DOCUMENT RESUME

ED 393 837 SP 036 602

AUTHOR Duran, Bernadine J.
TITLE Language Minority Students in High School: Replacing Basic Skills Instruction with Explanatory Models.
PUB DATE Feb 96
NOTE 28p.; Paper presented at the Annual Meeting of the American Association of Colleges for Teacher Education (Chicago, IL, February 21-24, 1996).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS College Bound Students; College School Cooperation; *Concept Teaching; English (Second Language); Higher Education; High Schools; Instructional Innovation; Language Role; Language Skills; *Learning Processes; *Learning Strategies; Limited English Speaking; *Mexican Americans; Models; Multisensory Learning; Prior Learning; Secondary School Science; Social Studies; Student Role; Teacher Role; Teaching Methods; *Visual Aids
IDENTIFIERS Illinois (Chicago); *Language Minorities; Teacher Centered Instruction

ABSTRACT

This paper describes an instructional approach for language minority students in high school science and social studies--using explanatory models or graphical representations of disciplinary concepts to guide students systematically as they construct a concept or conceptual relationship. Data came from a longitudinal study of two successive groups of Mexican American high school students in Chicago who were attending a weekly outreach program to enhance their academic skills for college. As the first group was studied and their learning strategies became more apparent, a method for expanding those strategies and energizing more active use of everyday concepts and language was refined for use with the second group. A preliminary analysis of observations indicated that students were hindered in learning complex concepts because the strategies and skills they possessed were too limited. At the same time, students brought many social skills to classroom interaction, indicating their high motivation. After much reflection and experimentation, teachers realized that literacy experience in one or both languages prepares students to use language for learning. Teachers could then focus on using explanatory models to present content and influence learning without requiring a mediating academic language. This experience led to the conclusion that substituting language arts instruction for appropriate high school content is unacceptable educational policy because it closes the door to higher learning. (Contains 25 references.) (ND)

Language Minority Students in High School: Replacing Basic Skills Instruction with Explanatory Models

Bernadine J. Duran

DePaul University

American Association of Colleges for Teacher Education

1996 Annual Meeting

Chicago

Language Minority Students in High School:

Replacing Basic Skills Instruction with Explanatory Models

The purpose of this article is to describe an instructional approach for language minority students in high school science and social studies. A model of instruction is offered to replace basic skills instruction with the use of explanatory models as a means of teaching disciplinary knowledge to a population of students who, research shows, has difficulty with independent reading of subjects. Explanatory models are graphical representations of disciplinary concepts that guide students in systematically constructing a concept or conceptual relationship. This instructional approach shows how explanatory models enable teachers to manage the social interaction of instruction to transform students' prior knowledge and language as they cognitively construct disciplinary concepts. Our research focused on Mexican American high school students.

Background

Students whose home language is not English are challenged by the need to develop the reading proficiency assumed by high school teachers and textbooks. If they are unable to do so, their achievement lags behind that of their English speaking counterparts. Although reading skills generally influence high school achievement, the influence of reading proficiency on academic success of language minority students is particularly strong (Buriel & Cardoza, 1988; Nielsen & Fernandez, 1981). Even high achieving math students struggled. Differences in ACT achievement in sciences and social studies were related to proficiency in reading in the ninth grade (Duran & Weffer, 1992).

For primary school children, studies showed their reading performance was directly related to their English proficiency (Garcia, 1991). In high school, language background (an unmeasured variable) was indirectly related to achievement through basic reading skills (Duran & Weffer, 1992). Generalizing from studies of primary school children, the findings of high school research have also stressed the importance of overcoming a limited English background by improving reading skills. The typical instructional outcome was a reemphasis on basic reading skills including memorizing additional vocabulary and drills in English grammar. Currently, this approach (which yielded poor results) is criticized because it fails to recognize the general literacy skills of bilingual children including their enhanced metalinguistic awareness. Critics point out that bilingualism creates an enhanced awareness of language as a tool for organizing the physical/social world and communicating understanding (R. Diaz & Klingler, 1991). They fault instructional practice for not assessing and utilizing the strengths of the bilingual learner.

