Literacy and Expertise in the Academy

Cheryl Geisler
Rensaeller Polytechnic Institute

The ability to read and write are usually regarded as a birthright in this country. The transmission of reading skills to the general public has been part of the agenda for American education since the initiation of the public school movement (Cook-Gumperz; Graff; Soltow and Stevens). As a result, we regularly espouse the ideal if not the practice of teaching everyone to read, and recent educational reforms have attempted to add writing to this agenda.

The concept of expertise, on the other hand, has a less egalitarian ring. Not being an expert in our society is seen as the default value, something of which no one is ashamed and some are even proud. In American culture, in particular, the figure of the "expert" invokes strong and ambivalent reactions as we, on the one hand, look to experts for guidance in everything from toothpaste to national fiscal policy, and, on the other, excoriate these same people for running roughshod over average citizens and using lucrative professional monopolies to give advice we no longer trust.

For these reasons, some readers may question my bringing them together in this study of literacy and expertise in the academy. Yet a growing body of research on literacy practices repeatedly points to the complex ways in which reading and writing have been transformed by the academic professions. In fact, reading and writing practices, which on the surface look open and easily available to all, may actually have become arcane practices restricted to just a few.

Author's Note: The arguments made in this article are taken from Chapter 5 of Academic Literacy and the Nature of Expertise, forthcoming from Lawrence Erlbaum Associates in the spring of 1994. The author would like to thank the Fund for the Improvement of Post Secondary Education and the Spencer Foundation for their support.

In this article, I attempt to untangle the complex relationship between literacy and expertise in the academy. Highlighting patterns in evidence reviewed more extensively elsewhere (Geisler), my main argument will be that the cultural movement of professionalization has used the technology of literacy to bifurcate expertise into two distinct components — domain content and rhetorical process — creating, in effect, a Great Divide between expert and layperson.

Expert Cognition in a Dual Problem Space Framework

At the end of the last century, American schooling assumed two functions with respect to expertise. First, the academy took on the task of certifying the cognitive expertise of a limited number of individuals who would eventually make up the core of the modern professions. Following an initial decline in the aftermath of the Jacksonian era, academics — like other professionals — emerged by the end of the century as far more numerous and far more middle class than they had been in earlier decades (Collins; Oleson and Voss; Veysey).

The changing fortunes of the academic professions were closely tied to changes in the credentialling requirements of the professions generally. At the opening of the century, the only professional career which had required a college degree was the clergy. Over the course of a few decades, this pattern was to be altered significantly as universities took on the central task of certifying professional expertise through the awarding of credentials (Freidson, Chapter 4). This credentialling system, in turn, both guaranteed academic professionals some life-time jobs in universities and colleges and mandated coursework in their areas of specialization.

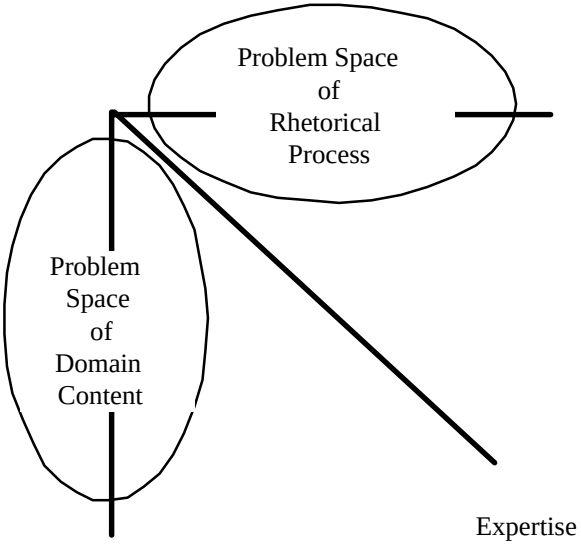
The second task taken on by the academy at the turn of the century was educating the general public. As Larson has pointed out, the modern professions not only had to arrange the conditions for their own market advantage through a credentialling system, they also had to create the market for their professional services (Larson 8). That is, the general public had to be educated concerning those areas of activity which had best be left to experts. Paradoxically, this required inculcating a respect for expertise and delimiting its proper areas of operation — all without actually transmitting the expertise itself (Bourdieu and Passeron 41).

The American academy was thus faced with what I call the dilemma of expertise. On the one hand, it was charged with the task of producing experts — that is, producing the expert knowledge upon

which professionals would act and passing that knowledge on through certified educational programs. On the other hand, it was also charged with the task of producing consumers for expertise. In many systems, these two tasks would have been undertaken by a different set of educational institutions. In France, for example, students who will enter the professions branch quite early in their schooling from those who will not, and the content of their education is tailored accordingly (Collins 91). In the United States, however, these two sets of students were educated simultaneously. That is, at the same time and in the same classrooms, students who would eventually become experts in the domain content of the curriculum sat side by side with those who would become consumers of that expertise. Such was the dilemma of expertise.

The American academy appears to have responded to this dilemma by using the technology of literacy to separate expertise into the two distinct dimensions of knowledge. The first of these is the dimension of domain content; the second, the dimension of rhetorical process. This separation has transformed not only social institutions, but, as shown in Figure 1, the shape of expert thinking itself. In particular, the institutional forces of professionalization in this country have shaped and are shaped by a cultural practice of expertise which plays itself out, cognitively, in two distinct "problem spaces" in the sense Newell and Simon (1972) first introduced: a problem space in which experts explore the domain content of a particular field, and a problem space in which they consider a field's rhetorical dimensions.

