the area of a circle having radius

4√

2; another marked off

√

2 as the diagonal of a unit square, then drew a

rectangle using this as one side andas the other. The area she identified

as

√

2·(Fig. 11.3). Those who used successive approximation were challenged to explain how 1.4 (an approximation for

√

2) could repeat 3.14 (an

approximation for) times. Their immediate explanation was that first

314 was multiplied by 14 (or repeated 14 times), and then the required

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divisions by 10 and 100 were performed, resulting in the relocation of

the decimal point. The Russian students never mentioned “rules”; they

spoke of “actions” instead, and the meaning of such actions was consistent

throughout a variety of algorithmic reformulations (cf. Schmittau, 1993b,

for a more extensive discussion of grounding mathematical meaning in

action).

Davydov’s curriculum maintains students’ mathematical actions at

Leontiev’s (1983) level of goal-directed action, whereas the “rules” U.S. students referred to occur at the operational level where actions have become

routinized. The algorithm for multiplication of decimals is one example.

Fortunately, constructivist influences are focusing more attention on goaldirected action in U.S. classrooms, but difficulty in linking conceptualization to the algorithm often occurs, with computation consigned to a calculator. Dependency on a calculator for the simplest computations has fueled

the current “back to basics” movement in the United States. Ironically,

while constructivism rails appropriately against mindless drill on algorithms, it promotes calculator usage, which is the ultimate mechanization

of human action, “transmitting to the machine those elements that begin to

be formalized in human activity itself” (Tikhomirov, 1981, p. 275). From a

Vygotskian perspective, the algorithm is an important cultural–historical

product, and great pains are taken in Davydov’s curriculum to trace its

historical and conceptual links to fundamental mathematical actions, of

which the algorithm is a symbolic trace. As a result, our children who

have completed 3 years of Davydov’s curriculum here in the northeastern United States not only have a deep conceptual understanding of the

mathematics involved, but are accurately multiplying three-digit numbers

and dividing three-digit numbers into six- and seven-digit numbers. The

conceptual versus procedural debate in the United States reflects a false

dichotomy; an algorithm is asymbolic trace of the meaningful mathematical

actionsrequired to solve a problem. We move to manipulation of the symbols (such as numerals) when cultural factors bring about an increase in

complexity whereby action on objects becomes tedious and consequently

prone to error.

The dysfunctional manner in which American students reduced conceptually complex structures to cardinal instances reflected the fact that this

category was for them structured around the counting number prototype.

We originally anticipated that this category, developed pedagogically in

the form of a generative metonymy, might have a formalistic structure, but

we found no evidence that any student had succeeded in apprehending it

as a generative metonymy with formalist connections among the instances.

(None, for example, defined a fraction as a quotient of two integersa/b,

such thatb= 0.) Perhaps this, together with the difficulties encountered

by students during the “new math” era, reflects the human need to traverse individually a cognitive path similar to that taken by the culture as

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a whole in the original development of these concepts (Vygotsky & Luria,

1993). Clearly, the cultural-historical development followed by Davydov’s

curriculum resulted in far greater conceptual coherence for the category of

multiplication for real numbers.

multiplication as a vygotskian scientific concept

There is, however, one final and extremely important consideration.

Davydov (1990) extended Vygotsky’s research into spontaneous and scientific concepts, finding a primary distinction in their manner of formation.

The process of empirical abstraction, of identifying similarities and differences at the level of appearances, is sufficient only for the formation

of spontaneous concepts. What can be empirically abstracted concerning a phenomenon such as the diurnal cycle, for example, is the “fact”

of the Sun’s revolution about the Earth. The rotation of the Earth on its

axis, the real cause of the Sun’s “rising” in the east and “setting” in the

west, cannot be apprehended at the phenomenological level (Lektorsky,

1984; Kozulin, 1990), but requires the development of a theoretical mode

of thought (Davydov, 1990). This is the case for mathematical concepts as

well, but Davydov observes that because pedagogy has for the most part

advanced no further than the level of Lockean empiricism, such empirical

methods as comparison and contrast are reinforced throughout schooling.

What our combination of Rosch’s and Vygotsky’s research methods detected in the U.S. subjects were the results of attempts at formation of a

scientific concept through the cognitively dysfunctional means of empirical abstraction. Prototypic organization, a common occurrence in generative metonymic categories (Lakoff, 1987), develops empirically on the basis

of representativeness of features and is extended through a comparisonto-exemplar process. We may consider the construction of the category

“fruit” investigated by Rosch (1973). One who has appropriated the scientific concept as “that which contains the seeds” has apprehended a theoretical essence that is not apparent among a variety of surface features.

Such an individual might be expected to approach pertinent new botanical

knowledge in a fundamentally different way than those to whom a fruit is

quintessentially an apple.

In the case of mathematics the consequences of empirical abstraction

are more devastating, however. Once a premature cognitive commitment

(Langer, 1989) has been made to a cardinal structure, one cannot determine empirically by a process of comparison of their differential features

what multiplication might mean for various types of numbers, such as

fractions, irrationals, and their algebraic formulations (Schmittau, 1993b).

The result is not a true scientific concept but a pseudoconceptual generalization, the Vygotskian designation for many of the so-called alternate

conceptualizations or misconceptions found in the data of U.S. subjects,

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but conspicuously absent in the protocols of the Russian students. We saw

no evidence, for example, of such common misconceptions as “multiplication makes bigger,” the apparent result of conceptualizing multiplication

within the framework of cardinality. Because the Russian children apprehended the theoretical essence of multiplication, the concept retained its

constancy of meaning across contexts and, hence, could confidently be

extended into new ones.

The pedagogical experiences of the Russian students, however, were

the result of an extensive historical, conceptual, and psychological analysis on the part of Davydov and his colleagues. The generation of the real

numbers through actions of measuring (rather than their derivative formation as “quotients,” for example, of numbers that arise through actions of

counting) avoids the scholastic repetition of the historical development of

the concept of real number, in which 2,000 years were required to unite the

products of counting and the products of measuring into one conceptual

system. It is here that considerations of Davydov’s work and its theoretical basis have the potential to open up new perspectives in our own reform process. In addition to providing a prototype of pedagogy informed

by Vygotskian psychology, they have much to contribute to considerations of epistemological and psychological foundations for curriculum and

instruction.

the extension of multiplication to exponentiation:

another generative metonymy

It is significant that the generative metonomy is not confined to multiplication in American mathematics pedagogy. When multiplication is extended to exponentiation, for example, the basis of this extension is again

the counting numbers. Typically the textbook and classroom treatment of

this subject begins with the definition of an exponent as repeated multiplication. That is,x

3

is defined as x·x·x, or the repeated multiplication ofx

by itself. Consequently 5

4=5×5×5×5, which is analogous to the definition of multiplication as repeated addition. Hence, as multiplication was

defined as a simple extension of addition, rather than a separate mathematical action or operation, we now have exponentiation as a simple extension

of multiplication, and another category that is developed as a generative

metonymy. However, just as with multiplication, students must encounter

and be able to understand exponents that are fractional or irrational, and

the generative metonymic approach is not sufficient to account for these

since it is predicated on counting numbers.

We researched the understanding of university students with respect

to this category and found so little understanding of this concept among

students who were not mathematics majors that often they told us that

an exponent was a little number in the upper-right-hand corner next to

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another number or letter, but they did not know what this little number

meant. We presented a “fantasy” problem of plant growth, which was not

designed to mimic botanical reality, but to explore the concept of exponentiation from a cultural–historical perspective rather than as the generative

metonymic category it has become. The plant is first noticed (on day 1) and

found to be 3 cm in height. It is measured at the same time on successive

days and found to have heights of 9, 27, and 81 cm, respectively. Students

are asked to assume this pattern is representative and to give the heights on

several days previous to the first day on which the plant was observed. This

yields heights of 1, 1/3, 1/9, and so on, and generates the nonpositive integer exponents for powers of 3 (3

0

,3

−1

,3

−2

, etc.). Then students are asked

the plant’s height 12 hours before it was first measured. Even students who

have nearly completed master’s degrees in mathematics find this surprisingly difficult. They want to say that the height is 3

1/2

, which they “know”

(i.e., have been told and accepted) is

√

3, but find this difficult to establish.

This problem follows the cultural–historical development of exponents

and logarithms, which involved mathematicians in the juxtaposition of

arithmetic and geometric sequences similar to those that constitute the domain and range of the plant growth function. In solving the problem, which

approaches the development of exponents through the analysis of an exponentialfunction, a student is constantly working back and forth across these

two sequences, the arithmetic representing time and the geometric, growth.

Such a development is consistent with cultural–historical theory, provides

greater conceptual coherence for the category, and prevents its development as a generative metonymy emanating from the positive integers.

conclusion

I have noted several differences between constructivism and cultural–

historical theory, especially as these pertain to mathematics pedagogy.

There is another important difference. From a Vygotskian perspective, the

scientific concept has been constructed historically by the culture, a product

of “universal generic thought” (Davydov, 1990, p. 311). In order to allow its

appropriation by the individual, such a concept must be subjected to genetic and psychological analyses and pedagogically mediated. A student

has very little chance of “constructing” the scientific concept of multiplication independently. Further, “within the theoretical learning approach,

‘the child as an independent learner is considered to be a result, rather than

a premise of the learning process’” (Kozulin, 1995, p. 121; cited in Karpov

& Haywood, 1998, p. 33). This explains the underlying difference beneath

the surface similarities in classroom teaching from a constructivist and a

cultural–historical perspective. Because the problem solving done within

the curricular structure in Davydov’s program is designed to develop the

cognitive abilities of theoretical generalization, the approach to the subject

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matter is fundamentally different, although in both cases the teacher may

function as a facilitator and the instruction is in neither case didactic.

It is scarcely possible to close this discussion without commenting

on currently popular attempts within mathematics education to frame

Vygotsky as a “social constructivist.” In light of all that has been said

here, it would appear that such attempts not only are ill conceived, but,

in fact, miss the mark by a wide margin. At the very least, they obscure the deep theoretical and pedagogical differences between constructivism and cultural–historical theory that are reflected both in the construction of curricula and in the actual processes of teaching and learning

mathematics.

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12

Sociocultural Theory and the Practice of Teaching

Historical Concepts

Jacques Haenen, Hubert Schrijnemakers,

and Job Stufkens

Learning awakens a variety of internal developmental processes that are able

to operate only when the child is interacting with people in his environment

and in cooperation with peers.

(Vygotsky, 1978, p. 90)

In our teacher education courses, we discuss with the trainee teachers

educationally relevant topics from the field of learning theory. One of these

topics is the acquisition of historical concepts. Through practical experiences and classroom assignments, the trainee teachers become aware of

some of the problems involved in the teaching of concepts. Often, they plan

to teach concepts in a straightforward matter-of-fact manner using a transmission model of teaching. As teacher educators, we challenge this idea

in order to replace this approach with more effective models. So, with our

trainee teachers we discuss how secondary education students can achieve

a deeper understanding of concepts. Two basic elements of helping trainee

teachers teach for understanding are (1) methods to create powerful learning environments and (2) methods to present the historical subject matter

in terms of a meaningful whole.

This approach is influenced by a Vygotskian sociocultural theory of

teaching and learning. In this perspective the creation of a learning environment can be conceived of as a shared problem space, inviting the students

to participate in a process of negotiation and co-construction of knowledge. Lev Vygotsky, the founder of the sociocultural theory, developed a

new framework for conceptualizing these educational dialogues, through

which students acquire new modes of handling knowledge and solving

problems. Piotr Galperin (1982) extended this framework in the light of its

educational implications. Galperin placed the students’ conceptual change

at the heart of education and emphasized the contribution to the teaching–

learning process of both the teacher and the students’ peers. In this chapter,

the focus is on the school-based implementation of a Vygotsky–Galperian

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learning–teaching context and the way trainee teachers learn to operate

effectively in such a context for teaching history. First, we provide a theoretical overview, including background on conceptual change, relevant

Vygotskian terms, and the contribution of Galperin’s mental action theory

in elaborating Vygotsky. Then, we illustrate how we have used this framework to teach historical concepts, both in our classroom research and in

our teacher education courses at Utrecht University.

conceptual change

Teaching historical concepts is often associated with fostering conceptual

change. Conceptual change within the context of education can be achieved

to the extent that the induced learning experiences correspond with the

level of the students’ prior knowledge. Conceptual change implies the

presence of prior knowledge in the students’ minds. This point seems obvious, but it is often overlooked. This is not surprising. As teacher educators

and history teachers, we know from our own classroom experiences how

difficult it is to pinpoint the level of the students’ prior knowledge and use

it as a foundation for further learning.

The relevance of prior knowledge as the basis for all education has

been clearly put forward by Ausubel (1968, p. IV), who simply stated that

“the most important single factor influencing learning is what the learner

already knows. Ascertain this and teach him accordingly.” This assumption

has not been challenged and still forms the basis of current research (cf.

Alexander, 1996), although its formulation has changed slightly over the

years. InHow People Learn,Bransford and associates (2000) summarize:

“There is a good deal of evidence that learning is enhanced when teachers

pay attention to the knowledge and beliefs that learners bring to a learning

task” (p. 11).

However, what are still a matter of discussion are how prior knowledge

should be made educationally profitable and how this knowledge base

should be accessed, especially when it concerns the teaching and learning of concepts. Students enter secondary education with a huge number

of concepts representing a complicated and genuine ability to think and

reason, which mirrors students’ daily experiences. These practice-based

concepts are often simple word meanings at a very basic level of generalization. For example, to Grade 7 students the concepthistoryis still not

very specified. In general, they consider history as “all that happened in

the past.” In the course of secondary education this phrasing needs to be

enriched into a more sophisticated conceptualization of history as “the past

as far as we know it from the sources we have,” or even more specified

as “an interpretation of the past based on sources used by the author informing us about it.” And if we also ask these students to describe what

it is like to live in a democracy, they tend to call a nation a democracy if

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it holds elections. They understand the notion that elections lead to the

supremacy of the majority opinion (the winner takes all), because they often take votes about issues and proposals in their own classrooms. This

practical experience-based notion needs to be enriched in history classes

with a basic democratic idea such as “The majority takes care of the interests of the minorities, who never stand a chance to win elections.”

In secondary education, the level of practice-based thinking, associated

with such concepts as history and democracy, should be raised to a higher

conceptual level. As outlined in the next section, we achieve this change

by imposing on students a series of assignments that invite them to work

with these concepts. This approach in turn gives rise to the appearance of

new concepts, which have to be incorporated into the students’ thinking.

This process of concept formation usually requires the reconceptualization

of students’ existing body of prior knowledge. As we will see further on,

this reconceptualization of word meanings and concepts and its role in

teaching are a major point in Vygotsky’s sociocultural theory. However,

research indicates it is not an easy process.

Research in science education has shown that students’ prior knowledge is highly resistant to change. Research on conceptual change has become prominent in the field of science domains, especially as it is currently

being studied from the constructivist view of learning. In science education, particular emphasis has been put on introducing cognitive conflicts

and anomalies as an instructional approach to fostering conceptual change

(Lim´ on, 2001). However, the use of conflicting information does not always

lead to the desired results. Vosniadou (1999) has reviewed its effectiveness.