Given the input-output nature of school outcomes research, it is not surprising that educators have differed over the instructional implications of the findings. To address the absence of more direct observation of students' learning process, recent research has focused on identifying the specialized characteristics of learners who use more than one language (R. Diaz & Klingler, 1991; Garcia, 1991; Moll & Greenberg, 1990; Ramirez, 1992). However, this research described language minority students in elementary school and does not address the particular issues involved in mastering the abstract concepts of high school subjects. Moreover, critics have targeted basic skills instruction as a source of the reading difficulty experienced by language minority students in high school (Donato & Hernandez, 1993; Trueba, 1987). They argue that instruction organized around basal readers, language drills and writing workbooks results in low quality literacy skills (S. Diaz, Moll, & Mehan, 1986; Duran, Dugan, & Weffer, in press; Reyes & Molner, 1991). A higher quality literacy approach would teach the metacognitive strategies that enable good readers to interpret text structure, overcome poor text organization and focus learning on the construction of key disciplinary ideas. They also point out the irony of an instructional method that provides limited English students with less, rather than more oral practice with the discourse of school subjects.

However, what these critics regard as most harmful are the conclusions that result when second-language learners are provided more basic reading instruction and they still fail to advance. Language minority students are viewed as having deficits beyond the resources of high school teachers and are treated as low ability. Critics point to the similarities between the instructional approach used with these students and the compensatory education approach used with low ability students (S. Diaz et al., 1986; Donato & Hernandez, 1991; Reyes & Molner, 1991). This has led science teachers to substitute a less demanding content and scale down their academic expectations of language minority students (Duran, Dugan, & Weffer, 1996; Duschl & Wright, 1989). For students, the combination of reduced teacher expectation and basic skills instruction teaches them to manage their learning with strategies and goals more appropriate to basal readers than to disciplinary textbooks.

Learning Process

Our research with Mexican American high school students began as achievement outcomes research but shifted to qualitative study of their learning proeess as we became concerned about the effectiveness of existing instruction to prepare them as effective learners of high school subject matter. We undertook a longitudinal study of two successive groups from the public high school in a community that served as an entry point for Mexican immigrants to

Chicago. Our intent was to describe the process of instruction as students interacted with teachers and textbooks and to use that understanding to devise a method for teaching/learning cognitive strategies helpful to constructing disciplinary concepts in high school. The students were participants in an outreach program sponsored by the university to enhance their academic skills for college, particularly the quantitative professions. The program met on Saturdays during the school year and student attended for four years. In the first year, students were interviewed extensively about instruction before high school and asked to draw comparisons with current instruction. In the second and third years, students were studied as they learned biology (cellular processes) and history (industrialization as a theme). As the first group was studied and their strategies for learning became more apparent, a method for expanding those strategies and encouraging more active use of everyday concepts and language was devised. The instructional approach was refined, used and studied with a second group. The study of their learning process continues at present, and we expect to pursue this research with language minority students at other schools.

Although our findings are preliminary, we believe that these are important for informing teacher educators about the effects of past instruction and about an empirically derived method for advancing language minority students to conceptual learning. First, our theoretical approach led us to examine learner process from two perspectives, as a member of a social group and as an individual changing over time. Student actions were interpreted as both individual expression and as a role response to situations defined by a variety of social and cultural contexts embedded in instruction. We viewed individual learner skills as a response to the social expectations defined during instruction. From this viewpoint, we identified the cognitive strategies that these learners possessed before instruction, the kinds of strategies that they were expected to use during instruction, and the strategies that they were taught during the course of instruction in biology and history. Thus, our research attempted to distinguish what they knew from what they needed to know to learn disciplinary concepts. It also attempted to distinguish instruction related to disciplinary content from instruction related to the strategies helpful to learning that content. Because of the longitudinal framework, we were able to observe changes in language use, cognitive strategies, and conceptual understanding that followed our instructional intervention. The multi-year time frame enabled us to describe which behavioral changes were short term responses and which transferred to learning other subject matter. For example, certain writing skills might apply to history as well as science.

Second, our focus on actively supporting students' efforts at learning enabled us to identify instructional techniques that were supportive of their beginning actions to construct meaning. Thus, the instructional method that evolved originated from their actions (successful and unsuccessful) as they reasoned about logical relationships, constructed meaning, and transformed language to accommodate the new knowledge base. Following work on the richness of everyday learning (Cole, 1990; Rogoff & Lave, 1984), we adopted the perspective that students had developed communication skills that were interpersonally effective and, thus, had an understanding of the functions of language generally. We studied how they viewed the functions of student talk and teacher talk in the classroom. We proceeded by identifying their natural use of language during instructional conversations and then showed them how to use those skills to learn academic content. As regards motivation or self-concept, we interpreted their interest in college as an indicator of past academic success and of their confidence in being able to learn new content.