For the most part, cognitive science has not seriously addressed the possibility that expertise might involve more than one problem space. The work of Bereiter and Scardamalia represent one notable exception however. In their 1987 monograph, these authors were the first to suggest that writers negotiate between the two different problem spaces of domain content and rhetorical process (Chapter 12). While Bereiter and Scardamalia did not provide a full analysis of how these problem spaces might interact, a simple example can be imagined. The content problem space of a third grader trying to write an essay on her favorite topic, for instance, might consist of domain content concepts such as "dog," "collie," and "dalmatian." Within this problem space, the writer might explore her domain content knowledge through such operations as class inclusion ("How many kinds of dogs can I think of?"), use ("What are dogs used for?"), and life cycle ("How long do



The dual problem spaces of expertise.

dogs live?"). The rhetorical problem space, on the other hand, would be shaped by the writer's relationship to the intended audience. Its objects might include potential readers who are examined in such terms as recent experience ("What have my readers heard about recently?") and general beliefs ("How do my readers feel about this?"). According to Bereiter and Scardamalia, successful writers must shift among these two separate problem spaces, allowing the results of exploration in one space ("We've all just seen *101 Dalmatians*.") to guide exploration in the other ("What are dalmatians used for?") and vice versa ("I know a lot about collies. Why would my readers be interested in collies?"). By doing so, writers engage in knowledge transformation rather than simple knowledge telling.

Characterizing expertise as made up of dual problem spaces helps make sense of the complex pattern of expert problem-solving in ill-defined domains. The most obvious characteristic of the this problem-solving is the abstractness of their domain content representations (Glaser). This abstraction seems to emerge early in experts' training. Nearly all of the students in studies of cognitive expertise, for instance, appeared to use some kind of abstraction by early graduate school.

Such abstraction does not appear to constitute the whole of their expertise, however. Further training and experience were required

before these students developed the second characteristic of expertise in ill-defined domains: the capacity to adapt abstractions to case specific data. Without such adaptation, however, domain content abstractions seemed crippled. On the basis of the abstract sentencing precedents of the Australian courts, for instance, the aspiring magistrate studied by Lawrence produced sentences that ignored the issue of how to best prevent specific defendants from committing the same crime again. Based solely on their abstract models of patient anatomy, the resident radiologists studied by Lesgold and his colleagues produced misdiagnoses which ignored patient history and the radiological setting. With just social scientific abstractions to go on, the experts in Latin and South America studied by Voss, et. al. developed an analysis of the Soviet agriculture problem that failed to consider aspects of Soviet culture.

These results suggest that the ability to adapt to case specific data is distinct from and subsequent in development to the domain content abstractions on which they are based. This difference and sequencing can be accounted for, I am suggesting, by modelling expertise as the interaction of a relatively early developing problem space of domain content and a later developing problem space of rhetorical process. In the domain content problem space, experts develop the abstractions that enable them to go beyond everyday understanding. But it is through the rhetorical problem space that they develop the reasoning structures that enable them to bring those abstractions to bear upon the contexts in which they work.

Thus, as shown in Figure 2, the problem space of domain content and the problem space of rhetorical process — like all problem spaces — are both susceptible to either a naive representation fairly close to everyday understanding or a more abstract representation characteristic of expertise. In the problem space of domain content, expertise reconfigures naive and everyday objects into more abstract entities with different features and different relationships (Bundy and Byrd; Chi, Feltovich and Glaser; Clement; diSessa; Forbus; Gentner and Gentner; deKleer; Greeno; Larkin, 1981; Larkin, 1983; Larkin, McDermott, Simon and Simon; McCloskey; Williams, et. al.; Wiser and Carey; Young, as well as the review by Glaser). Thus, for example, physics experts see forces and vectors where most of us see carts and pulleys (Larkin).

In the second, or rhetorical, problem space of expertise, all the evidence points to the same pattern of transformation: novices appear to operate with a more everyday understanding of texts as repositories of knowledge, completely explicit in their content but utterly opaque in

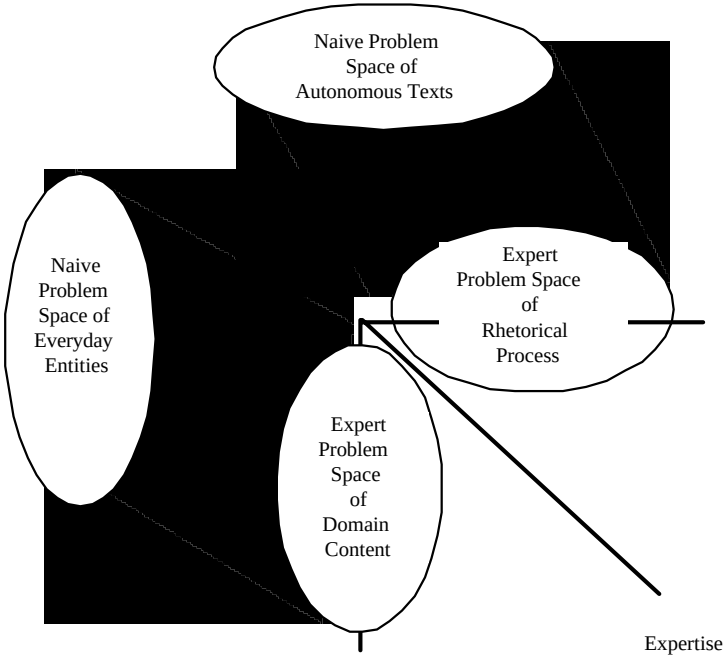


Figure 2
The relationship between naive and expert representations.

their rhetorical construction. Experts take these same textual objects and manipulate them in more abstract ways, attending to features the novices ignore and ignoring the features to which novices attend. The most obvious example of this is the way novices overlook the fact that texts are authored while experts cannot even begin to understand a text without knowing who wrote it (Bazerman; Charney; Geisler, Chapter 10; Haas; Haas and Flower; Lundeberg; Penrose and Fennell; Wyatt, et al.).