According to her, students often fail to spot the inconsistencies or simply

start combining them superficially. These students do not really understand the meaning of such inconsistencies. Being confronted with conflicting issues does not change the semantic level of their concepts. They tend

to merge the diverse information into a loose and unstructured whole. In

fact, this constitutes what could be called, with Vygotsky (1987, p. 135), a

“syncretic image,” whose principal property is that it draws together the

complex relationships between the inconsistencies. A Grade 11 student’s

synthetic conception of heat and temperature can serve as an example of

such a syncretic image in secondary education. Harrison and colleagues

(1999) found that students consistently fail to distinguish between these

two basic physics concepts, viewing them as equivalent entities. During instruction, the syncretic image of both concepts may not necessarily change

in the desired manner. However, Harrison and coworkers (1999) showed

the variety of learning activities that may adequately restructure the students’ conceptions. One of the implications of their study is that in secondary education much more time needs to be spent on such basic physics

concepts; otherwise, the students’ intuitive conceptions may remain intact. In our own research, we drew the same conclusion, as basic historical

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concepts are at stake. Although reasoning in the humanities differs from

reasoning in the sciences, we see comparable results when teaching historical concepts at school. The content of these concepts is frequently of a

rather schematic nature, and, without special arrangements, this condition

will remain the same even after deliberate teaching.

Of particular interest to history teaching is Mason’s (2001) qualitative

study on the role of anomalous data in relation to topics such as the construction of the Giza pyramids in Egypt. She asked eighth graders (aged

about 14) to consider anomalous information conflicting with the dominant theory, which indicates that the Egyptians built the Giza pyramids

as the burial places of pharaohs in about 2700–2500b.c.A recently proposed alternative theory suggests an alignment between the pyramids and

Orion’s belt, leading to the conclusion that the pyramids might have been

built by a much earlier civilization than the Egyptian and not at all meant

to be tombs. In her instructional strategy, Mason introduced the conflicting

information along with the alternative theory and its supporting data. This

is more than is being done in traditional conceptual change research, which

has usually merely introduced anomalous data in order to promote a new

understanding of students’ own conceptions. The instructional context

established by Mason appeared to be more effective in regard to conceptual change, because her secondary school students were given an alternative theory explaining why the anomalous data contradicted the leading

theory.

Although Mason (2001, pp. 473, 477) mentions this finding only in passing, it is important, because it is in accordance with the sociocultural view

on teaching and learning. By the teacher’s introducing opposite and contrasting information at the start and discussing its relevance in relation

to the dominant theory, students will be stimulated to become aware of

an alternative way of thinking. This approach, however, demands skillful teaching and discussion techniques of teachers, because they have to

deal with students’ emerging questions and answers. The teacher’s role

becomes more explicit in guiding the students’ thinking processes. This

prominent role for the teacher is in accordance with the sociocultural view

on teaching and learning. It could be said that this view integrates a studentcentered approach with a form of deliberate teaching, at least as it has been

proposed by the Russian psychologist Piotr Galperin (1902–1988).

developmental teaching

According to Galperin (1982), learning will be more effective if, from the

very beginning of the teaching–learning process, the students are aware of

the different aspects of the learning task. On the basis of this awareness,

students develop their independent learning processes through their own

activities. This development results from the teacher’s guidance, because

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he or she is instrumental in presenting the learning task and the knowledge and skills to be learned. First, for these to be learned, they are called

to the students’ attention and outlined within their horizon of problems

to be solved. Students receive an advance organizer of the action and its

goal. This provides the initial requirements to stimulate motivation and to

maintain it during the subsequent teaching–learning process. According

to Galperin, this method requires that the learning content be presented

as a meaningful whole right from the start of the teaching–learning process

(see later how this should be done in practice). This sense of the whole will

enhance the students’ personal involvement in the learning process that

follows. Presenting knowledge as a meaningful whole implies presenting

it as some kind of “tomorrow’s knowledge.” First, students have to understand and accept the affective, motivational, and cognitive value of the

to-be-acquired knowledge before the focus shifts to the actual appropriation and ability to use it. As we will see, this can be considered as one of

the practical consequences of Vygotsky’s concept of “developmental teaching” and its maxim that education “is only useful when it moves ahead

of development” (Vygotsky, 1987, p. 212). Galperin has lent momentum

to Vygotsky’s adage by outlining what the first steps in instruction have

to be like. He proposed concrete student activities revealing the relevant

and substantial aspects of the learning task and providing the means for a

systematic orientation toward it (cf. Arievitch & Stetsenko, 2000). By doing

so, Galperin helps the students to retrieve and elaborate new information and experience the boundaries of currently held – and perhaps to be

changed – concepts. In our research over the past several years, we have

examined students’ own learning activities instrumental to these processes

of conceptual change.

two types of concepts

In order to get hold of such activities, we point to Vygotsky, who elaborated on the principal psychological differences between the students’

personal concepts (“everyday concepts”) and the concepts to be learned at

school. Vygotsky (1994, p. 359) calls the latter “academic concepts,” because

they are formed during the students’ learning of academic knowledge at

school. In principle, these academic concepts are part of a systematic, scientific domain of knowledge. In the context of school learning, academic

concepts are calledscientific, not because their contents are scientific, but

because they are systematically learned. The historical notion of democracy described earlier would be an example of an academic or scientific

concept.

According to Vygotsky, the development processes of everyday concepts and academic concepts are different. Everyday concepts originate

in the child’s own life experiences, whereas academic concepts develop

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during the teaching–learning process. However, the two types are united

“into a single system of concepts formed during the course of the child’s

mental development” (Vygotsky, 1994, p. 365). The formation of academic

concepts influences the already existing concepts and triggers a change

in their structure. With this interpretation of the two types of concepts,

Vygotsky (1978) took issue with the traditionally held view (at that time

proposed by Jean Piaget in 1924) that there is an antagonistic relationship between teaching–learning and development (Stetsenko & Arievitch,

2002). Vygotsky, on the contrary, considered the processes of teaching–

learning as intertwined with learning’s leading development.

For Vygotsky, the child’s development is structured through, embedded

in, and mediated in and by relationships with peers and adults. Psychological functions and the means mediating development are viewed as

emerging from the child’s social interaction with adults, peers, and objects. Before these functions become an integral part of the personality,

they manifest themselves in the “outer” world as interaction between the

child and the people around him or her. They emerge in the social context

and are gradually absorbed and transformed “inwardly.” Vygotsky views

social interaction as analytically prior to individual functioning, or, as he

puts it, “It is through others that we develop into ourselves” (Vygotsky,

1981, p. 161).

zone of proximal development

Vygotsky (p. 163) formulated the idea of the zone of proximal development in his often cited “general genetic law of cultural development,” stating that a psychological function appears twice: first on the social plane,

and then on the psychological plane. As a consequence, to put it in current

terminology, psychological functions are basically “socially distributed.”

Traditionally, these functions (attention, memory, cognition) were treated

as being properties of the individual mind. This conception of “individuality” has lain the foundation for much educational practice. In our times –

and Vygotsky was instrumental in this – this conception has been totally

changed. In recent educational psychology, psychological functions are

conceived as encapsulated and distributed in a community of learners.

This turning away from a predominantly individualized to a contextualized and social approach to education has entered the mainstream of educational psychology (cf. Davydov, 1995; Forman, Minick, & Stone, 1993;

Kozulin, 1998; Mercer, 1995; Rogoff, 1998; Salomon & Perkins, 1998; Wells,

1999; Wertsch, 1998).

In order to elaborate the social dimension of psychological functioning

concretely, Vygotsky developed his well-known notion of a zone of proximal development (ZPD). He placed the interaction with adults and more

competent peers at the very heart of this zone, providing “the foundation

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upon which, in an ideal world, the education of children would be organized” (Cole, 1996, p. 111). Therefore, the formative role of education is significant in Vygotsky’s ZPD. It is in this very zone that teachers can lay their

hands on the actual learning processes going on in the students’ minds, in

Vygotsky’s words: “Learning awakens a variety of internal developmental

processes that are able to operate only when the child is interacting with

people in his environment and in cooperation with peers” (Vygotsky, 1978,

p. 90).

Vygotsky did not follow up his “new look” on learning in relation to its

educational implications, but continued to use cross-sectional and crosscultural comparative methods to diagnose mental development. It is at this

point that Piotr Galperin (1969, 1982, 1989, 1992) added to Vygotsky’s new

approach by exploring a new educational program within a Vygotskian

framework. He tried to fill a gap and outlined some steps in the teaching–

learning processes that take place in “Vygotsky’s zone.” For this purpose,

Galperin developed his model of the formation of mental actions (Haenen,

1996, 2001).

In the early 1950s, Galperin with some coworkers (among them V. V.

Davydov and N. F. Talyzina) began to study the mental actions and concepts (elementary arithmetical and geometrical concepts) that have to

be learned in the classroom. They studied the qualitative changes the

teaching–learning process has to go through in order to achieve the status

of mature mental actions. On the basis of both empirical and theoretical

knowledge, Galperin distinguishes the steps an action passes through before becoming a fully fledged mental action. Depending on the action to

be learned, the specific learning task, and the learners’ prior knowledge,

the steps can be shortened, combined, or even skipped. Also, the sequence

of the steps can be altered. So Galperin’s stepwise approach is a working model or blueprint outlining the teaching–learning process and the

instructional interventions of the teacher in supporting and guiding the

learners.

the formation of mental actions

Galperin capitalizes on insightful learning integrated into activity. He sees

the appropriation of knowledge and skills from the point of view of the students’ actions. The teaching–learning process aims at the qualitative and

gradual improvement of the students’ repertoire of actions. Within the

framework of activity theory, actions are conceived as conscious attempts

to change objects according to some intended result (Galperin, 1992). Action has to be very broadly conceived. It refers to the sawing of a branch,

the decoration of a room, the doing of a sum, the using of a concept, and so

on. The examples show that an action can be simultaneously executed on

several levels of abstraction. So Galperin classifies each concrete form of an

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action into four basic levels of abstraction: the materialized, the perceptual,

the verbal, and the mental levels. At thematerializedlevel, the action is performed with the aid of physical objects or their material representations –

models, pictures, diagrams, displays. At theperceptuallevel, the action is

based on the information stored in images and performed without the actual hands-on manipulation of the physical objects or their representations

(e.g., refurbishing one’s own room by looking around and “moving” the

furniture mentally). At theverballevel, the action is performed “speaking

aloud”; at this level the external objects are no longer needed. At themental level, the action is exclusively performed internally (“in the mind”),

and both external objects and audible speech are no longer necessary (cf.

Haenen, 2001).

According to Galperin, these fundamental levels of abstraction are of

identical importance and each should have its place in a teaching–learning

process, especially when new learning actions have to be appropriated.

When the actions pass through all these levels, there is, according to

Galperin, a reasonable guarantee that a fully fledged mental action will

be formed. The reason for this is twofold and can be subsumed under

the labels of generalizationandabbreviation. First, passing through all the

levels requires that several different representations of the materials involved have to be used in order to draw the students’ attention to both the

essential and the inessential properties of the objects of an action. This contributes to the generalizationof an action representing the degree to which

those properties of the object of an action that are constant and essential

to its performance are isolated and distinguished from the inessential and

variable ones. This ensures that the students become fully familiar with

the distinctive features of the learning task. Second, as an action develops

through the four basic levels, the number of operations originally part of

an action is reduced and the action becomes abbreviated. Initially, at the

materialized level, an action is executed in its most extended form. Then,

some of its operations are joined or telescoped, as it were. Thus, theabbreviationof an action contributes to the mastery of an action and the ease and

speed with which an action will be carried out.

To summarize, Galperin developed an idea about how to form mental

actions based on four levels of abstraction. Apart from theorizing, he conducted research into how to implement his approach in real classroom contexts (Arievitch & Stetsenko, 2000; Arievitch & van der Veer, 1995; Fari˜ nas

Le´on, 2001; Haenen, 1996, 2001; Karpov & Haywood, 1998). Galperin and

his coworkers designed experimental curricula for such educational subjects as handwriting, elementary arithmetic, elementary grammar of the

Russian language, and geometrical concepts. In addition, Galperin’s approach has provided the learning–psychological basis for our curriculum project on historical concepts. Our study is a part of wider research

into factors playing a role in knowledge restructuring in history learning

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(Haenen & Schrijnemakers, 2000; Schrijnemakers, 2001; Van Drie & Van

Boxtel, 2003).

the practical implications of galperin’s approach

Discussing with our trainee teachers the implications of Galperin’s innovative approach for their own lessons, we formulated three practical solutions

for the teaching of historical concepts:

Orientation to the task

Use of models

Educational dialogue

These practical solutions integrate the four levels of abstraction. They

allow students to become familiar with a historical concept by elaborating

its content at the materialized and perceptual level (through the use of

models) and at the verbal level (through the educational dialogue). But,

before working with the concept at these levels, there is the importance

of orientation to the task. Already at the very beginning of the teaching–

learning process, Galperin provides the students with the means to orient

themselves systematically to the subject to be studied. As a result, the students reach a higher degree of independence from the teacher in the course

of their education. This lays a robust foundation for the second and third

aspects of our approach to the teaching of historical concept, that is, the use

of models and the educational dialogue. We are making extensive use of

models in order to visualize the processes of thinking and reasoning and to

make tangible to the students which products of their thinking efforts are

available in the process of acquiring new concepts. These results should be

compared and discussed in cooperative learning sessions (Cohen, 1994),

because individual learning is supported by educational dialogue, or – as

the original Russian terms used by Galperin may be translated – by communicated and dialogical thinking (Haenen, 1996, 2001; Wertsch, 1991).

Those are the practical approaches to the teaching of historical concepts

we discuss with the trainee teachers participating in our courses. However, we need to supplement these with additional educational literature

to make trainee teachers sensitive to and knowledgeable about the issues

under discussion. In the Netherlands, after receiving a university degree

in the teaching subject, one needs to take a 1-year full-time teacher education course to qualify as a teacher. In this teacher education course, special

attention is paid to the translation of subject matter content for students

at the secondary school level and its different grades. In addition to the

subject matter theory, used as a basis for how to proceed in translating the

subject content, we offer a basic grounding in relevant educational, developmental, and learning psychology. All of these ways of thinking have to

be integrated within the teacher in such a way that together they form a

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suitable knowledge base for daily reference in the classroom (Korthagen

& Kessels, 1999).

Thus, we try to pursue a fitting alternation between the practical and

theoretical components of the course. We avoid being general and theoretical and present the theoretical themes through brief practical assignments

in the trainee teachers’ own classrooms. The results of these assignments

are discussed during group meetings at the university. In reporting their

practical experiences, the trainee teachers are expected to reflect on the relevant theories, such as those found in Woolfolk (2001). Woolfolk (pp. 278–

286) provides a good basis for our trainee teachers from which to start

thinking in terms of a student-centered approach to concept learning. She

gives an introduction to the traditionally held theory on concepts as categories and describes, among others, Bruner’s model (Bruner, Goodnow, &

Austin, 1956). This model is of particular interest, because it emphasizes the

importance of active and inductive learning. Joyce and coworkers (2000)

have given this model a practical elaboration for use in teacher education

courses (cf. Haenen & Schrijnemakers, 2000). In addition, it gives room to

the teachers in their guidance of the process of knowledge restructuring

in the learning of historical concepts. So on the basis of this literature we

enter into discussions with the trainee teachers about the teacher’s role in

student learning, one of the central themes of sociocultural theory. Starting

from the study of concepts as categories, we pursue a line of thinking, giving the trainee teachers guidelines as to how to teach concepts in today’s

classrooms.

concepts as categories

The study of concepts as categories is a very well-developed domain within

learning theory. Concepts are the building blocks of human thought; they

reduce the complexity of the environment and enable us to respond to it

efficiently. The learning of concepts consists essentially of a process of abstraction, because a concept refers to the essential common features of a

class of objects. At first sight it may be a class of rather arbitrary objects

(e.g., castles may look quite different). However, when carefully compared,

they have features in common. Because of these common features of objects, a concept is helpful in identifying regularities in the environment. In

order to expand this notion of a concept into the direction of the teaching

and learning of concepts and to improve the quality of instruction for concept learning, we distinguish five elements in any concept (Bruner et al.,

1956):

1. Anameis given to a category or class of experiences, objects, events,

or processes; think of such names ascitizen, federation, treaty, castle,

andslave.