Students' Prior Skills

Our findings, which are described more extensively elsewhere, are summarized here to illustrate their prior level of academic skills. First, we found that the strategies they used for learning disciplinary concepts were the general strategies that they acquired for reading and learning academic information prior to high school. (They distinguished their learning outside of school as "more hands on".) They were adept at a limited number of strategies, and these were relatively resistant to change because of their past and current success in school. We observed the social interaction between teacher and students in which they renegotiated the academic task until it could be managed by the strategies students possessed. For example, students had difficulty reading their school textbooks so they avoided reading our biology text unless it was a classroom activity. They responded enthusiastically to teacher lecture and asked many questions about body functions (e.g., Is it true that ...?). Hence, the amount of direct instruction increased, which reduced the amount and form of information covered. Students memorized definitions, names of things, and theoretical principles with ease. They did well on tests such as listing the functions of the cell, but had difficulty relating that information to the functions of organelles and other cell structures. They discovered the limits of memorization when they were required to outline the changes in the cell when a person is exposed to smoke from an apartment fire. They also discovered that their written notes of the teacher's lecture were not helpful in reconstructing the process that they wished to describe. They had recorded items written on the chalkboard but the construction of meaning was fragmented rather than systematic. They devised a strategy for working together so they could combine ideas. They struggled with the idea that a concept was not a definition to memorize, but rather an idea they could use to understand real world events. They had no prior academic experience with structure-function relationships.

Writing assignments required large amounts of time to complete. The majority had little experience with answering essay questions and little awareness of scripts for composing formulaic writing such as compare-contrast. They asked numerous times how to construct an answer. They generally covered main ideas, but they were uncertain about the addition of details and other elaborations. Our analysis of their school work indicated that students in the honors courses were expected to write report or summaries of their reading, but they were not given instruction on how to write these. Few reports included an introduction to the topic or drew conclusions at the end. Other students had reports that were unmarked and ungraded. Their understanding was that the purpose of the reports was to document that they had done the reading. They were ambivalent about whether teacher feedback was desirable. Students, currently enrolled in the bilingual program, had not been taught the function of text structure. Their experience focused on sentence writing so they presented their ideas in a list of sentences down the page. Their logical reasoning imparted a logical ordering to the sentences, but they had to be taught how to impose a hierarchical ordering through the use of paragraphs.

A preliminary analysis of our observations led us to the conclusion that these students were hindered in learning complex concepts by the failure of prior instruction to provide the procedural knowledge for systematically constructing disciplinary concepts. The strategies and skills they possessed were useful but too limited. For example, their reading strategies were sufficient for a literal construction of the textbooks they encountered before high school, but these did not lead them to grapple with meaning at a deeper level when they encountered disciplinary texts. They constructed the text base in linear fashion, as if it were narrative structure. Moreover, because prior instruction had included little experience with monitoring the effectiveness of different cognitive strategies, they did not maintain an awareness of the quality of their understanding. There was little need to acquire additional strategies so long as surface understanding of subject content met teacher expectation.

On the other hand, they brought many social skills to learning. We concluded that the social skills exhibited in classroom interaction and interpersonal communication reflected their interest and motivation to achieve academically. They valued and respected the authority of disciplinary knowledge and wanted to participate in social transactions involving the discourse. Despite their trepidation with written discourse, they engaged in oral discourse whenever invited. They valued the expert knowledge of the teacher and maintained a climate of mutual respect when students participated in that role. Overall, their actions fit well our intent to design an intervention that would respect and value what they had accomplished to that point. While we did want to engage them in renegotiating their participation in academic tasks, we did not wish to begin by devaluing their literacy skills or by concurring in the view that they might be responsible for the gaps in instruction between primary and secondary school. The latter was a particular problem because second language learners are prone to interpret missing information as a failure in language processing rather than a communication breakdown in the instructional conversation.

Instructional Method

Having concluded that their skill level in literacy and metacognition represented the end point of their prior instruction, we wanted to identify strategies that would be useful to this group as second language learners. We begin by presenting them with additional strategies for understanding oral and written discourse. As we identified the need for other strategies or practices, we were able to organize these in a method of instruction with specific goals and a set of practices. However, in designing the intervention we rejected the idea of beginning with a concern for their prior knowledge. It had become clear to us that describing students' prior knowledge was beyond our conceptual grasp. Even in our small group of students, there were different versions of knowledge and skills that translated into many different behaviors depending on the instance in which these were utilized in social transactions. Cognitive theory has not progressed to classifying differences in prior knowledge states and relating these to individual behaviors during instructional transactions (Wertsch, 1990).