By describing the achievement of expertise as an interaction of two distinct problem spaces, we can provide a better account for the basic pattern of development in our schools. This process appears to fall into three periods. During the period of general education, as shown in Figure 3, roughly kindergarten through late high school, students appear to operate with naive representations in both problems spaces. As the research on physics problem-solving suggests, students by and large approach the domain content of the curriculum by assimilating informa-

tion into their everyday understandings or by maintaining distinct representations, one for the formal knowledge of the classroom and one for their everyday life. Participation in the IRF structures of schools teaches children that academic knowledge is different from and superior to the indigenous knowledge they bring from their home cultures (Mehan; Edwards and Mercer). The problem space of formal concepts becomes more extensive, as more and more concepts are added, but it remains a basically naive representation.

During this same period, the rhetorical problem space is relatively stable and underdeveloped. Students are encouraged to view texts as the totally explicit source of formal knowledge, as autonomous texts. In the first few years of elementary school, attention is paid to learning the reading procedures by which this knowledge can be read out of texts (Heap; Baker and Freebody), but from then on relatively little attention is paid to the text. Writing during this period is relatively rare (Britton, et al.; Applebee, 1981), but when it does occur it serves simply to reverse reading procedures: The text to be written is made isomorphic with the structure of the domain content as the writer understands it, using what Bereiter and Scardamalia have called knowledge-telling procedures.

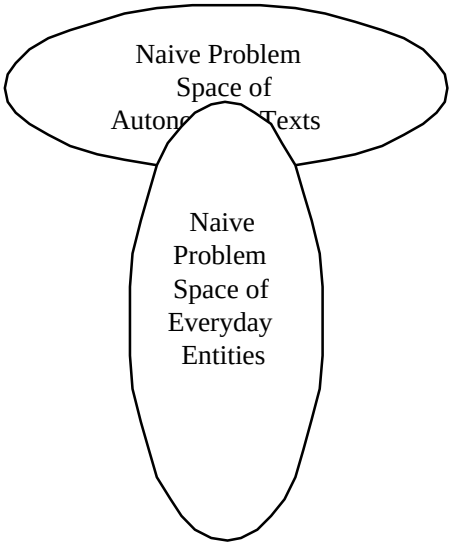


Figure 3
The collapsing of problem spaces in K-14.

Through these reading and writing practices, then, the rhetorical problem space is almost entirely collapsed onto the problem space of domain content. Under this naive representation, texts are taken to be equivalent to what they say.

Sometime during the early years of undergraduate school, some students begin to work with more abstract representations of domain content as shown in Figure 4. Such development does not appear to be the result of any direct teaching but rather the result of hours of individual effort at hands-on problem solving. That is, students who acquire the abstract representations necessary to do expert work appear to do so tacitly. Their textbooks and classroom lectures seldom acknowledge the existence of these abstract representations or give directions in how to use them. Nevertheless, some students do begin on their own to think about the domain content in more abstract terms.

During this intermediate stage, the rhetorical problem space remains distinctly naive however. Textbooks, still the mainstay of the curriculum, are interpreted as containing the domain content upon which students will be tested. Writing, on the rare occasions it is used, serves to duplicate the knowledge structure of these texts (Applebee,

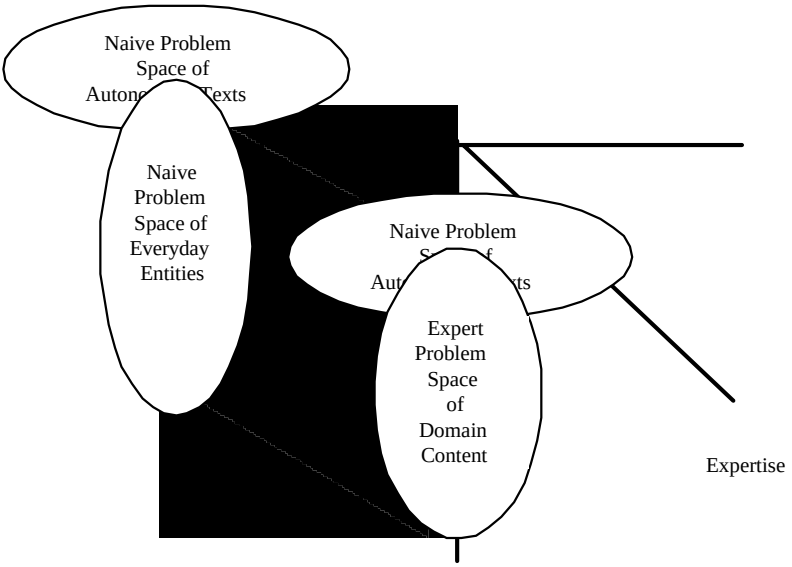


Figure 4
The emergence of the expert representation of domain content in undergraduate school.

1984, Chapter 4; Brown, Day, and Jones; Garner et al.; Sherrard; Nelson). Students know intuitively that to do more would jeopardize their mastery of content knowledge they will be required to demonstrate on tests (Penrose; Schumacher and Nash; Langer and Applebee). It is only the occasional academic researcher, wandering into the school, who is surprised by what they do. Knowledge still has no rhetorical dimension.