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2. Examples(positive or negative) refer to the instances in which the concept may or may not be used. Windsor Castle and the Gravensteen

in Ghent are positive examples of a castle, whereas Versailles is not

a castle, but a palace. Nineteenth-century laborers may have had a

hard life, but generally they were not slaves.

3. Attributesare the common and essential features leading us to the decision to subsume examples within the same category. The functions

of castles are to defend and to shelter. Form, construction materials, and the presence of towers, steeples, or belfries are not essential attributes, however determinant they may be to the image of a

particular castle. A slave could be sold or killed, because he was a

possession. Consequently, knowing a concept also means being able

to distinguish essential attributes from nonessential ones.

4. Thevaluerange of attributes: The examples of a concept are not

standardized. Castles were built in many centuries, and they all

look quite different. Nevertheless, we call them all castles. However,

American castle-like buildings constructed in the 20th century can

hardly be called castles, because they lack any defensive functions.

A serf was neither a free man nor a slave. We speak of the acceptable

variation of a given attribute as its value range.

5. Arulespecifies the essential attributes and the connection between

them. For example, a guild is an association of people sharing an interest in a craft, business, or profession. Within the teaching–learning

process, a rule is a provisional working definition or statement that

has to be elaborated further in the course of the students’ gradual

grasping and understanding of the concept elements.

The five elements of a concept mentioned can be further illustrated by

outlining Joyce and associates’ (2000) proposal of how to teach concepts

in the classroom. First, the teacher leads the students through an exercise,

giving them the opportunity to describe a concept in terms of the essential

and nonessential attributes and to list positive and negative examples.

The students consider different concepts and think and talk about their

elements. For this purpose, a form may be used as a students’ exercise

page (see Table 12.1). In this form, particular blanks are designated to fill

in the details about the elements of a concept. We also use this form as

a preparation tool for the trainee teachers’ lessons in which concepts are

discussed and conveyed to the students.

The rule or working definition in the formis provisional. Many questions

can and have to be asked in order to make the usually somewhat abstract

character of a rule more tangible. Here lies the practical relevance of the

use of such a student’s exercise form. The listing of the elements and the

weighting of what has to be considered as positive or negative give rise

to a working definition leading on to new questions. And as the proverb

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table12.1.Sample Form – Analyzing the Elements of the Concept Decolonization

Name of the Concept Decolonization

Examples positive negative

(=matches the rule) (=does not match the rule)

Algerian independence The Dutch Revolt

Mahatma Gandhi’s

political actions

War between India and

Pakistan

Proclamation of the

Republic of Indonesia

Abdication of the shah of

Iran

Features No national sovereignty

Before a colony, dominated

by the motherland

No relation between

motherland and colony

Values In the 20th century Before the 20th century

Rule (=working Decolonization=Territories that were colonies before

definition) becoming independent states in the 20th century

says, A good question is half the answer. In discussing questions such as

“Is the American Revolution an example of decolonization?” the students

experience the boundaries of a concept and have the opportunity to specify

the concept further. In working along these lines the trainee teachers begin

to understand better how the students’ concept formation can be nourished

and how a lesson plan can be made for this purpose.

The next section of this chapter shows the application of conceptual

change based on the sociocultural theory in the context of school learning and teaching. In secondary education, this implies that the teacher

organizes the structure of a lesson in such a way that the students feel

themselves invited to think about and discuss the concepts to be learned.

Instead of conveying to the students the definition of the concept under

study, the teacher prepares a series of assignments inducing the process of

the students’ working with the concept’s content.

starting a lesson on imperialism

As part of our research we videotaped a teacher in Grade 7, working with

12-year-old students, which in the Dutch educational system is the first

grade of secondary education. This teacher deals with the history of the

Roman Empire and starts a particular lesson with the following sentences

introducing the first assignment:

teacher:What are we going to do this lesson? We will have ample opportunity to dwell extensively on the concept of imperialism. That is

an awkward concept. In your study book something has been written

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about this concept. Who can take me to these particular sentences in

your study book and read them aloud?

[The student Lennart raises his hand and gets a turn to read aloud a few

sentences out of the textbook.]

teacher:Thank you, Lennart, that is very good. You found these sentences halfway on the page, but probably you agree with me that these

sentences are not easy to understand directly and do not say much

about such an awkward concept. There is a lot more to say and to

know about it.

Now, I want you to take your notebook and, on your own, start

making a concept map. You know how to construct it: placeimperialism

in the center and around it write words that, according to you, are

connected with it. You may find it helpful to use your textbook, but

you may also try to think of what you yourself already know about

it. So, in your opinion, what is relevant to the concept of imperialism?

What is it all about? Start to work on this assignment by yourselves,

not together yet.

[The students silently start working on the concept map. After a short time the

teacher asks for the students’ attention:]

teacher:I want to go back to the sentences read aloud to you by

Lennart. Lennart has just said that the essence of imperialism is that

one nation controls another. How can you control a nation?

student 1:By keeping the people in revolt, in order to prevent them

from leaving; so, to keep them as slaves.

[Obviously, this student has no clear concept of imperialism. He even says

something(“By keeping the people in revolt”)that is actually contrary

to the meaning of imperialism, because he wrongly uses the word revolt.

But, from his words it can be concluded that he has, nevertheless, a vague,

still unfocused idea of the concept of imperialism. The teacher makes small

corrections:]

teacher:To keep in revolt? Maybe you have in mind; to oppress?

student 1:Yes, to oppress, to exert power over them.

teacher:How could someone have power over them?

student 2:By placing soldiers along the border.

[This student also has a vague notion about imperialism. This time, the teacher

does not make corrections, but builds on the student’s answer:]

teacher:Yes, by placing soldiers along the border.

student 3:Wage a war.

teacher:Wage a war. Yes, I think it is far from strange what you are

considering, because your first idea, of course, is something military.

However, there are a lot of other ways to control a nation. But before

you all tell me what possible ways there are, I have something else

for you.

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[The teacher gives a second assignment, requiring the students to read a supporting text.]

I have chosen a text telling you how the Romans used to control

the nations and regions conquered by them. First, read the text by

yourself, and subsequently work in pairs in order to make a diagram

in which you put down the examples of imperialism found by you in

the text. But, first, have a look at the blackboard. I have already put

the empty diagram. Also, you will notice the four kinds of themes

you will find in the text. I listed the themes at the left side. These are

the Roman religion, judicial system, education, and architecture.

student 4:What is a judicial system?

[This question of one of the students gives the teacher an unplanned opportunity

to try to elicit from the students’ prior knowledge, however vague it might

still be, the concept of judicial system.]

teacher:Judicial system! Who can tell what a judicial system is about?

That also is not an easy concept! Jasper?

jasper: That is what a judge does starting a lawsuit. It is in order to

maintain the law.

[The student Jasper mentions in this case his everyday concept of judicial

system. The teacher does not interrupt by reacting to the mistaken aspect

of the answer, for instance, by saying something like “That is only partly

correct” or (more positively) “That is a positive start for an answer,” but he

accepts Jasper’s answer to continue the discussion:]

teacher:Try to clarify it by giving an example. When do we need to

take someone to court?

student 4:When there is some kind of disagreement, for example,

when there is a fight between two persons, who is guilty and how the

row has started.

[The teacher does not aim at a fully fledged definition of the concept of judicial system, either passed on to the students by him or formed by the students themselves. On the contrary, he feels satisfied that the students work

with a prescientific notion of that particular concept without knowing its

essence.]

teacher:Yes, you are right, when there is a row between two persons

or two groups of persons, somehow a solution has to be found. In that

case, justice has to be done. Thank you, Jasper, correctly answered.

[After this clarification of the concept of judicial system, the teacher proceeds

with his enumeration of the categories of Romans’ imperialist strategies to

be used by the students to analyze the text.]

teacher:Besides religion and judicial system, there are also education

and architecture. These are all ways by which the Romans tried to

control a nation. So, apart from military means, there are other means

as well. That is calledromanizing.

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Now, I will hand out the text. First, read the text in silence by yourselves. Then, in pairs, try to fill in the diagram with the appropriate

examples. And, if you have written this in your notebooks, try to

imagine what the opposite of that particular example will be. Add

that to the diagram in your notebooks. Or, in other words, what do

you consider not to be imperialist?

the series of assignments

Summarizing the series of assignments, we see that the students have to do

the first assignment on their own. From the transcription of the videotaped

lesson, we learn that this first assignment is meant to give the student an

orientation to the concept. After a short discussion with the whole class,

the teacher gives a text to the students to be used as a starting text for the

next assignment, that is, in pairs to think of positive and negative examples

of the conceptimperialism.

These assignments are aimed at stimulating a broad range of learning

activities such as

Activating prior knowledge

Making a map of concepts related to the concept being studied, and thus

exploring the connection and range of concepts and their relationships

Independently thinking of positive and negative examples of the concept under discussion

 Putting these examples into a diagram

Exchanging the results with other students

In terms of sociocultural theory, all these assignments function as scaffolds for the students’ understanding by mutual exchange, negotiation,

and co-construction of the concept’s essence. The teacher’s role is preparing and organizing the series of assignments and can be characterized as

coaching and guiding the process of the students’ gradual grasping of the

concept’s content. The teacher is no longer the “sage on the stage,” but a

valuable coach during the students’ acquisition of knowledge.

In order to process knowledge along these lines and to visualize and

imagine positive and negative examples of the concept to be learned, the

student should have some notion of the concept, however vague and nonspecific it may be. According to Vygotsky, this notion functions as an everyday concept, and its existence forms the basis for the acquisition of

academic concepts (van der Veer & Valsiner, 1991, p. 274). In relation to

historical concepts, the following example may be illustrative. Young children of preschool age have a fairly clear idea of the conceptking. Disguising

themselves in pretend play, 4-year-olds usually know that a king wears a

crown and often some kind of a long robe. In elementary education, and

also beyond it, for example, by watching television or by inference from

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other sources, students learn to combine the conceptkingwith splendor,

magnificence, and power: “The king is in charge.” An everyday concept of

that kind has to be present, when, in secondary education, the differences

among monarchy, oligarchy, and democracy will crop up in a discussion,

and, in later years, the differences between absolute and constitutional

monarchy. During secondary education, there is no further reference to

the religious–magical aspect of kingship. In the Netherlands the position

of the monarchy is at present being debated, because a large part of the

population adheres to a strong, but irrational, relationship of “God, the

Netherlands, and the House of Orange.” The Dutch people consider the

Orange family as chosen by God to lead the nation through hard times,

such as the 16th-century revolt against Spain, the assault on the United

Provinces by France and England in 1672, and the German occupation

in 1940–1945. There is an irrational belief in the monarchy (especially the

Protestant monarchy) that makes people support it in spite of the pleas for

modernization of the Dutch governmental system. Nevertheless, religious

aspects of the monarchy such as the ceremonies at the Byzantine Court

or the healing of the sick by the French king (cf. Bloch, 1924/1983) are

never referred to in the classroom. Therefore, the religious–magical background of kingship never figures in the social debate about the monarchy.

The conceptkingis neither completely understood in school nor in society.

One could even ask whether a concept ever could be. This forms a serious

obstacle to the definition of this concept, because an important feature remains neglected. Thus, the conceptkingwill not be completely understood

or finished after formal teaching in secondary education. This holds true

for any educational and professional level: A definition of kingship will

always remain a working definition to be developed further and adjusted

as one becomes more and more knowledgeable and familiar with the concept. Even for the scholar of constitutional law, the working definition will

be the starting point for further study.

The 12-year-old students in our research are restricted to their everyday

knowledge of the concept, partly enriched by elementary education. But

in secondary education, this concept has to be developed further toward

a more sophisticated concept, more fit for thinking and reasoning on the

aspects of democracy. This process requires continuing education, and it

has to be the teacher’s task to situate the development of that particular

concept in the zone of the students’ proximal development. Researchers

such as Piotr Galperin have shown us which kinds of learning activities

suit the demands of that zone.

the practice of initial teacher education

The teacher’s task is twofold. First, in the history lesson, the teacher stimulates the students to connect their knowledge, partly acquired beyond

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secondary education, with the academic concepts to be learned formally at

school. And, second, the teacher has to prevent an academic concept from

remaining an empty shell for the student, that is, a concept that is not experienced or understood and can only be learned by rote. Experience teaches

us that such undigested knowledge is of no use to students and rapidly

evaporates. Teachers must learn how to guide their students in sequences

of assignments aiming at using everyday knowledge as a means to absorb

and “own” academic concepts. In our teacher education courses, we devote ample discussion time to these tasks of the history teacher. Basic to

these tasks is a learning-psychological starting point, combined with our

interpretation of historical consciousness.

Our learning-psychological starting point is inspired by a Vygotsky–

Galperian approach to the orchestration of teaching–learning processes.

We have translated this into a series of assignments to be practiced in class

so as to make the students familiar with the content of historical concepts.

This is a gradual and step-by-step process. In practical terms, it means

a genuinely student-centered teaching approach, with teaching–learning

processes based on the students’ own learning activities. The teacher helps

the students to find, retrieve, process, and elaborate new information by a

sequence of short exercises, discussions, explanations, and questions. Performing these learning activities, the students experience the boundaries

and range of a concept and are forced to specify it further.

Such a student-centered approach is an explicit aspect of our teacher educations courses. In experiencing these approaches firsthand, the trainee

teachers become aware of the necessity of using everyday concepts as a

basis for building academic concepts and preventing these concepts from

remaining empty shells or undigested knowledge. For this demands of

trainee teachers an inquiring attitude toward their students. However, secondary students are not usually accustomed to such a pervasive teacher

attitude demanding that they perform learning activities that turn them

into productive co-constructors of the historical knowledge to be learned.

Additionally, we should mention that these kinds of student activities are

not described and prescribed in the history teaching methods used by the

trainee teachers at their practice schools. So, during the institute meetings,

we discuss with them their lesson preparation plans, focusing on the mediating student activities related to the everyday concepts. For example,

during such meetings the trainee teachers introduced for discussion the

following assignments prepared for their forthcoming lessons:

Could you give an example of a medieval town in Holland? How do

you know it is medieval?

Could you tell us a myth and a legend? What distinction do you make

in telling us?

Please make a full sentence using the conceptmodernization.

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What is the opposite of an army of mercenaries? (to introduce the concept

ofconscription).

Please, tell me in your own words, what is meant byindustrialization.

Did any relatives of yours tell you about the resistance to the German

occupation during the Second World War?

trainee teachers’ responsiveness

As teacher educators, we discuss with the whole group of trainee teachers

what kind of responses can be expected during that lesson and how to react

and continue. Next, we look for additional possibilities in order to make

the assignments and their formulations even more student-centered, for

instance, by having the students draw up concept maps, make diagrams,

look for patterns, and work collaboratively. Because all of the trainee teachers take in their preparations, objectives, and expectations for a particular

lesson, we have ample material for discussion. Often, we do a simulation

in which we play out a lesson part: The group plays the roles of that specific grade, and one of them presents her lesson. So these trainee teachers

become well prepared to give that lesson in vivo. We ask them to report

the results of teaching the lesson in the schools on the discussion pages of

the electronic course environment (we use Blackboard). In reporting their

practical experiences, they are expected to reflect in such a way that their

colleagues can react from their own individual experiences.