Since we wanted to minimize assumptions about their prior knowledge, we focused on those aspects of instruction that would allow this. Our observations of students and our initial attempts to collaborate with them in constructing concepts showed us that they would learn complex concepts if we did not overwhelm their ability to process language. Supporting their cognitive and linguistic processes required explicit explanations and graphically represented concepts. Thus, we devised a method for teaching the subject matter of high school by causing instruction to be comprehensive and explicit in all respects. This meant that, initially, we shifted the responsibility for teaching/learning away from the presumed independent learner to the resources of the discipline community, especially the teacher who represents disciplinary expertise in the classroom.

To manage this within instruction, we drew upon the research concerning the mental models of novice and expert learners. Mayers (1989) has shown that graphical models developed by experts can be used by novices to understand complex mechanisms and processes in science. As an instructional technique, we were interested in a parsimonious method for introducing disciplinary content. The volume of subject matter taught must be manageable by these students, and this must be accomplished without compromising expectations for learning content at the appropriate grade level. We constructed graphical representations of the concepts and relationships that we intended to teach and called these explanatory models. The model was intended to focus student attention on major concepts and conceptual relationships in the discipline and serve as a guide to understanding complex material. For each major idea taught, an explanatory model was the entry point for teaching/learning.

Explanatory Models

The explanatory model was the focal point of our instructional method with language minority students. Overall, instruction was in a framework that addressed the cognitive, metacognitive and social components of learning. Our goal was to identify content for cognitive processing, indicate the procedures including sequence for explaining content, and indicate the social activities in which both cognitive and metacognitive actions occur. The modeling of information accomplished this. The construction of explanatory models of key conceptual relationships identified the important content and exposed the reasoning by which meaning was constructed. Since the model was the focal point of instruction, it also mediated the social interaction of instruction including the social roles of participants and the functions of language. Because the model caused thinking about concepts to be visible, the effectiveness of instruction was in a form that could be monitored as individual learner process as well as social process.

Our approach began with a consideration of the content that we wanted to teach. In this respect, we distinguish what we do from what the textbook does as a more comprehensive resource. The goal in selecting information was to assist a learner who is unfamiliar with the discipline to identify major concepts and conceptual relationships that are fundamental to the discipline. These are the concepts that give students entry into the discipline. The criterion for selecting idea units was coherency. As concepts were connected in relational statements and relationships connected in higher order principles, the knowledge base as a whole had a complex but coherent organizational structure. The structuring of information involved hierarchical relationships in which global structures incorporated more specific relationships or concepts. The hierarchy of relationships implied functions and processes that were increasingly complex. Vygotsky (1978) referred to this as the systematic nature of disciplinary knowledge.

Relying on the organization of ideas inherent in the knowledge base, we selected a major chunk which could be broken down into smaller chunks, each of which was relatively coherent (van Dijk & Kintsch, 1983). For us, this meant organizing information under a central theme in history or a major scientific principle in biology. We generated a structure that is a model of the target information through diagrams, which can be elaborated or connected to represent conceptual relationships. For example, a study of the cell in biology involves an analysis of the arrangement of structures and functions that are organized into increasingly complex structures and functions. Further, cellular process involves the arrangement of many smaller processes that are repeatedly re-organized to carry out major life processes; some are relatively specific like protein synthesis while others are more global like homeostasis. To understand the cell as a whole, we divided the general concept into a study of separate structures which were then re-organized into a global idea unit of the whole. Our cognitive goal was to construct knowledge structures made up of small, coherent idea units that were connected mentally through their interrelationships into a larger idea unit for the whole. Thus, the study of individual cell components was re-integrated into the study of cellular processes of the whole. For this, we used diagrams of the cell as a whole, diagrams of specific organelles to explain unique functions, and a global diagram of the cell membrane to illustrate methods of active and passive transport related to organelle functions. The model of the cell becomes increasingly complex as each layer of conceptual understanding is added.

Learning Strategies

The procedures for constructing a coherent knowledge structure are implicit in the subject matter. Teaching students to understand the cell as the basic unit of structure and function in multicellular organisms implies a study of structures and their functions but also suggests strategies to accomplish this. In this respect, disciplinary procedures point to the major cognitive tools for processing and organizing content. Thus, what was modeled by the explanatory model was the relationship between structure and function. The instructional strategies used in conjunction with the model were those that explicate the relationships in the model in terms of structure and function. These strategies and their use guide students in constructing a mental representation that mirrors the form of the disciplinary concept so that it can be incorporated into a more complex structure of related concepts.