Beginning in late undergraduate school for some, graduate schools for others, this naive representation of rhetorical process undergoes a major reorganization and abstraction. As shown in Figure 5, the rhetorical dimension of expertise is suddenly revealed as something distinct from the domain content. Texts are now seen to have authors, to make claims, to be acts that can be understood only within in a temporal and interpersonal framework (Haas; Penrose and Fennell). Some issues are hot, some issues irrelevant, some issues settled. Some authors are credible; some discredited; some irrelevant. People write texts not simply to say things, but to do things: to persuade, to argue, to excuse.

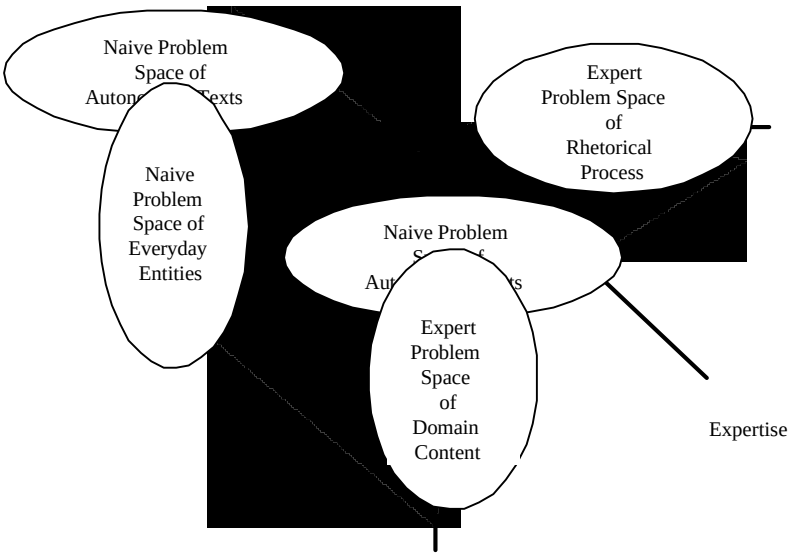


Figure 5
The emergence of the expert representation of rhetorical process in graduate school.

This emergence of an expert representation of the rhetorical problem space is the final stage in the acquisition of expertise. For it is only when both the domain content and the rhetorical processes of a field are represented in abstract terms that they can, together, engage in the dynamic interplay that produces expertise. Teachers, who once remained remote lecturers on issues long dead to their fields, now come alive as mentors in cutting edge research. The oral discourse and accompanying hands-on activity of knowledge construction start to restructure the basically flat formal domain content abstractions learned earlier. Rhetorical knowledge and domain content knowledge, as Bereiter and Scardamalia first suggested, come into dynamic transformative interplay. Expertise, then, is recovered whole, becomes a *knowing that* linked to a *knowing how*.

Literacy and the Great Divide

The cognitive tradition — the source of the concept of "problem space" used in the above discussion — can rightly be understood as part of the movement to open up expertise, to make it explicit and more available to those who aren't born to it in apprenticeship training. Consistent with this goal, nearly all investigations of cognitive expertise have accounted for expertise as a complex skill which, if better understood, could be made more freely available to more students earlier in their careers. Bereiter and Scardamalia, for example, clearly hoped to encourage students to abandon their simplistic knowledge-telling model of writing and instead adopt a more reflective dual problem space model.

But in order to actually meet the goal of opening up expertise, we cannot afford to remain blind to the sociological dynamics by which cognition has been used to support accounts of school failure. Dual problem spaces, for example, could be understood simply as the way experts handle the complex tasks of expertise. Simon has noted in connection with ill-defined problems in general, for example, that experts tend to decompose a problem into subproblems each of which can, to some extent, be solved independently (Simon). This decomposition, he further suggests, follows the naturally-occurring weak boundaries among entities in a system. Thus, a good decomposition is supposed to keep entities with strong bonds together and separate those with relatively weak bonds.

Using this explanation, we might assume that experts operate in the dual problem spaces of domain content and rhetorical process

because of naturally occurring bonds and boundaries among concepts. That is, by operating in the problem space of domain content, experts could be simply keeping domain concepts with domain concepts; by operating in the problem space of rhetorical process, they could be simply keeping rhetorical concerns with rhetorical concerns. This interpretation of the dual problem space framework would be a dangerous one, however, for it accepts as "natural" what is actually the outcome of social arrangements and cultural power. In particular, it might suggest that academic expertise is so cognitively complex that we can reasonably expect only some students to master it.

We must avoid this interpretation. Some kind of decomposition may be inevitable given the limitations of human information processing, but no particular decomposition is itself inevitable when the entities involved are cultural objects. Instead, we must consider the ways in which culture can influence not only the deployment of material resources and the development of institutional structures, but also the structure of thinking itself. The development of the dual problem spaces of expertise simply dovetails too well with the institutional requirements of professionalization to be accepted as simply the outcome of processing limitations. Thus, in building a dual problem space framework, we need to ask: Why these bonds? Why these boundaries?

The answer to these questions appears to be that the separation of expertise into the distinct problems spaces of domain content and rhetorical process is an important mechanism by which our society delivers expertise to some while withholding it from others. Expertise, which was restricted in the late nineteenth-century to the indigenous culture of the upper-class Eastern elites, appears to have been taken over by the middle-class professionalization movement (Collins; Haskell, Chapter 4; Bender; Higham) and divided into two distinct components: a formally explicit knowledge of domain content which became the mainstay of a universal education aimed at producing laypersons, and the more informal and tacit knowledge of rhetorical process which remained the more or less hidden component of advanced training aimed at producing a new class of professional experts.