In this way we discover that trainee teachers often experience in their

lessons that their students have only a very limited or partialidea of the concepts they have to learn, and that they act on these concepts starting from

their own individual level. This results in unexpected student answers

and additional questions, which demand a kind of not-yet-acquired responsiveness of the trainee teachers. Often, this leads to a trainee teacher’s

expression of dissatisfaction with the teaching method and with the results

of a lesson. As teacher educators, we should be very attentive to intent in

such signals and make them educationally productive in our courses. If

such feelings do not crop up after that particular lesson, they often do after the assessments using paper and pencil tests. Then, it surfaces that the

students do not correctly understand the lesson content and that a lot of

additional teacher work has to be done. But now, the trainee teacher understands that “telling isn’t teaching.” Gradually, along these lines, we teach

the trainee teachers to determine the level of the concepts they want their

students to attain in a single lesson or lesson period and act accordingly.

This process of the gradual formation of historical concepts also follows

from the requirements issuing from the complexity of historical concepts

(Husbands, 1996; Pendry, Husbands, Arthur, & Davidson, 1998). It is part

of historical consciousness that these concepts are never definitively definable. Historical concepts are ill definable, and this turns history into a

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“discussion without an end” (Geyl, 1955). Historians are continuously reinterpreting the past, a process that leads to the shifting content of history

education. Each generation newly writes its own history and constructs

its historical images differently. As part of their historical consciousness,

students have to be well aware of this aspect of historical knowledge. It

is our conviction that such an educational objective can only be achieved

by a student-centered approach. To get at the historical concepts, history

teaching to a large extent has to rely on the students’ own construction

abilities. This means that the history teacher must create a “construction

zone” to give the students ample opportunities to come to grips (under

the teacher’s guidance) with their own historical concepts. This is more

easily said than done; it asks for skillful and subtle teaching activities and

it should be quite systematically practiced. Piotr Galperin has given us

the tools to orchestrate these kinds of classroom practices, in which the

students’ learning activities receive central place.

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13

Formation of Learning Activity and Theoretical

Thinking in Science Teaching

Hartmut Giest and Joachim Lompscher

problems of science classrooms

One of the main tasks of schools today consists of preparing students for

lifelong learning. That means, first of all, enabling students to learn and

think independently and efficiently. It is well known that learning tasks and

demands in science education present substantial difficulties for the majority of students (Solomon & Aikenhead, 1994; Yager, 1996; Wiser & Amin,

2001; Vosniadou, Ioannides, Dimitrakopovlov, & Papademetriov, 2001;

Mikkil¨a-Erdmann, 2001). International comparisons (e.g., by the Third International Mathematics and Science Study [TIMSS] and the Programme

for International Student Assessment [PISA]) have shown large problems

concerning application tasks, problem solving, and scientific argumentation, whereas reproductive tasks and skills were better mastered. Science

education suffers – among other shortcomings – from the dominant orientation toward isolated, nonsituated facts, which are seldom applied to

real-life situations. This approach leads to difficulties in understanding and

a loss of sense and motivation in many students.

In this context, many important questions arise, among others: What

can teachers do to maximize the effective construction of adequate science

knowledge by students? How can teachers maximize the opportunities for

students to construct new schemata, new ways of thinking about the world

(Adey & Shayer, 1994; Demetriou, Shayer, & Efklides, 1992)? The problem

and the questions are not new. And there exist different approaches and

answers. The present predominant “theory-oriented programs” that focus

on cognition are either Piagetian in nature (e.g., Lawson, 1982; Rowell &

Dawson, 1983; Shayer & Wylam, 1981) or based on some form of an

information processing model of cognition (e.g., Larkin, McDermott,

Simon, & Simon, 1980). The “theory of conceptual change” (Posner, Strike,

Hewson, & Gertzog, 1982; Chi, Slotta, & de Leeuw, 1994; Carey & Spelke,

1994) lies between these two.

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One main problem of learning science consists in the need for conceptual change. If the learner really acquires science concepts adequately, her

or his preinstructional conceptual structures have to be fundamentally restructured. Science classrooms fail to enable students to master conceptual

change and to reach a theoretical level of scientific thinking. This situation

seems to be the root of the recent crisis in science education (Black & Atkin,

1996). Whereas in the 1970s many investigations of students’ preinstructional concepts (often misconceptions) in various science domains were

conducted, in the 1980s and early 1990s conceptual change approaches

which were based on more or less radical constructivist epistemological

positions, moved to the foreground (Duit, 1999a, 1999b).

The constructivist approach has given many benefits to science classrooms and facilitated the understanding of learning processes in students.

But currently some severe problems and limits of this approach are being

discussed. Radical constructivism tends to overemphasize the individuals’

conceptions and development, reduce cognitive development to the content level, often overlook that learning science content has to be embedded

in learning environments that support the acquisition of these rational issues (Pintrich, Marx, & Boyle, 1993), overemphasize the sudden insights

facilitated especially by cognitive conflict (Vosniadou & Ioannides, 1998;

Lim´on, 2001), and overlook that a theory of science learning has to include

not only individual cognitive development but also the situational and

cultural factors facilitating it.

The main problem of the constructivist approach we see consists in

the fact that the learners’ construction processes are interpreted predominantly as activity developing from “inside,” based on the existing cognitive

structures, which mostly depend on the operation modes matured so far.

The question of how conceptual change really takes place has not been

clearly answered (Caravita, 2001). It seems that sudden insights facilitated

by cognitive conflicts cause changes in the cognitive structure and promote

conceptual change in students. Teachers’ more or less direct influence on

the students’ activity in the classroom seems to be impossible or not helpful

in this approach. Teachers only moderate students’ learning, rather than

helping to shape it.

We see a second important limitation of the radical constructivist approach. If learning depends most on what the learner already knows, a

productive cognitive conflict will occur only when the student encounters

a problem with more or less familiar and meaningful terms. That often

means the problem stems from everyday life. So, the difficulty arises of

how conceptual change will occur (in the direction of a paradigmatical

change of thinking), if knowledge acquisition is seen only in terms of its

immediate usefulness in everyday contexts. Certain scientific concepts and

methods may be formed this way, but the learners’ perspective remains an

everyday one (empirical thinking, which is discussed later). The necessary

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change of perspectives – toward what is characteristic of a scientific approach that enables people to apply scientific knowledge (e.g., laws and

rules) to a wide range of different everyday life situations – does not take

place. Thus, the central task of instruction consists of teachers’ creating

conditions for the emergence and development of a new kind of activity

in students corresponding with what is characteristic for science, both in

domain-specific and in more general respects, including special motives

and attitudes, goals and actions. That means, from our perspective, that a

systematic formation of learning activity is needed.

the activity-theoretical approach and its

educational application

Theoretical Prerequisites

Activity theorywas elaborated in the framework of cultural–historical theory by Leontiev (1978) and many others (see, e.g., Chaiklin, Hedegaard,

& Jensen, 1999; Engestr ¨om, Miettinen, & Punam¨aki, 1999; Lektorsky, 1990;

Lompscher, 2002) and was applied to learning activity by Galperin (1992),

Davydov (1988, 1996), Engestr ¨om (1990), and others. It has great potential

for solving the task discussed (for further details see also the chapters by

Chaiklin, Zuckerman, and Karpov, this volume).

Activityis understood as the fundamental interaction between humans

and the world – humans behave actively toward the world (fragments of

it), change it (them), and change themselves in this process. Humans as

active subjects make fragments of the world objects of their activity and

at the same time are affected by the world (fragments of it). The cultural–

historical process of societal development is the main basis of individual

psychological development, which depends mainly on the concrete conditions, opportunities, and qualities of activity.Learning activityis a special

kind of human activity developed in the course of societal development as

an important aspect of human culture that has to be appropriated by individuals in order to be used, then, for concrete learning goals that depend

on learning motives, objects, and conditions. Learning processes and outcomes are essentially determined by prior knowledge and interest, on the

one hand, and by already acquired learning means (actions, strategies, but

also material means, such as models, schemata, books, computers, as essential artifacts of cultural–historical development) available to be applied

to new learning tasks, on the other hand.

The crucial point here is that learning activity cannot be reduced to

the acquisition (or “construction”) of domain-specific knowledge. It is a

process of acquiring the domain-specific activity itself in all its complexity

as a product of cultural–historical development – according to the level of

the learners’ psychological prerequisites (the zones of actual performance

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as well as of proximal development) (Vygotsky, 1998). A major task for the

teacher, therefore, consists of creating conditions under which the learning

activity makes sense for the students and may be formed according to the

learning object (e. g., science), of organizing the students’ learning activity

as interaction and cooperation, of giving the necessary learning means or

leading the process of finding and further developing them. This is much

more than the position of an observer, mentor, coach, attendant, or the

like – the teacher has to guide learners in such a way that they experience

learning as a meaningful, necessary activity that makes them increasingly

competent and independent.

Instructionhas to be organized in such a way that students really can become subjects of their own activity (instead of being more or less passive

objects of educational arrangements and teachers’ actions). That means

learners must become more or less conscious of the goals, course, and

results of the activity and become actively engaged with the learning material, analyzing this material, solving problems in that context, drawing

their own conclusions – not under pressure but through their own initiative. This is possible only if students acquire the necessary means and

develop attitudes directed toward the essence of the learning material and

the learning process itself. These means must include, first of all, their

own learning actions directed toward understanding and applying the

material to be learned with regard to the specific subject matter or content (Hedegaard & Lompscher, 1999; Hedegaard, 2001; Lompscher, 1989a,

1999a, 1999b, 1999c; Giest, 1998, 2001). Active learning begins when people

(1) want to learn and (2) know what they want to know and be able

to do. Learning activity develops as a unity of learning motives, learning goals, and learning actions – but this is not the result of a spontaneous process under accidental conditions: As part of the societal culture,

learning activity has to be appropriated by learners and formed through

instruction.

Among the developmental effects of learning activity we especially

stress theoretical thinking because of its high importance to the quality

of knowledge and competences to be acquired. Theoretical thinking is

a level or quality of thinking characterized by the ability (and motivation!) to reveal the essence, the substantial features, and the relationships

of an object (cf. Davydov, 1988). It is distinguished fromempirical thinking,

which is more directed toward superficial features and relationships of

phenomena.

1

These two levels or qualities are interrelated and necessary

1

This discrimination was elaborated in gnoseology, especially in dialectical logic, used by

Vygotsky and Rubinstein in the psychological analysis of the problem of generalization and

concept formation, for example, with the discrimination between everyday and scientific

concepts, and especially further elaborated and applied to learning and teaching by one of

Vygotsky’s outstanding followers, Davydov, and his coworkers.

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aspects of thinking. But a lack of theoretical thinking has strong (negative)

consequences for the acquisition of scientific concepts and methods. Many

problems we find in today’s science classrooms are strongly related to students’ lacking ability to discriminate between and interrelate empirical and

theoretical concepts and respective levels of domain-specific thinking by

way of conscious mental actions.

There are several similarities and correspondences between the activitytheoretical approach and the constructivist one: orientation toward independent acting and thinking, reflection and metacognition, social

cooperation, role of prior knowledge, and cognitive conflict. But there

are also principal differences concerning the understanding of the role

of teacher and teaching, the societal essence of activity, acquisition, and

development.

The main difference between the activity-theoretical and the constructivist approaches – without detailing different versions – may be seen

in the fact that the former implements concrete and differentiated ways

of promoting the learners’ activity and development. That means, first

of all,

1. Orientation toward the concrete learning activity relevant for a certain object domain in the course of which the necessary and adequate

motives and personal meanings emerge and the psychic development as a whole is taking place2

2. Orientation toward the availability of learning means as products of

cultural–historical development that help acquire the corresponding

activity as the main condition for the learners’ cultural development

3. Orientation toward the systematic formation of that activity with

such substantial features as theoretical thinking and cognitive motivation in the process of ascending from the abstract to the concrete

(discussed later).

Developmental Teaching

There are a wide range of positions concerning therelationship between

psychological development and teaching or instruction– from denying teaching a substantial role in development to overemphasizing that role – with

different positions between these extremes, such as models of direct and

indirect instruction (Bliss, 1996; Weinert & de Corte, 1996; and others), of

combining instruction and construction (Pravat 1999; Oers, 1998; Mandl,

1997), of guided participation (Newman, Griffin, & Cole, 1998; Rogoff, 1995;

2

This does not mean that psychic development is taking place in learning development only.

Other kinds of activity have specific potentials and shape specific conditions for psychic

development as well.

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Rojas-Drummond, Hernandez, V´elez, & Villagr´an, 1998; and others). The

activity-theoretical approach claims not only that development takes place

under conditions of teaching, but that it organizes the concrete learning activity and its formation. Davydov (1988, 1996) used the termdevelopmental

teaching in this respect. We use the same term (Giest, 2001), though our

concept differs somewhat from Davydov’s.

From our point of view, teaching has to use the dialectical relationship

between different developmental zones (sensu Vygotsky). In afirst phase,

the teacher creates conditions for a high degree of self-regulated and discovery learning in the students’zone of actual performance,applying what

was learned and acquired so far. She or he tries to stimulate the emergence

of problem situations (cognitive conflicts) corresponding to main tasks,

goals, and contents of the teaching–learning process. In such problem situations, learning goals emerge, when the learners’ efforts are not directed

only toward solving but also toward reflecting on their own prerequisites

in relation to the demands of the situation, in order to find out what isnot

knownorcannot be performed yetand what can be done well and why. Such

(conscious) learning goals as an orientation toward the unknown are prerequisites and are the motivational basis for powerful effects in the further

process of learning activity.

Thesecond phaseis more characterized by direct instruction and systematic learning in thezone of proximal development. The teacher’s task now is to

help students reach their own learning goals by stimulating their learning

activity (creating the orientation basis for new learning actions; making

available necessary learning means; guiding their adequate application,

including the possibility of making mistakes and correcting them; forming

the whole learning activity necessary for the acquisition of new pieces or

domains of subject matter and/or more general aspects of culture; organizing cooperation and discourse among the students and with the teacher).

The central point here is to help children acquire what is necessary to know

and what must be performed in order to solve the problems and reach the

learning goals.

In thethird phase of developmental teaching(when the zone of proximal

development becomes a new zone of actual performance), students solve

problems by themselves, work on projects, and the like. Self-regulated and

discovery learning are the foreground again and a new phase of indirect

teaching starts, but on a higher level. Thus a new zone of proximal development opens.

It is clear that this approach puts high demands on the teachers’ psychological and educational competence concerning the differentiated analysis

of the real developmental state, including its potentials and permanent

changes; the determination of tasks, problems, means, and so on, according

to that developmental process; and the creation of suitable conditions for

the formation of efficient and increasingly independent learning activity.

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Ascending from the Abstract to the Concrete

In order really to understand the world, to acquire and apply relevant

knowledge and skills, and to become able to act in an adequate and competent way, the learner must have the opportunity to incorporate the material

to be learned into existing knowledge and skill systems. The problem is

that, as a rule, such systems are not available at the beginning but emerge

and develop only in the process of acquisition of the applicable knowledge

and skills. This contradiction and the learning difficulties caused by it can

be overcome by ascending from the abstract to the concrete.

Relatively early in a learning processstarting abstractionsbased on the

learners’ own practical and mental actions are generated. They contain

the most essential and constitutive features and relationships of a learning

domain and serve as a framework and cognitive tool for further analysis

and acquisition of the learning objects in the process of ascending to the

concrete (as a second step in the learning process). Here the conceptconcrete

means that the object has been cognitively processed more or less deeply

(on a theoretical level) and has been understood and incorporated into a

network of relationships (a theory). Starting abstractions emerge, when

the learners actively operate on the object and try to change and transform

specific aspects of it. In such situations, learners have the opportunity to

distinguish features that are essential and necessary for a certain object

(these remain stable in varying forms of the same object) fromother features

that may change in different phenomena of the same essence.