Our instructional method involved the use of three types of strategies: situating explanations in the discipline, integrating concepts through a study of process, and teaching disciplinary tools which enable students to grasp the abstraction beyond the concrete experience. First, we situated our discussion of structure and function in the discipline of biology. When we attempted to teach this relationship as a generic topic, we found that students who are unfamiliar with the concept do not automatically see its application to the discipline. This subsequently hindered their confidence in learning the relationship as a disciplinary concept. By contrast, when we discussed how a biological structure functioned, we were able to contextualize the explanation in a discussion of why this activity was important. Because their understanding of real world events was situated in solving life problems, this form of reasoning made sense to them and allowed them to use their prior reasoning skills in problem solving to understand biology. It appeared that they generated a rudimentary understanding of the conceptual relationship for structure and function through extracting it from experiences they could make sense of using their own mode of reasoning. Through a repeated use of this strategy, they acquired experience with how this conceptual relationship guided them to organize and relate information. They learned that engaging in this type of activity is an important procedure shared by participants in the scientific enterprise and that skill is acquired through practice. We also used references to real world biology to assist them with monitoring their understanding by engaging them in practical applications to situations at home or school.

Our method of decomposing the explanatory model into component concepts created the need for a set of strategies for integrating the separate idea units. It was apparent that students had fragments of information about individual cell structures that were not automatically integrated into an understanding of cell functioning generally. Our cognitive goal was to connect these idea units using disciplinary tools and procedural knowledge while maintaining student awareness of why we were following the sequence of procedures. Since students had a basic understanding of cell structures, the next step involved studying cellular processes that showed the relationship among structures in a sequence of activities. This clarified their understanding of the purpose of cell functions, while explaining the manufacture of familiar items such as proteins. Because these students had limited experience with a detailed discussion of a process, this was a key step. They needed guidance in realizing that the purpose of learning basic concepts was to understand process. They also needed instructional support in recognizing when their school textbooks included both types of learning because the textbook format did not always develop the information in the logical sequence of our instruction. Subsequently, we were able to use their understanding of protein synthesis to read independently and discuss a related process, membrane synthesis. The sequence of these learning activities was important to elaborating and extending the core ideas that they learned first.

However, even this careful attention to understanding concepts and their relationships did not automatically generate an understanding of the concept as an abstraction that would transfer as a conceptual approach to new information. For example, they could distinguish active and passive transport but had difficulty generalizing this distinction into a means of categorizing the activity of molecules not directly discussed. This led to the routine use of a third type of strategy. Sigel (1981) had pointed to the need for strategies that instill distance between the learner's concrete experience of an object and the abstract mental representation of it that can be used for academic purposes. Since then Wertsch (1985; 1990) and other social constructivists (e.g., Moll, 1990) have pointed out that the mental representation in memory is not detached of its socially situated referents. Hence, what is retained in memory is abstract mainly in the sense that is representational of whatever is memorable in the actual experience. It is not abstract in a theoretical sense. However, when students' conceptual experience is anchored in disciplinary practice, these connections are potentially helpful to seeing patterns among relationships, which is abstract thinking.

Although we found that situated learning did not generate automatically the higher order patterns that constitute theoretical relationships, it did form the basis for advanced learning involving scientific principles. We observed that, when students drew their own diagrams of complex process, they clarified their understanding of the operational activity involved. Their diagrams externalized misconceptions that could then be repaired, which increased their awareness that their learning was also in a mental form that they could control. We inferred that the external model of their thinking stimulated analysis in a more abstract manner because they were aware that they were manipulating a conceptual representation of the process. To test this hypothesis, we looked for other tools that could be used for this purpose.

We were familiar with the practice in more advanced texts of using tables to organize information into categories so that conceptually related information can be summarized in a succinct form. We considered this a powerful tool of disciplinary practice that could be added to instruction. Most of our students were aware that tables presented a summary of information, but had no experience with how these were generated. Consequently, they were unaware that the relationship among categories could be analyzed to achieve a more advanced understanding of the concepts involved. They experienced their first discussion of tables as a tool of science. We examined how tables explain the relationship between concepts, such as active and passive transport of molecules, by reflecting on the characteristics of the two types of transport and making predictions about the transport of molecules not in the table. From this discussion, they realized how science progressed from experiments with specific real world things to more general statements about the categories to which those elements belong. Obviously, this type of discussion requires considerable instructional support, but it did explain scientific practice in a manner that made sense to these students.