As a result, our current educational sequence provides all students with a naive understanding of the more formal component of expertise while withholding an understanding of this tacit rhetorical dimension. In this way, as suggested in Figure 6, a Great Divide has been created — not a great divide between orality and literacy as literacy scholars originally suggested (Goody and Watt; Havelock; Olson), but rather a

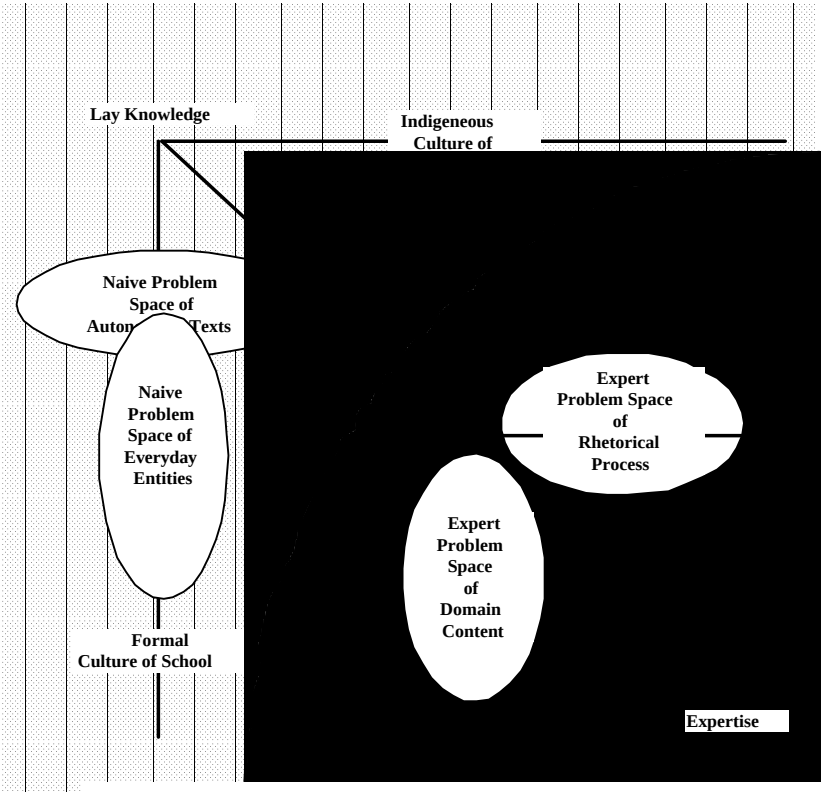


Figure 6
The Great Divide between expert and lay knowledge

great divide with experts on one side with a complete if disjoint practice of expertise, and laypersons on the other side facing what seems like a choice between buying into the formal culture of the schools or remaining loyal to their indigenous home cultures.

This Great Divide has been maintained for the most part through the literacy practices of the academy. Literacy in the early years is predominantly concerned with building a naive representation of the domain content problem space. Stripped of metadiscourse (Crismore), texts neglect the rhetorical dimension of expertise, making the problem space of rhetorical process absolutely indistinguishable from the problem space of domain content. As a result, students may be able to use textbooks to perceive that their everyday understandings are inconsistent with formal knowledge (Alvermann, Smith, and Readence). But they do not seem to be able to use them to gain insight into the context-

bound processes by which such formal knowledge can be integrated with personal knowledge brought from their indigenous home cultures.

At this level, then, the literacy practices of the schools help to create a layperson attitude. In textbooks, knowledge is packaged in exactly the way that it will be most likely to be ignored or misunderstood by students. When these students grow up to be laypersons, they will be well educated in what Halloran (personal communication) has called *professional incompetence*. That is, they will already know that domains of knowledge exists which they do not and cannot understand, and they will thus will be willing to look to professionals in these domains and thus guarantee them their livelihood.

Persistence beyond this level of the system is the key to the acquisition of expertise, and the literacy practices of the schools are the key to that persistence. Taken at their face value, school texts appear to be lifeless artifacts which, by their very autonomy, invite little by way of further interaction. Interaction, indeed, seems to be beside the point. Rather than engaging students on grounds where their personal experience and beliefs might be relevant, reading and writing in the schools seem to require an abandonment of indigenous home culture, a trading of everyday concepts in favor of the formal culture of books. Students unwilling to make this trade will not pass over the Great Divide.

As an ideology of privilege, professionalization does seem to induce some individuals to make this trade, however. One group of students who seemed eager to make this trade in the late nineteenth century were those motivated by the prospects of upward mobility. In the early decades of the professionalization movement, educational credentials did appear to be effective in creating a fairly sizable redistribution of income from the upper-class to the newly emerging middle class (Collins 189). Once the surplus wealth of industrialization had been redistributed and absorbed by this emerging professional class, however, upward mobility no longer seemed assured (Collins 4). Groups might cling to the professional ideal as a prospect but it was often at variance with the reality of a stratified society in which only some professions attained the full complement of professional privileges and, within the same professions, only some individuals reaped unusual economic advantages (Friedson 88; Larson xviii). At this point, then, professionalism was transformed into more of an ideology shaping individual aspirations than an actual reflection of reality. It is still, however, an ideology that can motivate some students to persist in school.