Starting abstractions that are appropriate for transcending the phenomena given and can serve as cognitive tools for further penetrating a learning

domain must not be presented by the teacher, but have to be formedby

the learners themselvesthrough their own practical and cognitive activity (of

course, under the teacher’s guidance). That means that the process does not

start with these abstractions, but with special actions on particular objects

and situations. These are also “concrete,” but they have not yet been cognitively processed and understood. Thus, the whole cognitive cycle moves

from the concrete not yet understood, via the abstract containing a limited

number of essential and constitutive features and relationships for a certain object or domain (and therefore easier to be understood and stored in

memory than a number of isolated facts, as often is the case in beginning

phases of introduction to a new domain), to an increasingly differentiated

and deep understanding of theconcrete complexity of phenomena and processesin a given domain. In this way, students can achieve (among other

results) systematic and flexible knowledge as well as theoretical thinking

and cognitive motivation through their own activity and cooperation.

Mostly, instruction is organized “the other way around”: Concrete

phenomena are shown and compared with each other, in order to find

out which features of the objects correspond and which are different. The

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generalization based on such comparisons, as a rule, leads to formal or

empirical abstractions not containing the really essential features and relationships, because it lacks a criterion for distinguishing the general and

the essential. Such a criterion is available in the process of actively changing the object under study, as explained earlier. In this process theoretical

generalization and corresponding abstraction take place.

The conception of ascending from the abstract to the concrete was elaborated in the framework of gnoseology and dialectical logic based on

the analysis of the historical development of science and applied to

psychological and didactic problems (Davydov, 1988, 1996; Hedegaard,

Hakkarainen, & Engestr ¨om, 1984; Lompscher, 1989b). This teaching strategy gives a general orientation to be concretely elaborated in each case

related to the theoretical and factual content of subject matter. The success

of its implementation to a large degree depends on the teachers’ active

participation in the elaboration process (and then in the process of implementation itself and reflection on it). That means, above all, that the

teachers themselves have to acquire the strategy, find ways and methods

of putting it into practice, and be motivated to work correspondingly. We

are conscious of the fact that our description of the activity-theoretical approach and its educational application is short and abstract itself. In the

next section we give selected examples from some of our empirical investigations in order to make clear how this theory works and which practical

results it produces.

empirical research

Disciplinary Classrooms

Operationalization of the Theoretical Approach

At first, we analyzed the basic theories, concepts, and models of science

relevant to comprehension of the learning objects in elementary and middle grade classrooms. This analysis included the corresponding modes of

scientific operations and methods. On the basis of an analysis of the students’ prior knowledge, interests, and everyday concepts, we generated a

hypothesis concerning their zone of proximal development. In line with

the dominant goal of our investigation, we focused on cognitive and motivational aspects of learning and development, especially learning motives,

learning goals, learning actions and tasks, modes of action regulation, and

other aspects. A condition that received particular consideration was that

the teachers’ activity was not to dominate the students’ activity. The teacher

had to create learning environments that enabled students to shape their

own development by way of learning activity.

On the basis of these considerations we constructed experimental

courses. The independent variables in the investigations were (1) choice,

order, and structure of the learning object (aspects of motivation and

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knowledge); (2) learning actions (hypothetically) necessary for the acquisition of the learning object (aspect of action); and (3) systematic formation

of the learning activity (aspect of formation). The formation experiments

(about 30 lessons or more) were conducted with a pre–posttest design

with experimental and control classes. The tasks contained characteristic

requirements of the respective scientific domain (science, mathematics, geography, history, native and foreign language) concerning, first of all, components of theoretical thinking and learning motives as well as knowledge

qualities. We generally chose the beginning phases of subject matter teaching or a new segment of a subject, because in such introduction phases the

formation of learning motives, goals, and actions is especially important

to further progress in the respective domain and general development as

a learner. In what follows we illustrate the design and organization of the

formation of learning activity in science education.

finding starting abstractions.If children are to learn to explain natural phenomena, they have to trace them to their essence. Various

phenomena in nature can be traced to particularities of movement of matter. In a philosophical sense, movement means change. Changes in nature

are callednatural processes.They take place under defined conditions and

cause further changes, further natural processes. A necessary condition is

energy,which is transmitted during a natural process. In a very elementary form, these considerations should enable students to develop more

dynamic knowledge of nature. They should understand that nature has

developed and continues to develop.

The starting abstraction of our primary science course in grade 4 (10-year-olds) contained the following statements (Irmscher, 1982): (a) Changes

in nature are permanently proceeding; (b) changes in nature indicate natural processes; (c) natural processes run under specific conditions and produce further effects, that is, further natural processes; (d) the existence of

energy is a necessary condition for all natural processes; (e) there are different energy forms (e.g., movement energy, thermal energy, light energy,

electrical energy), which are tied to specific energy straps; (f) energy may be

transferred to different natural processes; (g) often, energy transmission is

connected with energy conversion. These statements have to be discovered

by the students through special learning activity (described later).

The formation of theoretical thinking (directed to conceptual change in

the sense of changing the paradigm of thinking) is a long-term process.

Therefore, it does not make sense to reduce it to a single classroom experiment. So, the recognition and understanding of the essence of natural phenomena were picked up in grade 5 (introduction into biology and physics).

In the physics experiment (Giest, 1985) we concretized the concept natural

process and elaborated theconcept of physical process,which is characterized by changing physical quantities but invariability of the substance. A

major problem in physics education are the difficulties of the learners with

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mental discrimination and connection of the visible level of phenomena

with the level of physical explanation, which is characterized by high abstraction. We argued that a possible way to overcome these difficulties

might be the presentation of the abstract explanatory level in the form of

a graphic model. In physics there are two basic abstractions (the particle–

spatial discontinuum; the field–spatial continuum). These can be used as

starting abstractions in order to acquire knowledge about physical processes. The two basic models that correspond to these abstractions are the

particle and the field model. Because of its relevance to physics and high

potential for graphic presentation, important not only in grade 5, we chose

the particle modelas the basic idea of the instructional course. The main

aspects here were the construction of bodies (solids) from particles and

primary importance of energy as the condition for changing bodies (solids)

in the framework of a physical process. Thestarting abstractionwas characterized by the following statements: (a) Bodies are made of particles, which

are invisible; (b) the way bodies are constructed from particles is changing during a physical process (the particles themselves are unchanging

in the physical process); (c) energy is an essential condition for changes in

the construction of bodies. The starting abstraction connected two sides: the

observable changes of the bodies and the invisible changes in the construction of the bodies from particles that can be described with the help of the

particle model. Phenomena on the “body level” justify the statements that

were derived from the model (on the “particle level”). These statements in

turn can be consulted for the explanation of the observable phenomena.

ascending to the concrete.In grade 4 the elaboration of the starting abstraction took place as a process of actively dealing with natural phenomena that led the children to a deeper understanding of the emergence

of wind, the water cycle, nutrition, and growth of plants, animals, and humans, tracing them back to their essence. Ascending to the concrete in the

physics course, the concepts and statements on the “particle level” were the

basis for the explanation of various phenomena of thermodynamics (diffusion, volume change with temperature change, aggregate states and their

change, heat conduction, and others). In the process of ascending to the

concrete, the particle model became concretized (changes of the distance

between the particles, the kinetic and potential energy of the particles, and

the kind of movement).

modeling the learning object.Fourth graders are hardly able

to work with starting abstractions without specific educational support

directed to the formation and acquisition of the corresponding learning

actions at a mental, internalized level (discussed later). A stepwise elaboration of the starting abstraction is required and sensory structures are necessary in order to allow students to deal with the abstract learning object

via concrete materialized actions. In this process, the teacher gradually

developed alearning modeltogether with the children (cf. Figure 13.1).

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Natural process

CONDITIONS CHANGE FURTHER CHANGES

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figure13.1 Learning model: natural process.

Adequate models were also worked out in the other courses on the basis

of this learning model. Choosing the physics course as an example, we will

show how this was done.

At first the students were confronted with a paradoxical phenomenon.

Everyday experience leads us to the explanation that by pouring one

volume-part of a liquid into a glass twice we will get two volume-parts

of mixture. And even if we take two different liquids we do not expect

another result. But after pouring one part of water and one part of alcohol

(each 100 ml) into a glass students recognized that the resulting quantity

of liquid was not, as expected, 200 ml, but 180 ml. So, the problem – What

happened to the missing 20 ml of water and alcohol? – arose. Children discussed different possibilities, and they repeated the experiment, but each

time the same result occurred.

Students could not find a way to solve the problem. So, the teacher

showed them two glasses, one containing sand and one peas. He then

asked the children what they expected to happen if the sand and the peas

were mixed. After this they tried it out and confirmed their expectations.

This way the children (supported by the experiment) found the answer

and solved the problem: We could imagine the two liquids as being constructed from particles of different size. So the small ones could move into

the space between the bigger ones, and this process would lead to a possible explanation of the phenomenon: Water and alcohol (like each body)

are built from particles and these particles are of different sizes or are at

different distances from one another.

In analogous learning situations all the starting abstractions were generated stepwise together with the respective graphic model (learning model).

These learning models represented the corresponding starting abstractions

and gave sensory support to the learners. It was in principle beneficial that

now the considerations were already theoretically oriented (could be carried out on the basis of the starting abstractions worked out and modeled

so far). This made it easier for the students to think scientifically and acquire the corresponding learning activity adequately, using the models in

the classroom more and more independently.

modeling the learning actions.The acquisition of a learning

object is tied to the acquisition of adequate learning actions, which are

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the main means of learning activity. We concentrated on learning actions

that allowed students to cope with large classes of learning tasks within

the respective domain. Solving scientific problems (finding answers to a

question concerning nature) is appropriate for this goal and ensures an

adequate acquisition of the learning object.Problem solvingas a complex

mental action and method includes other important science methods (observation, experimentation, modeling). These are powerful means to reach

the learning goal of our courses of study and are of principal importance

for theoretical thinking. Children need scaffolding in the form of learning

models for the acquisition of learning actions, such as problem solving, as

well. The learning model is used as an orientation basis for the acquisition

of the learning action and as sensory scaffolding during actions.

provoking cognitive conflicts.Learning was arranged as a process of problem solving evoked by statements that contradict everyday

experience (Heraklit: “Nobody can enter the same river twice”) or by use

of contradictory experiences (“In the morning the grass was wet, although

there was no rain at night”) or paradoxes, and the like (discussed earlier).

This way of proceeding was characteristic of the whole learning path of

ascending from the abstract to the concrete.

stepwise formation of mental actions.The acquisition of

learning actions was organized according to the concept of stepwise formation (Galperin, 1992; see also Haenen, 2001). Materialization of thinking

in a visible form is a powerful tool for acquisition of the learning object and

for successful learning in general. In the physics course, it was necessary to

connect the observations on the visible level of the physical body with the

explanation on the level of the particle model. To give an example: Starting from everyday experience (if we try to mix water and syrup we must

always stir to get a good mixture), the teacher asked what would happen

if we did not stir. Students planned an experiment and carefully poured

water and syrup into a glass and observed for several hours and days

what happened. They observed that if we wait long enough, water and

syrup mix. This observation was stated and drawn using the corresponding learning model. The question of what energy might be driving the

process arose. Another experiment was planned and executed. Students

compared the process of mixing under different heat (energy) conditions.

This way they found out that it is heat that causes the mixing. Mechanical energy (stirring) or heat energy causes the mixing of water and syrup.

But why? Guided by the learning model students looked for analogies on

the particle level that might explain the observations on the body level.

Before the natural process started, particles of water and syrup are separate. After the process they are mixed. So, the particles must have moved.

The two energies (mechanical and heat) must be connected with the movement of the particles. Additionally guided by a corresponding drawing that

showed the mixing of particles, the students developed an explanation: We

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observedthat water and syrup were mixed (without stirring), and weexplain

this (using the particle model) by the movement of the particles caused by

energy (the particles’ movement energy). Further conclusions were drawn:

The movement energy of particles must correspond to the temperature of

a body, and so on.

Selected Results of the Formation Experiment

In order to test the learning results of our classroom experiments, we were

interested in whether the students were able to have a generalized concept

of the natural process, to analyze concrete natural processes with the help

of that abstract and generalized concept (that means they had to be able to

put it in concrete terms), and to solve problem tasks. Only 5% to 10% were

unable to do so. In individual investigations, we analyzed the solution of a

problem whose content was the subject of instruction in both control and

experimental classes. Here, too, the experimental classes outperformed

the control classes significantly. Of the students in the experimental classes

86% could generate an adequate question, whereas only 60% of the control

class children could; 77% of the experimental class students – versus 46%

of the control class children – generated an assumption independently

or with little help; 43% succeeded in planning an experiment independently, versus 25% in the control classes. The children of our experimental

classes developed more interest in problem-solving tasks (versus receptive

and reproductive ones) and in means and methods of knowledge acquisition (versus mere results) when compared with children in control classes

(Scheibe, 1989). B¨ ohme (1989) conducted small group experiments based

on the same science course with low-performance students and achieved

learning results corresponding to the average performance of students in

classroom experiments.

As one result of the physics course in grade 5, half of the experimental

class students were able to move mentally between the two levels (observations of physical processesand“explanations”

3

on the basis of the

particle model), which was a tremendous problem even for 6th, 8th, or

10th graders.

The intellectual potential of the children is higher than expected in traditional curricula, but this potential can only be realized by alternative

classroom instruction. In special investigations, we compareddirect instructionand tendencies ofindirect instructionwithdevelopmental teaching(Giest,

2001). Direct instruction had little influence on cognitive development: The

dominant orientation in teaching (without giving space for the students’

own activity) restrains learning. But only trusting students’ self-regulated

learning without guiding them into efficient learning activities does not

3

From the point of view of scientists in the domain of physics, it is a description on a model

level, not a real explanation.

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lead to better results. Developmental teaching (discussed earlier) clearly

reached a higher level of concept formation and theoretical thinking. For

example, a class inclusion task with the conceptplantwas solved by 68%

of the students, whereas in classrooms with the other instructional models

the solution rate was two to four times lower.

Up to this point, our research had been directed to disciplinary learning and disciplinary classrooms. Starting abstractions were formed for the

acquisition of disciplinary knowledge and the formation of (disciplinary)

scientific thinking. This is no longer viable since humankind’s problems are

growing more and more complex. In order to solve them it is not enough

to approach them solely from the point of view of a single discipline. Disciplinary thinking has to be complemented by inter- or transdisciplinary

thinking that includes skills in dialectical thinking. Thinking dialectically

means thinking in units of contradictions and in mental systems. This point

has not been satisfactorily resolved in our research on ascending from the

abstract to the concrete and in developmental instruction reported to date.

Because of the limitations of disciplinary science, instruction has to be

complemented by transdisciplinary instruction, including not only different sciences but also arts as a different kind of acquisition (Huber, 2001).

This might be another step to overcoming the crisis of science education,

which is mainly a crisis of meaningfulness in the view of students. Transdisciplinary instruction has to put humankind’s problems and their solution

at the center and has to ask whether and how disciplinary science can

contribute to the solution of such complex problems. And a further point:

Modern society is characterized by the need for lifelong learning, in order

to enable citizens to cope with a steadily (exponentially) growing knowledge base. Self-directed learning associated with modern media might be

a solution to such problems of modern society. Therefore, we now focus

our research onsystem educationanddistance learningby means ofmodern

media.