Social Process

Because our main goal was to find a means of explaining subject matter to language minority students, we did not plan specific social interactions but rather, allowed these to emerge from the requirements of the task. Together, the content of the explanatory model and the sequence of activities related to its use as an instructional means suggested a social process. First, since we began instruction with the viewpoint that students did not have conceptual knowledge directly related to the academic task, we took responsibility for selecting and identifying content. Second, we accepted responsibility for guiding them in the use of explanatory models so that they constructed concepts and relationships in a logical coherent set of ideas. We also recognized that, initially, we would model the use of conceptual language and scientific tools. However, our expectation was that they would learn through our interaction to accomplish these tasks for themselves. To combat student inclination to memorize or to be confounded by learning that did not end in a simplified right answer, we engaged them in oral practice with explaining concepts and relationships. Through repeated practice, they were able to transform their prior language use to accommodate the terms and relationships of biology.

This type of activity placed us in the role of experts and students in the role of novices who were expected to learn through guided understanding and practice. As they achieved an understanding of basic concepts, they became capable of taking on increased responsibility. They were expected to use their conceptual knowledge to understand new information and to engage in scientific talk. We had in mind Vygotsky's framework of the zone of proximal development, because it suggests when novice learners should take responsibility for independent practice. Although we allowed them to negotiate teaching/learning responsibilities, we did not permit them to avoid writing tasks by doing poor work. For example, they could renegotiate a difficult task in order to gain psychological support through collaboration with others, but the composition was their own work. What eventuated was social interaction in which we had different roles based on expertise. What changed was the social responsibility that the different roles involved. This also resulted in changes in instructional talk. Conceptual understanding empowered students to participate in the authoritative talk so their talk increased and became more collaborative with peers and less directed at the teacher. Their questions became matters of inquiry related to application of concepts rather than wondering about science as mystery. Changes in student participation occurred in three phases: (a) students as audience for authoritative talk and expertise of the teacher, (b) trial and error disciplinary practice with teacher support, (c) participate in authoritative talk while applying concepts to real world events.

Discussion

Prior Knowledge

It is important that we distinguish our strategy for addressing prior knowledge from knowledge activation procedures used more typically in instruction (e.g., "brainstorming" ideas). In that approach, the goal is to bring forward a related idea so that the new information can be connected to an existing scheme. The assumption is that the criterion for relatedness is determined by someone other than the learner. By contrast, we assume that students always possess relevant knowledge, and only they are aware of the multiple strands that create associations between ideas. Further, we do not believe that cognitive theory has advanced to characterizing the complex knowledge associations that form from fifteen years of life experience. In brief, cognitive science is unable to predict the functioning of that complex mental structure. However, research, since Piaget, indicates children learn early to organize their understanding in spatial, temporal and causal terms. Many of these elements are reflected in the mastery of narrative structure during primary school in which they demonstrate their understanding that people have motivations, solve problems, and engage in actions that have predictable consequences (Graesser, Singer &Trabas. ~, 1994; van Dijk & Kintsch, 1983). When we assume related knowledge, we give learners the social responsibility for figuring out how they will use it to understand the current discussion. The teacher's responsibility is to expose the reasoning that explains the conceptual relations under study so that learners can determine relatedness.

We managed this during instruction through the use of explanatory models that identified the nature of the conceptual relationship and exposed the type of reasoning involved. If they made sense of the relationship in the model, we inferred that they accomplished this by utilizing prior understanding. If not, we collaborated in constructing an explanation and began with a situating strategy. During this process, they invariably discovered and used related ideas. The instructional experience was repeated while they gained experience with reasoning in the discipline. Once they understood basic disciplinary concepts, we did expect to influence the connection between old and new knowledge because these are predicted by the knowledge base of the discipline.

Transforming Prior Knowledge

Constructing concepts was a collaborative process. As we supported student efforts in sense making, it appeared that they were reworking prior reasoning to accommodate the disciplinary situation discussed. For example, we discussed the actions and events reflected in the conceptual model as simple causal reasoning until they could transform their everyday causal reasoning about events to accommodate those described in the disciplinary context. Their problem solving skills translated into reasoning about events in history more quickly than in biology. The transformation occurred through repeated practice with disciplinary situations during instruction. The role of the teacher was to support student efforts to understand causal reasoning situated in an unfamiliar context and, subsequently, to engage students in using their newly created schemes to interpret other actions and events. The sequence that we described for constructing and integrating conceptual information appeared to facilitate the transformation, possibly, because it clarified relational connections that students would not likely articulate without instructional guidance. The transformation of earlier forms of reasoning was an active process on the part of the students involving much trial and error. We could not predict with confidence when a strategy would succeed. In this regard, cognitive science has much to learn.