By and large, however, most students who persist with literacy in the schools are relying on what Bourdieu and Passeron have called the "cultural capital" they bring from home (Bourdieu and Passeron 32; see also Collins 9; Gouldner 20). As Heath's research has indicated, students from middle class Anglo-Protestant homes bring to school a whole host of interaction patterns with texts that are not common in the other indigenous cultures. These early literacy events appear to be a powerful determinant of students' later success in school (Wells). Such interactions, Scollon and Scollon have suggested, enable children to recast themselves as textual agents, thus rehumanizing autonomous texts and understanding them as a part of their everyday lives. Such an advantage, in effect, initiates students' development of a problem space of rhetorical process years ahead of those who do not bring comparable cultural capital from home.

If, for whatever reasons, students persist in school, they will move on to undergraduate school where they will be exposed for the first time to the problem solving contexts in which abstractions about domain concepts are valuable. This is the boundary with expert practice and, not coincidently, it is here that differences are the greatest between what experts do and what laypersons do. Laypersons solving the well-defined problems of textbooks struggle with laborious means-ends analyses to come up with the right answer (Larkin, McDermott, Simon and Simon). Experts in the same situations, by contrast, call on highly routinized forward-search procedures in which the solutions are built into the very way they represent the problems (Chi, Feltovich, and Glaser). At this boundary with expertise, knowledge is in so little dispute that everyone has agreed to archive it in textbooks; solutions are so pat they can be made available at the back of the book. Articulate problem solving in the rhetorical problem space is thus unnecessary, and knowledge takes the highly tacit form most difficult for experts to articulate and therefore most difficult for students to learn.

Only after students declare their majors, select professional schools, or apply to graduate school will they be allowed to move on and reap the rewards of professional expertise. By this time, students will have demonstrated a decided aptitude in their chosen area of specialization, almost single-handedly developing the more abstract representations characteristic of the expert problem space of domain content. In addition, they will have passed through two years of general education aimed at inculcating the virtues of an upper-class liberal culture. Only with these declarations of cognitive and sociological affiliation in place will they be invited to cross the Great Divide.

Once at the cutting edge — where knowledge is most contingent and problems are by definition ill-defined — students find the reasoning procedures experts use to explore the problem space of rhetorical process more explicit and accessible. Experts don't simply see the solution to more ill-defined problems but explore extensive chains of reasoning aimed at being informative and persuasive (Lesgold, et al.). Texts, reconceived, are central to this activity. Now metadiscourse, instead of appearing to be a bothersome or irrelevant aspect of the text, becomes the source of important clues: how certain is this author's claim? did this researcher do the right thing in the lab? does this guy know what he's talking about? Texts, which used to be read straight through are now taken apart for clues.

A process of rhetorical recovery is initiated. And what is recovered, strangely, is the temporal and human aspects of indigenous culture that students once thought they had to leave behind. It is the details of lived experience, in the lab, in the conference room, in the funding agencies, that must be recovered. But it is a reconfigured indigenous culture, one more abstract in which the "career" of a professional serving humanity, uncovering truth, and contributing to progress takes on a public significance. Professional identity becomes part of personal identity (Larson 227-229). The abstract temporal dimensions of cultural progress, the getting and using of knowledge, become the temporal rhythms of the professional's daily life.

From a sociological perspective, however, we need to ask why such bonds and boundaries appear to be so natural. For what purpose has such complexity been sustained? In whose interests has this bifurcated practice been developed? Any complete answer to these questions must admit that expertise is not simply a developmental phenomenon. It is simply not the case, for example, that students in the general curriculum are taught to read in a way that must only be further developed when they go on to the university. After fourteen years of being taught that the text has all the answers, is it any surprise that some students find it hard to understand that they must read rhetorically, that they must ask about the author's purpose and context in order to use knowledge productively? Even those who operate as experts in one domain resort to relatively naive strategies in other domains and take texts at face value (Bazerman; Ackerman). In each area of specialization, then, students must actually be untaught the distrust of personal opinion and contextualized understandings that has been drummed into them through the period of general education.

We might argue, of course, that this lack of rhetorical interpretation arises out of these laypersons' absolute lack of knowledge. That is, perhaps students can only draw on background knowledge if they *have* such knowledge. While such a statement looks eminently reasonable, we must recognize that it can only be made once we have *already* discounted all knowledge outside the academic framework. After all, experts are not the only ones who can make connections between specialized content and experience. They are simply the only ones whose experience counts.

The contrast between the neat developmental sequence suggested by Figure 2 and the complex transitions diagrammed in Figure 5 is a telling one: The development of the two problems spaces of expertise does not take place along two independent and straightforward continua as Figure 2 suggests. Instead, obscured by the myth of the autonomous text, the rhetorical problem space is only allowed to emerge, as shown in Figure 5, within the context of an already abstracted representation of domain content. In this way, the processes of cognitive development have become heavily intertwined with the sociological dynamics legitimizing professional privilege. That it, the circuitous development of rhetorical process practically guarantees that experts will be the only ones able to use a field's texts in any kind of sophisticated manner, will be the only ones who can sustain serious interaction or invite serious response on specialized content.

The Problem of Reflection

In closing this brief and too rapid survey, I would suggest that we simply can make no real sense out of the literacy practices of the academy unless we understand institutional forces of professionalization that create a society made up of experts on one side and laypersons on the other. In a similar manner, however, we can get no purchase on the sociological phenomenon of expertise unless we see how it is played out on the minute practices of reading and writing of individual agents. This is what I have referred to elsewhere as the problem of reflection (Geisler, Chapter 13).