Transdisciplinary Classroom, Distance Learning, and Hypermedia

finding starting abstractions.One of the complex problems

mentioned earlier is related to the necessity to change the present relationship between humans and nature. So far, both sides form a contradiction:

Nature rules over humans, or vice versa. The environmental problems of

our world may be solved only if an alliance between humans and nature is

created. Our research is aimed at categorical thinking in the form ofinterdisciplinary concept pairssuch as part–whole, inside–outside, order–chaos,

and determining–being determined as a special kind of starting abstraction

(Giest & Walgenbach, 2002).

ascending to the concrete.We developed an educational course

subdivided into several successive learning modules in different activity fields: Starting from experience with water (representing here fluid in

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general), the starting abstraction (concept pairs) is generated. In a second

module, water (fluid, flowing matter) is examined and discovered asboth

the subject of art and the means in artistic activityby separating content and

form. By putting a pageof paperon top of thewater surface, pressing it down

lightly, and then lifting it up, the form of the water is caught in a picture. By

separating content (water) and form, it is possible to examine the different

forms not only of flowing water. The forms captured on paper represent

forms of moved liquid in general. And, at the same time, new perspectives

are opened on the basic problem of art. Forms are special subjects of art, and

the artist deals with forms to create new meaning, new knowledge, new

perspectives on reality. The third module invites the learner to leave the

forms and to move to a more abstract dimension of the problem: Now the

genesis of motion forms of water is investigated by methods of science. The

concrete flowing water is reduced to particles in movement. This waylaws

of the particles’ movementcan be recognized. Their behavior is dependent on

three factors: the form of disturbance, the flowing speed, and the viscosity

of the fluid. Using the Reynolds number, the relationships between these

parameters can beexpressed quantitatively. The lower the Reynolds number

the more order can be observed; the higher, the more chaotic it is. The ideal

Karmanic turbulent path is situated exactly on the border between order

and chaos.

The fourth module offers experience with fluid, flowing matter in the

form ofpoints as subjects of mathematicalrelationships freed from content.

The main objectives are to recognize and analyze mathematical (algebraic,

geometrical) analogies to flow. By experience with mathematical equations

(structures of numbers) and dot sets (a typical order of dots found in fractal

images) it is possible to analyze the interrelation between order and chaos

or determining and being determined at the level of mathematical abstraction, modern mathematical, and scientific theories such as fractal geometry

and chaos theory. In the last (fifth,etc.) modules, the learner is invited to

discoverpossible worlds in virtual reality; to rediscover sensitivity, sensitive

chaos, in it; and to establish relations to a given reality. He or she has to

look for analogies between the world of abstract possibilities analyzed earlier and the given reality – sensitive chaos in “cultivated” nature, different

forms of relationships created between order and chaos, and so on. At the

end of the course the learner is invited to develop an example of a concrete

utopian ecological system and to implement it practically or to participate

in practical implementation of such a project existing elsewhere.

What has been discussed so far is a completely different approach to the

development of inter- and transdisciplinary system education, compared,

for instance, with the usual environmental projects, which start with a complex real-world problem. The approach presented here chooses a selected

or constructed paradoxical situation (with the character of aminiature)as

the starting point of learning. It represents the whole complexity, but on

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figure 13.2 Vortex street: a special kind of learning model (at the same time

abstract and concrete).

a small scale. In order to deal with that complexity it is necessary to use

powerful cognitive (conceptual) means. Basic categories in the form of concept pairs are such means. At the beginning, these categories are abstract

and have little concrete content. But in the process of ascending from the

abstract to the concrete, the categories become increasingly complex and

concrete.

modeling the learning object.In order to recognize and use

categories in thinking, a special learning object is needed. It must provide

the opportunity to start thinking dialectically by containing or presenting

both contrasting sides of a dialectical contradiction in a sensorily perceptible form (sensitive scaffolding). For this aim we chose Karman’s “vortex

street,” a system of spirals in a fluid with different increasing sizes (see

Figure 13.2). It serves as alearning model because it represents not only

itself, but (as a prototype) a much wider learning object.

The learning model used here is not simply an illustration or application

of a learning object, but a heuristic means that may enable the learner to

develop theoretical (dialectical) thinking and to acquire new (theoretical)

knowledge. For instance in the first learning module (discussed earlier) the

learner is confronted with the vortex streetas a fascinating “gestalt” that

can be discovered and observed in the water of a river, but also in other

flowing matter, in air or gas. Each learner can produce it by using a basin

with liquid (e.g., water). This way one can imagine and experience that

behind the visible forms of moved water certain dialectical contradictions

are hidden and may be discovered, for instance, betweenorder(laminar

currents) andchaos(turbulence) or betweendetermining(I can determine

the water) andbeing determined(at the same time I am determined by the

water).

provoking cognitive conflicts.With the help of the vortex

street, the learner can start deep experiences in categorical thinking. It

is not a simple instance of a natural phenomenon, but a very productive

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heuristic meansfor the production of knowledge using and concretizing the

concept pairs mentioned. The vortex street is a “case which has the value

of thousand cases and contains them all” (Goethe, cited in Riedl, 1995;

see also Bortoft, 1996). It is a provocation for the learner’s thinking: She or

he cannot think in the same way as in everyday life – either it is order or it is

chaos. Order and chaos are in interaction with one another; both sides are

complementarily or dialectically interrelated. This experience may drive

the learner toward a more theoretical levelof thinking – a need for penetrating the paradoxical situation and understanding its substance will

emerge.

formation of mental actions.It has to be mentioned here that

the course we report on was developed for secondary level education.

4

In order to use our approach of such complex, systemic education in a

given educational setting, we developed ahypermedia module(a complex

web-based program). On the one hand, we did this with respect to the

educational requirement of self-directed learning, which is strongly connected with information and communication technology–based distance

learning; on the other hand, computer use is essential for the learning object

(e. g., fractal geometry and chaos theory).

The programconstruction follows the principles of formation of learning

activity described earlier but pays more attention to self-regulated and

self-directed learning, in our eyes, a prerequisite for successful distance

learning.

The program offers a structure of successive learning areas that constitute learning steps, but learners have the opportunity to decide whether

to follow them (each is constructed in a way that allows successful and

meaningful learning within a learning step). Depending on the learning

prerequisites, learners can start with a module of their choice.

The program offers learning goals, learning tasks, and learning actions,

but the learners have to decide whether to use and integrate them into

their own activity.

The program offers learning assistance in many ways (information, direct help, interactive programs to study a special theme or problem,

integrated links to relevant Internet sites).

The program purposefully encourages the learner to leave it and to turn

off the computer to learn together with peers in cooperative work and

to work directly in nature.

In a formation experiment on distance learning, after brief instruction,

university students received a compact disc (CD) with the program and

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We also developed and evaluated a similar course for primary school students (see

http://www.uni-potsdam.de/u/grundschule/sachgiest/delfin/index.htm) but there are currently

no data available.

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figure13.3 Pole differences in pre- and posttests.

studied only with the help of this program at home or in the university’s

Computer Investment Program pools.

selected results.In order to investigate changes in students’ cognitive orientation

5

we asked them to rate the poles of antinomical concept

pairs on a 6-point scale (6, highest relevance; 1, lowest relevance) concerning different complex subjects (systems):society, democracy, ecology, climate,

education. The concept pairs (conceptual poles) that the students had to rate

wereorder versus chaos; determining versus being determined; self-determination

versus outside determination; freedom versus responsibility. Figure 13.3 gives

an overview.

Without specifying the details here, we can conclude that concerning

the various systems or the concepts representing these systems, students’

thinking in antinomies decreased; the differences between the systems became smaller (concerning the rating of antinomical concept pairs). The

knowledge did not remain abstract but became applicable to everyday

life. We can interpret these findings as an indication for transdisciplinary

thinking and for crossing of the boundaries of domain-specific knowledge

on a high level of theoretical thinking. Further investigations are necessary

in order to show the applicability of this approach aimed at promotion

of theoretical thinking in different contexts and different developmental

stages.

conclusions

In this chapter, we have described several phases of our research concerning science teaching and learning. The investigations had different goals,

content, and forms of realization but were united by the concept of learning activity and its formation (here with a stress on theoretical thinking as

one – but not the only – aspect of the students’ psychological development).

This concept, elaborated in the general framework of cultural–historical

5

For details see Giest and Walgenbach (2002).

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theory, shows efficient ways and conditions of promoting cognitive development through learning and instruction (as shown by other authors as

well) and opens broad perspectives for further theoretical and empirical

research.

The implementation of this approach depends on concrete cultural and

regional conditions and individual differences among students, including

their educational background. For example, the material, financial, and

technical allocations of schools and universities vary considerably among

and within countries. The growing and increasingly efficient use of new

media for educational purposes is one of today’s most important challenges. Scientific research has to create necessary preconditions for relevant

changes in this direction. But, at the same time, society, politics, economy,

and educational systems have to do their job in this regard as well. There

is yet a lot to do!

The instructional strategies directed toward the formation of learning

activity and the promotion of independent, critical thinking and acting,

discussed in this chapter, may provide powerful guidance under different

conditions (e.g., with and without new media and technology) because

they focus on principal aspects of development through activity and result

in the formation of motives and competencies necessary for coping with

today’s and tomorrow’s challenges.

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14

How Literature Discussion Shapes Thinking

ZPDs for Teaching/Learning Habits of the Heart and Mind

Suzanne M. Miller

Within the last few decades literature has been broadly recognized in many

disciplines as a major way of knowing, a distinct narrative mode of understanding that can contribute to a keen and critical mind. By stimulating

attention to dilemmas, alternative human possibilities, and the manysidedness of the human situation, literature provides “the varying perspectives that can be constructed to make experience comprehensible” (Bruner,

1986, p. 37). Theoretical conceptions of the act of reading literature have also

changed during the last century from New Critical approaches forgetting

static meaning out of a text to constructivist approaches requiring readers’ activemakingof meaning (Bartholomae & Petrosky, 1986; Rosenblatt,

1978). Literature learning, in this view, involves creating and elaborating

responses and interpretations within the constraints and resources of the

text and classroom conversations – as a means of learning to enter into

larger cultural conversations about interpretations and possible meanings

(Applebee, 1996).

Research evidence, however, suggests that literature learning as taught

in the secondary school has not generally supported such constructivist

ways of knowing and thinking. In many classroom contexts, interactions

about literature cut off students from their own responses and reflection – even teachers who believe they are holding “discussions” insist on

their own “correct” textual interpretation (e.g., Applebee, 1996; Marshall,

Smagorinsky, & Smith, 1995; Nystrand & Gamoran, 1991). Research in such

classrooms reveals what students learn: that their responses and interpretations play no role in school literature reading, that they shouldnotdraw

on their social knowledge about human experience to make sense of literary texts (Hynds, 1989). Such a stance toward literary texts marginalizes

students as passive consumers of teacher-made interpretations (e.g., Friere,

1998; Scholes, 1985).

In contrast, engaging in open-forum classroom discussions in which

multiple perspectives on texts are invited can provide students with

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opportunities to examine individual interpretations in conversation with

others (e.g., Bridges, 1979). In the sociocultural approach to mind, thinking

originates in such collaborative dialogues, which are internalized as “inner

speech,” enabling children to do later in “verbal thought” what they could

at first only do in talk with supportive adults or more knowledgeable peers

(Vygotsky, 1986; 1978; Wertsch, 1991). Vygotsky applied this idea to literature teaching in hisPsychology of Art(1971), where he argues that the effects

of literature excite the individual reader aesthetically, but that the teacher

must aim, further, to form reflective consciousness through “intelligent

social activity” that extends the “narrow sphere of individual perception.”

In the ethnographic research I have conducted over the past decade, I

have examined the influence of open-forum class discussion on students’

thinking over time. This work traces how teacher mediation for students

in open-forum discussion of texts can create a zone of proximal development – an assistive social space – through which students learn with

the teacher and other students both how to make meaning from literary

texts and how to reflect on possible meanings. Using a framework integrated from Vygotsky’s sociocultural psychology (1986, 1978), narrative

theory (Bruner, 1986; Polkinghorne, 1995), and sociolinguistics (Bakhtin,

1981; 1986; Gee, 1996; Hymes, 1974), in this chapter I synthesize findings

from these studies of how constructivist literature study – particularly

open-forum discussion – shapes students’ knowing and thinking. This

research provides evidence, as Vygotsky argued (1978, 1986), that what

begins as purposeful social interaction in discussion moves inward to become students’ psychological tools (see also Kozulin, 1998). These tools

of the mind appropriated by students vary with the interactional context

but include, for instance, new social languages (Bakhtin, 1981) and specific

meaning-making strategies. Literature discussion plays, I argue, a central

role in developing students’ self-conscious reflection.

In the following sections, I first provide a short historical overview of

the theoretical and research bases for approaching the literature curriculum as conversation (Applebee, 1996), focusing on the perceived problems

and tensions of the teacher’s role. I then turn to a series of ethnographic

classroom studies that provide evidence that (1) students develop specific

habits of mind when teachers play a mediational role in literature discussions; (2) students learn qualitatively different habits of the mind and

heart in contexts in which teachers mediate discussion of texts from multiple cultural and critical perspectives; and (3) students carry these ways

of thinking into meaning-making contexts in other school subjects.

research on classroom talk

Research on the nature of classroom interaction in Western schools (e.g.,

Hoetker & Ahlbrand, 1969; Barnes, Britton, & Rosen, 1969; Cazden, 1988)

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highlights a century-long persistence of classroom recitation as the major

way of talking. In response to this pervasive evaluative genre of school

discourse, which inhibits student thinking, James Britton (1970) and his

colleagues (Barnes et al., 1969) in the United Kingdom argued the need in

schools for exploratory talk as a centralmeansof learning and of developing

higher psychological functions. Grounding their work in Vygosky’s educational theory, they focused on the power of purposeful talk as a mediational

means to help students make knowledge their own. In this language across

the curriculum (LAC) movement in the 1970s, literacy was reconstrued as

sense-making activity – as reading, writing, andtalkingto respond to the

world and make sense of it. “Talking to learn” through collaborative exploration in discussion served as the key to developing student understanding

and thinking (Barnes et al., 1969; Barnes, 1976; Barnes & Todd, 1977; Britton,

1970; Wells, 1986).

However, since traditional teacher talk focused almost solely on questioning and evaluating correct responses, the LAC movement was faced

with the “problem” of the teacher. The group, including many teacher–

researchers, engaged in extensive inquiry on student small-group discussion outside classrooms, to examine the potential of students to make

meaning without the traditionally intrusive teacher role (e.g., Barnes &

Todd, 1977; Britton, 1970; Edwards & Westgate, 1987). LAC researchers

documented students’ abilities in these small groups collaboratively to

use cognitive strategies, to explore connections between personal knowledge and the text, and to create their own understanding jointly through

language. Similar findings in the United States have demonstrated elementary students’ capacities to use their own language to explore problems of

meaning, for example, in book groups (Eeds & Wells, 1989) and book clubs

(McMahon & Raphael, 1997). In a statewide assessment in Connecticut

(Fall, Webb, & Chudowsky, 2000) even a 10-minute discussion in threestudent groups had a substantial influence on students’ understanding of

a story according to measurements on a language arts test – as compared

to those without benefit of discussion. This work is largely grounded in the

notion that students pursue understandinginterdependently, at times acting as and other times learning from more knowledgeable peers (Vygotsky,

1978).