Language Effects

Language played a major role in the transformation of prior knowledge. Although our research began with a concern for student language skills, we shifted our focus when we observed that students clearly understood the functions of language in communication and learning. For example, they expressed their ideas about causality and problem solving in sentences structured to convey their meaning. It was, however, their everyday language and did not reflect the precision required by scientific language. We speculated that, as they learned the concepts and relationships of the discipline, they would also acquire the vocabulary to label these. In our view, this was not learning English as a language; rather, it was adapting their everyday use of language to a new context. The disciplinary context required them to generate a specialized version of their everyday language to accommodate specialized meanings for familiar terms such as cell, transport, and structures. This was less obvious to them in history than in science, where the quantity of items that required labeling was high. We interpreted the construction of complex concepts as cognitive tasks, not linguistic ones. In this regard, the explanatory model that exposed conceptual relations was a helpful mnemonic for recalling the verbal labels during learning. The transformation of language that accompanied the growth in conceptual understanding was straight forward and did not require teaching/learning intermediaries such as some version of academic language.

The interworking of language and thought described by Vygotsky (1987) and others (Wertsch, 1985; 1990) was evident in the sequence of cognitive and linguistic transformations that resulted in conceptual understanding. Our interpretation is that their general language for expressing causality (as in, this made that happen) became differentiated and specialized to accommodate the processes of biology and history. In disciplinary relationships, causal relations are frequently quantified so they adapted to expressions such as an increase in A led to an increase in B. Qualitative differences were also accommodated as they learned to distinguish between contributing factors and direct cause. The use of a graphical representation to support their learning was important because it supported language practice. Students could refer to diagrams and engage in discussions of relationships. Without instructional support, their participation in conceptual talk would have been limited, and authoritative talk would have belonged to the teacher and a few advanced students. Their use of the diagram enabled them to distinguish conceptual difficulties from those associated with transforming language. Because of student belief that their language skills were the source of learning problems, it was important to keep this information before them.

For these language minority students, their language skills were not an obstacle to learning disciplinary concepts in high school biology and history. However, the basic skills approach used to teach them English literacy did result in a student perspective on learning that was a hinderance. In school, they struggled with language skills so often that they viewed their language skills as the cause of their learning difficulty. They constructed a belief in which a part of their identity was the cause of their academic problem and, therefore, was beyond change. Not surprisingly, this caused them to feel alienated from language use during instruction. Combating this belief was a major challenge whenever they encountered conceptually difficult tasks. They had to be reminded that they were hindered by not using the right strategies and not by using their language. When we were successful in overcoming this belief, we accomplished this by focusing on the cognitive means of constructing concepts and leaving it to them to use language pragmatically for labeling the process and participating in communication.

Instructional Implications

Teacher educators must restudy their instructional approach to language minority students. They can began by revising their conception of the learner. Rather than view student language skills as a problem in prior knowledge, they might recognize that the literacy experience in one or both languages does prepare students with the knowledge of how to use language for learning. This perspective allows teacher educators to focus their efforts on managing instruction so that content is presented in a form and rate that does not assume the automated processing of a native speaker of English. Instruction that relies on independent reading of school texts or on auditory processing of lecture does not provide the language support needed to engage cognition. Our instructional approach, which guides construction of conceptual models through pairing visual and auditory information, is one method of planning and implementing instruction in this manner. Our research findings are offered to provide teacher educators information that will enable them to formulate a more effective instructional approach. The key element in our approach was to support language processing of cognitive tasks. Our use of explanatory models to teach/learn disciplinary concepts and support language enabled us to directly influence learning without requiring a mediating language. While it has become common practice to direct instructional efforts toward building an academic language so that students can learn academic concepts, we found this step unnecessary. We also suggest that it might be necessary to revisit the theoretical basis for this practice.

Poorly conceived instruction causes teachers to seek alternative subject matter. High school teachers should not be distracted from their primary purpose of teaching disciplinary knowledge. If they are misled into thinking that they must identify prior knowledge structures upon which to anchor new information, they are led in this direction by poorly explained cognitive theory. Common sense and some reflection on everyday learning shows us that this sort of control over the process is unnecessary and that learners routinely manage such matters for themselves. In high school, it is critical that language minority students learn disciplinary concepts regardless of prior instruction because this is the knowledge that prepares them for higher education. Substituting language arts instruction for appropriate high school content is unacceptable educational policy because it closes the door to higher learning. Curriculum and instructional bear responsibility for enabling teachers to be effective with diverse groups of learners. To achieve this, methods of instruction must respect and value student resources. This is accomplished when we can teach content without blaming students for inadequacies or reducing academic expectations. We value student voices when we respect their past accomplishments in and out of school and allow them to use those skills (in whatever form) during learning. We do this by planning instruction that does not cause students to shoulder the responsibility of independent learners when instruction has not brought them to that point.