For, in one way or another, *we* are those individuals. Simply by virtue of being at home in these texts, reading and writing these texts, *we* are involved. Even those of us in the academy who do not see ourselves as implicated in the professionalization project must come to terms with the way the academy has been shaped by that project. It is all too easy to view expertise as the outcome of monolithic institutional

forces over which we, as victims or innocent bystanders, have little control. But as long as research on expertise is written as the account of what other people do, the account will be a false account. Only once we engage with the problem of reflection, seeking explanations which ring bells with our own experience, with what we ourselves do, will we be getting closer to the truth.

The stake for involvement are high. As long as students think that they have to abandon the resources of their home cultures in order to succeed in school and in the professions, a significant portion who refuse to make the move will be forced to drop out; a significant portion who do make the move will be crippled. Much is made today of school reform but in most cases, academic practitioners make these calls for the reform of others and never of themselves. The argument made here, however, is that some of the persistent inequities in American schooling began with the academy's alliance with the agenda of the professional movement. So long as this alliance persists unquestioned, so long as the university functions primarily as a credentialling wing for the professions, we will continue to construct and reconstruct the Great Divide in every act of our daily reading, writing, and knowing.

Works Cited

Ackerman, J. "Reading, Writing, and Knowing: The Role of Disciplinary Knowledge in Comprehending and Composing." Research in the Teaching of English 25 (1991): 133-178.

Alvermann, D.E., L.C. Smith, and J.C. Readence. "Prior Knowledge and Comprehension of Compatible and Incompatible Text." Reading Research Quarterly 20 (1985): 420-436.

Applebee, A.N. Writing in the Secondary School: English and the Content Areas. Urbana, IL: National Council of Teachers of English, 1981.

—. Contexts for Learning to Write: Studies of Secondary School Instruction. Norwood, NJ: Ablex, 1984.

Baker, C.B., and P. Freebody. "Talk Around Text: Construction of Textual and Teacher Authority in Classroom Discourse." Language, Authority and Criticism: Readings on the School Textbook.

Eds. S. de Castell, A. Luke, and C. Luke. London: Falmer Press, 1989. 263-283.

Bazerman, C. Shaping Written Knowledge: The Genre and Activity of the Experimental Article in Science. Madison, WI: University of Wisconsin Press, 1988.

Bender, T. "The Erosion of Public Culture: Cities, Discourses, and Professional Disciplines." The Authority of Experts: Studies in History and Theory. Ed. T.L. Haskell. Bloomington, IN: Indiana University Press, 1984. 84-106.

Bereiter, C. and M. Scardamalia. The Psychology of Written Composition. Hillsdale, NJ: Erlbaum, 1987.

Bourdieu, P. and J.C. Passerson. Reproduction in Education, Society and Culture. London: Sage, 1977.

Britton, J., T. Burgess, N. Martin., A. McLeod, and H. Rosen. The Development of Writing Abilities. London: Macmillan, 1975. 11-18.

Brown, A.L., J.D. Day, and R.S. Jones. "The Development of Plans for Summarizing Texts." Child Development 51 (1983): 968-979.

Bundy, A. and L. Byrd. "Using the Method of Fibres in Mecho to Calculate Radii of Gyration." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 254-265.

Charney, D. "A Study in Rhetorical Reading: How Evolutionists Read 'The Spandrels of San Marco.'" Understanding Scientific Prose. Ed. J. Selzer. Madison, WI: University ofWisconsin Press, 1993. 203-231.

Chi, M., P. Feltovich, and R. Glaser. "Categorization and Representation of Physics Problems by Experts and Novices." Cognitive Science 5 (1981): 121-152.

Clement, J. "A Conceptual Model Discussed by Galileo and Used Intuitively by Physics Students." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 325-340.

Collins, R. The Credential Society: An Historical Sociology of Education and Stratification. New York: Academic Press, 1979.

Crismore, A. Talking with Readers: Metadiscourse as a Rhetorical Act. New York: Peter Lang, 1989.

deKleer, J. "Assumptions and Ambiguities in Mechanistic Mental Models." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 155-189.

diSessa, A.A. "Phenomenology and the Evolution of Intuition." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 18-33.

Edwards, D., and N. Mercer. Common Knowledge: The Development of Understanding in the Classroom. London: Methuen, 1987.

Forbus, K.D. "Qualitative Reasoning about Space and Motion." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 54-73.

Friedson, E. Professional Powers: A Study of the Institutionalization of Formal Knowledge. Chicago: University of Chicago Press, 1986.

Garner, R., V. Belcjher, E. Winfield, and T. Smith. "Multiple Measures of Text Proficiency: What Can Fifth-Grade Students Do?" Research in the Teaching of English 19 (1985): 140-153.

Geisler, C. Academic Literacy and the Nature of Expertise. Hillsdale, NJ: Erlbaum, 1984.

Gentner, D., and D.R. Gentner. "Flowing Waters or Teeming Crows: Mental Models of Electricity." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 99-129.

Glaser, R. "Education and Thinking: The Role of Knowledge." American Psychologist 39 (1984): 93-104.

Goody, J., and I. Watt. "The Consequence of Literacy." Comparative Studies in Society and History 5 (1963): 304-326, 332-345.

Gouldner, A.W. The Future of Intellectuals and the Rise of the New Class: A Frame of Reference, Theses, Conjectures, Arguments, and an Historical Perspective on the Role of Intellectuals and Intelligensia in the International Class Contest of the Modern Era. New York: Continuum, 1979.