Evidence suggests, though, that such peer-led talk in many instances

has not resulted in students’ equal rights of constructing knowledge (e.g.,

Lewis, 1997) or productive conversations (e.g., Alvermann, 1996). The limitation of students’ social and cognitive strategies in small student groups

has led educators to suggest the additional need for teacher-supported

discussion (e.g., Barnes & Todd, 1977). The teacher’s role in such classroom discussion has persisted as a problematic issue in literacy research

(Miller, 1997), though. What is not clear is howpracticing teachers initiate changes in conventional roles, discourses (Gee, 1996), and speech

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genres (Bakhtin, 1986) to create open-forum discussions that engage and

transform students.

studies of teacher-mediated text discussion

In the ethnographic case studies discussed in what follows, I selected innovative secondary-school English teachers (i.e., those teaching students ages

13–18) through a process of progressive focusing in each study. To begin, I

observed teachers who were recommended by colleagues as using openforum discussion in their classrooms: This was an essential stage, since

what teachers mediate and students learn in such discussion contexts was

the phenomenon of interest. In general, each case study involved weekly

audiotaped observations in the classrooms over the course of a school year,

transcriptions of semistructured interviews of teachers and focal students,

descriptive field notes, class artifacts, and, sometimes, student writing.

Throughout each study I continued annotation and recursive analysis of

emerging data (LeCompte & Preissle, 1993), triangulating different data

types and sources to identify salient themes or categories relevant to student engagement in thinking for each focal student. These were taken to

students and teachers for verification or confirmation, including stimulated

recall sessions with discussion transcripts. Through descriptive–narrative

accounts tracing the developing thinking for each focal student and each

class, I created pattern explanations of how supported opportunities for

thoughtful discussion develop students’ thinking.

Because of space limitations, each study cannot be reported on in detail

(see specific reports for complete accounts). Instead, I focus on key issues

that emerged within and across studies, emphasizing the findings that

contribute to our understanding of how teacher-mediated literature discussion can create a zone of proximal development that shapes students’

habits of mind.

the need to transform classroom context−roles,

purposes, epistemologies

Vygotsky argues (1978) that the zone of proximal development (ZPD) can

be determined by comparing what a student can do alone and what she can

do during “problem solving under adult guidance or in collaboration with

more capable peers” (p. 86) (see also Chaiklin, this volume). In classrooms,

then, “functions which have not yet matured” can become the focus of

instruction only in the context of collaborative problem solving. To create

such an activity context, teachers need to transform much that has been

traditional in schools: the roles they and their students play, the purposes

for their talking, and the stance toward knowing and understanding. In the

Critical Thinking/Discussion study (Miller, 1988; 1990; 1992), I examined

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three urban-school contexts for whole-class discussion of brief versions of

challenging philosophical and narrative texts, largely Western classics (e.g.,

short excerpts from Kafka, Bacon, Pascal). Though all of the texts were not

literary, many were narrative, and the professional development project the

teachers engaged in approached these texts in classes across the curriculum as open to interpretation, asking students to draw on prior knowledge

to make meaning. An overview of selected findings from these classrooms

provides insight into why two of the teachers successfully transformed

their classroom social contexts for open-forum discussion, while one

could not.

“Trying to Understand Together” in Linda’s Class

Many students in Linda Mitchell’s ninth-grade class found open-forum

discussion unfamiliar and at first did not actively participate: Her student

Jack told me that he quietly observed in early discussions, to see “what was

normal.” To transform typical classroom talk, Linda said, she tried to send

consistent “messages” to students that as a group they all would be “working together.” Rearranging the desks into an “almost perfect circle” where

they all sat facing to see and hear each other, she physically signaled distribution to students of authority to interpret the text. She focused on changing her singular role as the knowledge expert by changing her usual verbal

behavior: Besides asking authentic questions about what puzzled her in the

reading, she listened to students more than she talked, allowed students to

determine their own turns for speaking, and changed to informal nonevaluative language (“I’m kinda’ confused”), to become a facilitative participant and encourage students to take on new active roles for themselves.

For students in early discussions who tended to “dispute” about who

was “right,” Linda provided strategies for helping students consider differences reflectively. For instance, she modeled probing strategies for responding to alternative perspectives, asking students to clarify what they

said: “So are you saying...?” She allowed long pauses (often more than

20 seconds), reminding students of the need for “thinking time.” Often she

focused on enforcing group-developed ground rules (“Julie didn’t finish

yet”) and provided strategies to help students learn discussion behavior –

“to listen, respond, and collaborate.” Linda persistently reminded them to

“listen to others,” supplying metaphors for collaboration (“meaning will

build and grow”), demonstrating useful, concrete strategies: For example,

it is evident on videotape that students look at each speaker, as Linda had

suggested. During discussion she looked thoughtfully around the circle,

reading students’ behavior to see how she could help (e.g., “David’s been

waiting” or “Did you want to ask Rose a question?”). In interviews students

pointed to their “ground rules,” developed together in an initial discussion

and enforced by Linda or students, as creating a “safe” atmosphere and

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a “serious purpose” (David) for discussion. As different points of view

emerged, students discovered what for many was the surprise and lure of

discussion: “People do have a lot of different opinions,” Nicole marveled;

“you would think they would have an opinion like yours.”

As social changes began to occur through negotiation in the talking itself, students were cognitively transforming, as well, developing a more

reflective stance toward meaning. They began to adopt Linda’s socially useful language strategies for trying to understand: They kept the talk open

to possibilities by stating claims tentatively (“Maybe not, maybe it’s...”),

owning their ideas (“I think that what he’s saying is...”), suggesting alternatives (“Could it mean that...?”), and asking, as Linda often did, for

clarification that invited others to explain, for example, “You’re saying [that

behavior] helps, but it doesn’t solve the problem?”

Over time, with Linda’s help at points when they needed it, the students

saw themselves change from their “debating” attitude. They began “talking witheach other” rather than “talkingateach other,” Jack explained,

which is “something that two people not in a discussion do.” Students I interviewed repeatedly pointed out that “how we learned to listen” and “talk

with” each other were shaped by their purpose of “trying to understand

together.”

The “Text Written in Stone” in Rita’s Class

At first it seemed that Rita Wilson introduced discussion similarly to her

class, telling students that the purpose was for them to provide proof for

their beliefs and opinions about texts. However, the quantitative profile of

thinking and discussion for the class – including indicators for students’

providing evidence, explanation, questions, and collaborating – declined

after the initial discussion. Rita’s response to student questions in discussions illustrated a tension in her discussion goals. In an early discussion

of a text by Francis Bacon, for example, when a student posed the initial

question “What is revenge?” Rita responded:

You mean, what is revenge according to him? To Bacon? When is the only time it’s

allowed? To him. Wait. Why don’t we find that spot and figure it out because it’s a

good question (two-second pause). What is it then? When does he allow it?

In the subsequent six turns, students searched for the place in the text that

tells when Bacon allowed revenge and asked Rita for “hints” about where

to look, and Rita told them where. When they found the right answers,

students were not sure what they had accomplished: One asked, “Do we

have an opening question?” and Rita went to write on the board to explain.

In six instances (two or three turns each) of students’ speaking to each

other in that discussion, Rita intervened to answer, explain, repeat, or

change the subject. By answering and transforming students’ questions,

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heading off their interaction, and focusing mainly on finding text answers

to her questions, Rita worked against her stated purpose of having students

generate alternatives and weigh the evidence for them. She communicated

that teacher and student roles would not change, and student attempts

to ask questions and collaborate virtually disappeared in subsequent

discussions.

Her discussion behavior revealed tension from conflicting attitudes

about the teacher’s discussion role: “To become an authority figure shuts

the whole thing down,” but “to play, to accomplish that [new] role is very

difficult.” In interviews she expressed anger about a student who asked

questions to introduce new topics: “He is trying to be the teacher.” Over

time, as Rita maintained a physical position of authority, often standing

at the chalkboard to explain, her behavior seemed to derive from strong

beliefs about texts.

When students in discussion of a music video did not see “themeaning of the song” that Rita saw, she told them, “You are just not thinking

critically enough to see some of the similarities.” She did not support her

interpretations but increasingly added them to conclude discussions: for

example, “What Schopenauer is trying to tell you....” Because of these

lessons that she could see in both written and visual texts, Rita eventually

told students: that “makes me think a little more critically than you.” On

the basis of her gradually revealed view that text meaning is, she said,

“written in stone,” to be read each time the same, Rita understandably had

concluded that it was students’ failure to interpret and think critically that

led them to alternative interpretations: “They want to talk, but not think.”

Rita’s 11th graders felt that, as her student Andrea put it, discussion

went “downhill” over time. Andrea, who was at first excited by discussion and actively participated, eventually fell silent, as many did. She

and other students became increasingly passive, waiting, as Michael put

it, “to see if we had the right answer.” Andrea perceived a problem:

Ms. Wilson “brings us to a conclusion...she has a better background,

but it throws us off.” All five of the students I interviewed said that compared to other classes, the social “atmosphere” was not good for discussion. Jeremy, whom Rita called a “bright student,” stopped participating.

He concluded that Ms. Wilson was like “most teachers,” who “give you

class work and say, ‘Okay, the answers are in the book,’ not letting the student really think about the answers. So students never really use critical

thinking.” Taken together, these two cases, Rita’s and Linda’s discussions,

illustrate the importance of teachers’ explicit and implicit messages about

text meanings, student and teacher roles, ways of knowing, and purposes

for talking in discussion. Rita’s conflicting messages undermined her explicit invitation to discussion: Students saw that they were not authorized

to ask questions or give their own responses or interpretations in the class.

In contrast, Linda’s consistent messages that the purpose for talking was a

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problem-solving activity – making sense of a perplexing text together –

created new reciprocal roles in an engaging social space. The successful teacher initiated the social context for discussion, and the resulting

mediated conversation created a zone of proximal development – allowing

students to do together with assistance what they could not do on their

own.

teachers as mediators: supporting ways of talking

and thinking

Teachers who mediated discussion successfully listened well, providing

support carefully when it was needed – after waiting to see whether other

students might provide a next step or move. These teachers showed continual respect for students’ emerging new abilities, allowing roomfor students

to take responsibility for posing and pursuing questions.

Supporting Interpretive Questioning

Over time, the way of questioning and reading that Linda Mitchell

demonstrated and encouraged during discussion influenced how students

learned to discuss. She asked what she called “legitimate questions,” ones

she did not think she “knew the answer for,” in a manner that suggested the

text needed to be responded to and puzzled over: She began one discussion

with, “I wondered about why the fourth reason was different and I thought

we could talk about that.” Questioning the text in this way and publicly

sharing even vaguely formed responses became the habitual approach for

students in the class.

Linda also mediated specific interpretive strategies for trying to understand together by asking questions that structured a movement back and

forthfromstudents’ own experiences and responsestothe written text. The

manner of her mediation of these routines for meaning-making is evident

in the sequences of her questions during the first class discussion. Linda

responded to encourage movement from personal response back to the text

in 30% of her 20 turns, an emphatic signal to students to look at what they

were composing through the frame of the text. Within this one discussion

two students began to return to the texton their ownto question meaning.

Over time, discussions became more textual as students took on this useful

strategy that Linda fostered.

These students felt their developing sense of interpretive authority

most sharply when they pursued student-generated questions together.

In the 16th discussion of the year, for example (of an excerpt from Euclid’s

The Elements), Ivan was keenly perplexed about what Euclid meant by “A

point is that which has no parts.” Even before Linda could ask her prepared opening question, Ivan said, “I don’t understand this; can someone

explain this to me?!” This authentic question prompted students to go

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spontaneously to the chalkboard for the first time to draw their explanations. Ivan’s question produced a quickening of the talk: The group

examined their ways of understanding “point” and other concepts –

“angle,” “next to,” and “straight line” – in a closely textual discussion

that many, including the teacher, felt was their best. Students asked more

questions of the text and each other than ever before as they saw “so many

complications,” Laura said, that they had never considered when they had

memorized similar definitions for their first geometry test. Much as Dewey

(1933) argues, perplexity spurred their reflection.

The results of coded discussions showed that the number of student

substantive and probing questions and text-base comments rose in discussion of this “difficult” mathematics text and then was sustained at a

generally higher level for the last three discussions. Over the course of the

year all indicators for collaborative thinking increased, including student–

student collaboration and student-initiated questioning, interpretations,

explanations, and evidence.

Supporting Evaluative Questioning

In this same study, in contrast to Linda’s discussion focus on interpreting the text, another teacher, Pat Baker, structured questions that provided

strategies for an evaluative stance toward text meaning. She explicitly tutored students in evaluative question-finding by asking them to “focus in

on some of the stuff I just read” – say what the author might mean. Then,

she asked students to consider, “Do you agree with that?” For example, she

began discussion of Pascal’sPens´ eeswith “What is Pascal saying?” After

students made a few interpretive observations, she asked, “Do you agree?”

Rather than working only within the text to interpret it, the question suggests, students evaluate – they analyze whether they are with or against

the author.

Pat approached evaluation of text justifications with a similar strategy,

another questioning structure, which provided her with a solution to the

problem that she had early on identified – developing her discussion role,

that is, how to help students “to clarify without the teacher doing all the

clarification.” Her questioning routines supplied her with the answer. For

instance, she asked of the text written by Galileo, “How does he try to

prove his point?” When Tannis said, “He uses examples,” Pat followed

with this sequence of questions: “What is his example? [students provided one]...Show us where you have that [students looked at the printed

example]...So is he proving his point or disproving it?” This structured

movement helped students learn to move between claims and examples to

evaluate justification – Pat’s own approach to meaning-making. At points

of need she supported what she called students’ “working on a process”

of questioning and evaluating justifications for beliefs.

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After 6 months of discussion in Pat’s class, a student for the first time

took up Pat’s repeated request for students to pose the opening question

for discussion. The dramatic text by Thucydides was a conversation between Athenian and Melian leaders. Jane tentatively asked, “Do you feel

the Melians were right [to fight the more powerful Athenians and die],

or do you feel they should have given up?” After 43 seconds of silence

(an eternity in classroom time), Pat nudged students to respond to Jane’s

“excellent question”– an evaluative one that called for questioning the

values operating in the text.

Terry immediately responded, “I think they should have given in!”

When students in an alarmed chorus asked, “Why?!” she answered that it

was “a chance for survival.” Pat probed students’ unelaborated claims

until a specific problem of the text became focused, when Jane said

the Melians were fighting for a “just cause,” and Terry scoffed at this

version of the world as a “fairy tale.” In the face of the opposing perspective to which Terry gave voice, students searched for ways to persuade her in long stretches of collaboration without the teacher’s help. To

illustrate, the following sequence occurred at the end of discussion, after

Terry argued that the Melians should give up because the Athenians were

“stronger”:

(1) student:But they [Melians] are still going to fight [as Athenian

conscripts]!

(2) terry:I think that’s foolish. That’s foolish.

(3) jane: When it is one-against-one you should fight, but when it’s

a larger amount against a large, larger amount they should give

up? (A reference to Terry’s earlier comment that she would fight

a bully for her lunch money)

(4) terry:I’m just taking into consideration all the people’s lives that

are going to be lost. And all the people’s lives that are going to

be saved (students speak all at once).

(5) tannis:On page 98, in the last paragraph where it says it was “a

hard fight.” Okay, you don’t know. (2-second pause) For the ones

that got killed, yeah, some of them got killed, yeah. But the ones

that started the fight [Athenians], their men got killed, too. So

they are saying life was taken and they was fighting for a good

reason.

(6) don:Terry (2-second pause), they were going to have to fight anyway. Why fight on a side that you really don’t want to, instead

of fighting for something that you do want to?

(7) terry:They didn’t want to fight period. They didn’t even want to

fight for this (students all speak at once)

(8) jane: Terry, that’s what everyone is trying to tell you. So why not

fight for something you want to protect, rather than go over there

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and fight and help these people? (an idea supported earlier – help

Athenians conquer other peoples)

(9) tannis:For something you don’t believe in (4 seconds).