References

Buriel, R., & Cardoza, D. (1988). Sociocultural correlates of achievement among three generations of Mexican American high school seniors. American Educational Research Journal, 25, 177-192.

Cole, M. (1990). Cognitive development and formal schooling: The evidence from cross cultural research. In L. C. Moll (Ed.), Vygotsky and education: Instructional implications and applications of socio-historical psychology (pp. 89-110). New York: Cambridge University Press.

Diaz, R. M., & Klingler, C. (1991). Towards an explanatory model of the interaction between bilingualism and cognitive development. In E. Bialystok (Ed.), Language processing in bilingual children (pp. 167-192). New York: Cambridge University Press.

Diaz, S., Moll, L. C., & Mehan, H. (1986). Sociocultural resources in instruction: A context-specific approach. In Beyond language: Social and cultural factors in schooling language minority students (pp. 187-230). Los Angeles, California: Evaluation, Dissemination and Assessment Center, California State University, Los Angeles.

Donato, R., & Hernandez, J. S. (1993). Metacognitive equity for Mexican-American language minority students: Questions of policy. The Journal of Educational Issues of Language Minority Students, 12, 17-32.

Duran, B. J., Dugan, T., & Weffer, R. E. (1996). Language minority students: The role of language in learning biology concepts. Manuscript submitted for publication.

Duran, B. J., Dugan, T., & Weffer, R. E. (in press). Increasing teacher effectiveness with language minority students.

Duran, B. J., & Weffer, R. E. (1992). Immigrants' aspirations, high school process, and academic outcomes. American Educational Research Journal, 29, 163-181.

Duschl, R. A., & Wright, E. (1989). A case study of high school teachers' decision making models for planning and teaching science. Journal of Research in Science Teaching, 26, 467-501.

Garcia, G. E. (1991). Factors influencing the English reading test performance of Spanish-speaking Hispanic children. Reading Research Quarterly, 26, 371-392.

Graesser, A. C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. Psychological Review, 101, 371-395.

Mayer, R. E. (1989). Models for understanding. Review of Educational Research, 59, 43-64.

Moll, L. C. (Ed.). (1990). Vygotsky and education: Instructional implications and applications of socio-historical psychology New York, NY: Cambridge University Press.

Moll, L. C., & Greenberg, J. B. (1990). Creating zones of possibilities: Combining social contexts for instruction. In L. C. Moll (Ed.), Vygotsky and education: Instructional implications and applications of socio-historical psychology (pp. 319-348). New York: Cambridge University Press.

Nielsen, F., & Fernandez, R. M. (1981). Hispanic students in American high schools: Background characteristics and achievement. Washington, DC: U. S. Government Printing Office.

Ramirez, J. D. (1992). Executive summary. Bilingual Research Journal, 16, 1-61.

Reyes, M. L., & Molner, L. A. (1991). Instructional strategies for second language learners in the content areas. Journal of Reading, 35, 96-103.

Rogoff, B., & Lave, J. (Eds.). (1984). Everyday cognition: Its development in social context. Cambridge, MA: Harvard University Press.

Sigel, I. E. (1981). Social experience in the development of representational thought: Distancing theory. In I. E Sigel, D. M. Brodzinsky, & R. M. Golinkoff (Eds.), New directions in Piagetian theory and practice (pp. 203-216), Hillsdale, NJ: Erlbaum.

Trueba, H. (Ed.). (1987). Success or failure: Learning and the language minority student. Cambridge, MA: Newbury House Publishers.

van Dijk, T. A., & Kintsch, W. (1983). Strategies of discourse comprehension. New York: Academic.

Vygotsky, L. S. (1978). Mind in society: The development of higher psychological processes. (M. Cole, V. John-Steiner, S. Scribner, & E. Souberman, Eds.). Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1987). Thinking and speech (N. Minick, Trans.). New York: Plenum.

Wertsch, J. V. (1985). Voices of the mind: a sociocultural approach to mediated action. Cambridge, MA: Harvard University Press.

Wertsch, J. V. (1990). The voice of rationality in a sociocultural approach to mind. In L. C. Moll (Ed.), Vygotsky and education: Instructional implications and applications of socio-historical psychology (pp. 111-126), New York, NY: Cambridge University Press.