Greeno, J.G. "Conceptual Entities." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 227-251.

Haas, C. "Expanding Notions of Author and Text: A Longitudinal Study of College Reading Practices." Paper given at the annual meeting of the American Educational Research Association: San Francisco, 1992.

Haas, C., and L. Flower. "Rhetorical Reading Strategies and the Construction of Meaning." College Composition and Communication 39 (1988): 167-183.

Haskell, T.L. "The Emergence of Professional Social Science." The American Social Science Association and the Nineteenth-Century Crisis of Authority. Urbana, IL: University ofIllinois Press, 1977.

Havelock, E. Preface to Plato. Cambridge, MA: Harvard University Press, 1963.

Heap, J. "Discourse in the Production of Classroom Knowledge: Reading Lessons." Curriculum Inquiry 15 (1985): 245-279.

Heath, S.B. Ways With Words: Language, Life, and Work in Communities and Classrooms. Cambridge: Cambridge University Press, 1983.

Higham, J. "The Matrix of Specialization." The Organization of Knowledge in Modern America, 1860-1920. Baltimore: Johns Hopkins University Press, 1979. 3-18.

Langer, J.A., and A.N. Applebee. How Writing Shapes Thinking: A Study of Teaching and Learning. Urbana, IL: National Council of Teachers of English, 1987.

Larkin, J. "Enriching Formal Knowledge: A Model for Learning to Solve Textbook Physics Problems." Cognitive Skills and Their

Acquisition. Ed. J. Anderson. Hillsdale, NJ: Erlbaum, 1981. 311-335.

Larkin, J. "The Role of Problem Representation in Physics." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 75-98.

Larkin, J., J. McDermott, D.P. Simon, and H.A. Simon. "Expert and Novice Performance in Solving Physics Problems." Science 208 (1980): 1335-1342.

Larson, M.S. The Rise of Professionalism: A Sociological Analysis. Berkeley, CA: University of California Press, 1977.

Lawrence, J. A. "Expertise on the bench: Modelling Magistrates' Judicial Decision-Making." The Nature of Expertise. Eds. M.T.H. Chi, R. Glaser, and M.J. Farr . Hillsdale, NJ: Erlbaum, 1988. 229-259.

Lesgold, A., H. Rubinson, P. Feltovich, R. Glaser, D. Klopfer, and Y. Wang. "Expertise in a Complex Skill: Diagnosing X-ray Pictures." The Nature of Expertise. Eds. M.T.H. Chi, R. Glaser, and M.J. Farr. Hillsdale, NJ: Erlbaum, 1988. 311-342.

Lundeberg, M.A. "Metacognitive Aspects of Reading Comprehension: Studying Understanding in Legal Case Analysis." Reading Research Quarterly 22 (1987): 407-432.

McCloskey, M. "Naive Theories of Motion." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 299-323.

Mehan, H. Learning Lessons: Social Organization in the Classroom. Cambridge, MA: Harvard University Press, 1979.

Nelson, J. "This Was an Easy Assignment: Examining How Students Interpret Academic Writing Tasks." Research in the Teaching of English 24 (1990): 362-396.

Newell, A., and H.A. Simon. Human Problem Solving. Englewood Cliffs, NJ: Prentice-Hall, 1972.

Olson, D.R. "From Utterance to Text: The Bias of Language in Speech and Writing." Harvard Educational Review 47 (1977): 257-281.

Penrose, A.M. " To Write or Not to Write: Effects of Task and Task Interpretation on Learning Through Writing." Written Communication 9 (1992): 465-500.

Penrose, A.M., and B.A. Fennell. "Agency and Proof in Scientific Prose: Tracing Socialization Via Semantic Feature Analysis." Paper given at the annual meeting of the American Educational Research Association: San Francisco, 1992.

Schumacher, G.M., and J.G. Nash. "Conceptualizing and Measuring Knowledge Change Due to Writing." Research in the Teaching of English 25 (1991): 67-96.

Scollon, R., and S.B.K. Scollon. Narrative, Literacy and Face in Interethnic Communication. Norwood, NJ: Ablex, 1981.

Sherrard, C. "Summary Writing: A Topographical Study." Written Communication 3 (1986): 324-343.

Simon, H.A. "The Structure of Ill-Structured Problems." Artificial Intelligence 4 (1973): 181-202.

Voss, J.F., T.R. Greene, T.A. Post, and B.C. Penner. "Problem-Solving Skill in the Social Sciences." The Psychology of Learning and Motivation: Advances in Research and Theory. Vol.17. Ed. G.H. Bower. New York: Academic Press, 1983. 165-213.

Wells, G. The Meaning Makers: Children Learning Language and Using Language to Learn. Portsmouth, NH: Heinemann, 1986.

Williams, M., J.D. Hollan, and A.L. Stevens. "Human Reasoning About a Simple Physical System." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 131-153.

Wiser, M., and S. Carey. "When Heat and Temperature Were One." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 267-297.

Wyatt, D., P.B. El-Dinary, M. Pressley, S. Stein, P. Evans, and R. Brown. "Reading Behaviors of Domain Experts Processing Professional Articles that are Personally Important to Them." Paper given at the National Reading Conference: Palm Springs, 1991.

Young, R.M. "Surrogates and Mappings: Two Kinds of Conceptual Models for Interactive Devices." Mental Models. Eds. D. Gentner and A.L. Stevens. Hillsdale, NJ: Erlbaum, 1983. 35-52.