(10) jane: Do you understand that?

(11) terry:Yeah...(students speak at once)

(18) andre:(speaking for the first time, loud, above the rest) On page

96, the third paragraph, that sum it up right there. It say, “If your

subjects will risk so much to be free of you, how can you expect

us to submit to you?’ We’re still free. Shouldn’t we try everything

to avoid losing that?’ ”...Anything can happen in a war.

In this excerpt, students test the power of an array of justifications and

reasoning for their claims: framing a contrast to question Terry’s reasoning

(3); translating words of the text as a drama of self-defense (5); posing

questions of motivating choices in the text (6); recasting Terry’s objection as

an argument for fighting “to protect” (8) – and in other previous sequences

numerous examples, analogies, explanations.

Right after Andre’s text evidence (18) Terry said, “Okay, I agree, I agree

with that.” Students broke into applause, but then, immediately, asked,

“Why?” – a question the teacher had frequently asked her students. Terry

summed up the class arguments that persuaded her. It was “our best discussion all year,” both Jane and Terry later told me, spurred on by “my one

little opposition.” In this discussion students saw for the first time what

they could do together. They felt their community form around raising

their own questions and pursuing them collaboratively – the essence of

critical thinking (Dewey, 1933).

The results of discussion coding in Pat’s class illustrate the dramatic

changes that occurred in this class that at the beginning Pat said “just won’t

discuss.” The proportion of student turns taken in each discussion changed

from a low of 58% to a high of 88% in this turning point discussion, the 19th

of the year. The proportion of student–student collaborative turns made

similar changes, to a high of 76% of student turns, and was sustained at this

new higher level for the last coded discussion. Student-initiated substantive questions, probing questions, explanation, and text-based comments

increased in this discussion and continued to rise. The greatest amount of

providing evidence also occurred. These gains were accompanied by decreases in Pat’s questions. For example, she asked about one-third as many

probing questions as students did in this turning point discussion.

Pat’s students were quite aware of what had happened in the class and

of these changes themselves. Jane saw Miss Baker as “giving us things

we’re missing,” but Sam explained how, then, she began to “let it go

and see if it can go by itself.” As discussions changed and students initiated and sustained their own inquiry, Pat was able to begin, as Sam suggested, to “slowly break away.” Asking questions was a sign, Terry said,

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of “really thinking”: She explained, “At first it was hard,” but “as time

went on, we started making up our own questions,” and by the end, “we

led” discussion, in a process that gives “students more ability to think for

themselves....It is like we are in control.” Pat’s student Sam told me that

after class he had “discussions” in his mind, so that it was “hard to concentrate in gym class.” These and other comments suggest that the dialogue

of critical thinking was moving inward.

In these two case studies, the teachers successfully transformed classroom ways of talking by constructing a classroom epistemology in which

texts were open to multiple interpretations and ways of knowing. Teachers

mediated class discussions in these contexts, creating a zone of proximal

development in discussion by providing the mediational means at the

points of need for interpreting written and oral texts together. Over time

students appropriated socially useful assistance from teachers and other

students to solve perceived problems of meaning. In two classes the change

to new intellectual dispositions was evident in students’ conscious use of

the mediated social and cognitive strategies.

instructional assistance for students with many

needs−sharon’s classes

In the Literature Discussion Study

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(Miller, 1991a; 1991b; 1999) I worked

with a teacher who carefully “read” the needs of her students to figure out

how to assist their performance. Sharon Legge mediated students’ narrative modes of thinking in multiple activities, but particularly through

text discussions. She saw that to engage students in the “at-risk program,”

she needed to provide more instructional assistance than in her collegebound class. As students in both classes resisted and then took up her

invitation to share their thinking and feeling responses to literature, she

provided narrative strategies at points of need, including heuristics to

help students (1) notice narrative gaps, (2) pose narrative dilemmas, and

(3) speculate on possible intentions behind human actions by drawing on

their own lived experience.

Sharon created varying forms of assistance to meet the needs of her

seniors who were at-risk of not graduating. She used writing as a tool

for generating response, giving students time “to just jot down what they

think about something and read it back” as a means of starting discussion. When students had difficulties understanding first-person narratives,

Sharon read the texts aloud, functioning as a “fellow reader,” stopping

often to ask the class to respond and speculate about possible interpretations; in short, she externalized the internal dialogue of reading. Her

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This work was sponsored by the National Council of Teachers of English Research Foundation Grant-in-Aid Program.

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close attention to what students needed was at the center of her effective

teaching – both an intellectualandan emotional attentiveness (see DiPardo

and Potter, this volume).

Teacher-Mediated Discussion in the Narrative Mode

Students in the at-risk class, who had failed in other literature classes,

were not accustomed to drawing on their life experience in school. During

discussion Sharon drew on her connection-making strategies, improvising

stories of her own experiences – of a relative’s losing her memory, Sharon’s

refusal to go to her brother’s funeral viewing, an acquaintance’s being

illegally jailed – and in the process demonstrated how she used what she

knew from her own and others’ experiences as a tool to make sense of texts.

The questioning procedures she provided also supported students’

making personal connections. In one questioning structure, for example,

Sharon moved from talking about one part of the text to ask, “Can you

connect that to your experience?” and, then, in response to students’ experiences, “So what do you make of the text, based on that connection?” For

instance, as the character Adam inI Am the Cheesetried to figure out his past,

the doctor asked him about his earliest memory. At this point Sharon asked

students the same question. Students shared their memory stories for 21

turns and Sharon said, “What’s a common thread about the memories we

have?” Mark summed up, “They’re bad.” Kate said, “Scary.” Then Sharon

asked students to take their stories back “to the painful experiences Adam

has in the story” to understand his feelings better. Sharon was asking students to use their own “storied experiences” as “a basis for understanding

new action episodes by means of analogy” (Polkinghorne, 1995, p. 11), the

central move of narrative reflection in literature and in life. This repeated

sequence of Sharon’s questioning helped students successfully draw on

personal social knowledge to inform their understanding of narrative text.

These students soon began to appropriate this strategy. For instance,

when students talked of how Holden was rebuffed by a boy he had been

nice to, Cara spontaneously drew on her own experience, providing a long

storied explanation of how “that usually happens,” how “people seem

to forget” what you do for them, even “best friends.” Sharon asked students to connect this knowledge back to the text: “What do you suppose

Holden’s experience in that area has been?” Students then seemed to feel

Holden’s loneliness. Cara said, “He’s gotten nothing back from anybody.”

This ability to see the social, psychological dimensions of texts in ways

similar to viewing events from their own lives has been shown to be an

important strategy for making inferences about character actions, motives,

and goals, a strategy that is often excluded from school approaches to texts

(Hynds, 1989). In literature, readers always need to “supply what is meant

from what is not said” (Iser, 1978, p. 168), interpretive gaps even college

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undergraduates have difficulty bridging on their own (Earthman, 1992).

Sharon’s instructional assistance for inquiring into the gaps supported the

dialectic of narrative reflection (Bruner, 1986).

Student-Initiated Narrative Reflection

Increasingly these students felt the usefulness of elaborating responses to

develop their own understanding and persuade others and began to appropriate the strategies, “interiorizing” them, Vygotsky (1978) would say.

The discussions provide evidence that students were consciously engaging in the kind of dialogic reading and narrative reflection that Sharon had

been supporting all year. In many sequences they raised problems in the

text for consideration, made connections to their lives to try to understand,

suggested explanations that would fill the gaps in plot and character, and

returned to the text for further consideration.

A fairly typical sample of conversation from the end of the school year

shows how students initiated the learned narrative strategies as tools for

making sense and reflecting on narrative significance. As students read

their written responses to the film Stand by Me, Janet suddenly posed a

question in response to another student’s interpretation: “Why did it take a

stranger’s death to make Gordie realize that his brother was gone?...Why

did it make him grow up so fast?” Janet was clearly perplexed, even agitated, as she spoke, and students responded by speculating on reasons,

drawing on the text and their own experiences. They suggested that Gordie

had not been able to say good-bye to his brother and then that the brother’s

death was just too shocking and unfamiliar, as were the recent deaths of

their own classmates. Sharon listened as her students puzzled over these

genuine questions. Here is a sample of how these students had learned to

make narrative sense together (underlined parts spoken simultaneously):

(1) janet: When I heard that Bill Spear died, I mean I didn’t know

him, I knew he went to this school, he was my age, it didn’t

affect me in the sense of that I grew up.

(2) mark:But when Sammy Kelly [another classmate] died, it was just

like, when you’re a teenager, and–

(3) janet: Iwasemotionally attached to Sammy!

(4) mark:Like when you’re a teenager you don’t think there’s any

chance you’re dying until you’re old, and then Sam died –

(5) janet: It’s hard, there’s a lot of people, there’ve been four or five

people that died since I’ve been in school here.

(6) terry:Yeah, but you’re older, they [the boys in the film] were a

lot younger. They were just getting out of elementary schools.

They’re not used to really dealing with it.

(7) kate:They needed something visual to make them realize death.

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(8) terry:When you’re in high school and you’re a senior, I mean,

you’ve probably had grandmothers or a friend or somebody who

died, at least you have that realization then.

(9) joyce: When you’re younger, you think no one dies.

(10) terry:We have that maturity to deal with it, more than you have

when you’re younger.

The strategies for narrative reflection students used on their own here were

the ones that Sharon had been providing all year at points of student need.

It seems clear here that students used the strategies seamlessly – as tools of

the mind ready for use. At first Janet (1) made a connection in a personal

story of their classmate Bill’s death to suggest a different possible world

where death does not cause growth and awareness. Then, from their repertoire of stories, Mark introduced the story of how Sam’s death shattered a

belief they shared as teenagers (2, 4). With this connection, an experience

Janet had felt more keenly (3), she began to remember consciously (5) a different story of the possibility that another’s death might profoundly change

the living. Terry (6) continued this narrative potentiality by relating it to

the boys in the text, pointing out how differences in life experience made

Janet’s experience with Bill Spear less helpful in understanding Gordie, a

much younger boy. Kate (7) persuaded further by speculating on another

possible reason for Gordie’s realization: the physical–visual incarnation

of death shocked him into an internal change. Terry (8) entered in to finish working out the differences in perspective between them, as seniors,

and the 12-year-old boys in the film: She enlarged Mark’s comment to

suggest additional experiences teenagers their age might have had. This

collaboration illustrates live narrative reflection – students’ moving from

interpretations of their experiences to reason out the puzzling perceptions

and beliefs of the characters. As they shuttled back and forth between

personal experiences and the text, they used their connections to consider

together how the boys in the movie are both like them, in trying to deal

with death, and, unlike them, “a lot younger.” As they filled the textual

gaps with connections to their own lived experiences, they developed personal relationships with the text and each other. Such recurring instances

of students’ attention and desire to understand impelled their aesthetic

and narrative reflection.

In discussions such as thisStand by Meexcerpt, students were engaged

in narrative reflection that “gives us explanatory knowledge of why a

person acted as he or she did; it makes another’s action as well as our

own, understandable” (Polkinghorn, 1995). In the whole stretch of discussion, they sustained their narrative reflectioninterdependentlyto understand the significance of a shared experience for the problem they posed

and pursued. Greene (1995) argues that the kind of question Janet asked

about what it means to understand death “can be refined only by sensitive

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inquiry, by dialogue, by connectedness” (p. 102). Brett, who was headed

to the navy after graduation, was conscious of how the dialogue had

become part of his thinking: “Discussions in Ms. L.’s class always have

meaning....We always talk about what we are reading so everybody gets

these questions....We ask questions of ourselves and if they sound good

we ask them aloud. We learn from everybody else’s experiences as well as

our own when we take part.” As students appropriated tools for their own

inquiry, they were learning to use narrative as “an instrument of mind on

behalf of meaning making” (Bruner, 1986, p. 41).

mediating cultural critique in literature

discussions

On one level, the mediated strategies for making sense of texts in the previous studies were varied. From another view, however, many of these

sense-making strategies required students to work primarily with the text

to interpret it, rather than questioning the text to critique its assumptions.

An important question thus arises, Which habits of mind do teachers mediate through literature discussion? (Miller, 1996a). Sociocultural theorists

who focus specifically on social uses of language as markers of identities and group membership suggest that the worldviews of texts must

be part of what we teach. For example, Gee (1996) suggests that to develop powerful literacy students need to learn to critique the dominant or

mainstream cultural discourse, with its worldview, through the lens of a

secondary discourse. This notion is congruent with Bakhtin’s formulation

that only through “interanimation” of different social languages can one

engage in critical thinking by becoming conscious of such languages as perspectives and actively “choosing one’s orientation among them” (Bakhtin,

1981). In current literature scholarship, many (e.g., Scholes, 1985) argue

that students need to learn how to question and historically contextualize

texts to gain textual power through consciousness of embedded cultural

values. In only one context that I studied – three integrated English–

social studies classes taught by the same pair of teachers

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– did teachers consistently provoke and support this kind of critical thinking about

narratives.

Assisting Critical-Narrative Thinking

The long-term problem for the integrated English–social studies class –

composing a coherent personal vision of the American Dream – served

as a guiding inquiry for students (Miller, 1996b, 1996d, 1998b). Several

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“ongoing conversations” characterized the talk and activity of the class as

they pursued this problem. Kira called it “the back and forth” of the class,

which included the recursive movement between the private and public

(e.g., from private journals to public discussion to private journals), between fiction and nonfiction texts (e.g.,The Jungleand the Statue of Liberty

inscription), and among social–cultural perspectives (e.g., early Europeans

and Native Americans).

In the Native American/Immigrant Experience theme, for example, students all read Hawthorne’sThe Scarlet Letterand individually read Native

American fiction, autobiography, and biography, which they reported on

and discussed with the whole class. Films included the fictionalThunderheartandAvalonand a documentary on Geronimo. Students individually

researched, wrote, and reported on family immigration histories and also

wrote poems about the Native American experience. By using stories of

the lived experiences of individuals or groups, whether autobiographical

or fictional, the teachers aimed to have students understand the “effects

of [historical] events on people’s lives.” As one student described it, “We

talk about the little struggles of people, rather than only the big struggles

of countries.”

Sharon, the English teacher described earlier, later in her career collaborated with Ron, a social studies teacher in this class; together they aimed to

create an “ongoing dialogue of history and stories and events.” As students

“entered into” lived experiences in reading literature and dramatizing history (e.g., the Columbus Trial and labor history newscasts), Sharon and

Ron supported activities and provided instructional tools. Sharon again

used the narrative reflection strategies that had been successful in the atrisk class – such as guiding students to connect their own experiences to

the text to make sense of narrative gaps. In addition, new conversational

strategies emerged for helping students reflect on their own and others’

assumptions and values – including raising alternative cultural perspectives, questioning the author’s values, and seeking missing voices. A key

heuristic mediated and learned in the class was a series of questions central

to critique of power and social relations: “Who is the speaker?” “What is

the speaker’s agenda?” “What voices are left out?” This sequence became

the basis for a critical-narrative text stance, which specifically asked students to make sense of stories, but also to question perspectives and stories

and to generate alternative cultural perspectives or stories not presented

by a text (or a discussion). Students were well aware that Sharon and Ron

provided them with what their student Nick called “major tools for understanding” both texts and social issues. As Maria saw it, “We’re kind of

taughthowto think, which is not taughtwhatto think....You have to catch

everything, you have to put it all together...everything connects to something else.” During the school year students in all three classes learned to

use these teacher-mediated tools consciously to engage in cultural critiqu