A First Course in Mind, Brain, and Education

Peter R. Blake[1] and Howard Gardner[1]

ABSTRACT—We describe what may well be the first course devoted explicitly to the topic of Mind, Brain, and Education (MBE). In the course, students examine four central topics (literacy, numeracy, emotion/motivation, and conceptual change) through the perspectives of psychology, neuroscience, genetics, and education. We describe the pedagogical tools we use to develop the skills critical for synthesizing information across the disciplines associated with MBE.

A NEW FIELD OF STUDY

Disciplines grow, evolve, differentiate, become reorganized, and sometimes disappear. Sixty years ago, the interdisciplinary fields of human relations, social relations, and behavioral sciences appeared to be on the rise. History of science was in its infancy, while no one had thought of cognitive science. Today, history of science is an established field of study, cognitive science has replaced psychology in many universities (and even more bookstores), and hardly anyone remembers Harvard's and John Hopkins' Departments of Social Relations or Yale's Institute of Human Relations.

Intellectual trends within the academy reflect a broader public interest in these disciplines that are deepening and altering our understanding of the world and ourselves. Whereas physics received much attention in the first half of the 20th century, biology flowered in the latter half of the century with new technologies and major breakthroughs at all levels of the organism—from the genome to the brain to the biological system. Increasingly, biology dominated the pages of science journals, newspapers, and magazines, and increasingly, journalists and the general public looked to biology for the answers to many issues, including how best to understand the human mind, human behavior, and human learning.

In the 1990s, scholars in a number of universities were beginning to ponder the implications of new biological findings for teaching and learning in the schools. At the Harvard Graduate School of Education (HGSE), Kurt Fischer conferred with colleagues, like Ann Brown, Howard Gardner, David Perkins, and David Rose, about the desirability of a more explicit connection of cognitive development and emotional development, on the one hand, and the need to introduce newly emerging methods and findings in the biological sciences, on the other. Harvard University already had a promising interdisciplinary program in "Mind, Brain, and Behavior"; faculty of HGSE sought to pattern our own initiative after that model in a number of ways.

It is worth mentioning that our sentiments were not immediately endorsed by other faculty members at the school. Many individuals in education are uneasy with the notion that education should embrace the biological sciences. Some of the uneasiness may result from the technical and occasionally forbidding nature of the work itself. But the deeper suspicion stems from the belief—which we consider completely unwarranted—that if one tries to apply findings from the biological sciences, one is thereby endorsing the view that learning and potential are fixed and cannot be changed. Indeed, at one time, faculty uneasiness with a proposed Mind, Brain, and Education (MBE) focus became so acute that we jokingly proposed the title "Mind, Blank, and Education."

In the year 2000, having allayed the worst fears of our colleagues, we officially announced a concentration in MBE, and in 2002 Fischer and Gardner began to teach a yearlong course called "Cognitive Development, Education, and the Brain." We believe that this course may be the first course on this topic to be regularly offered at a school of education. We have learned much over the years, and the course has changed significantly as a result of these lessons. In this essay, we describe the goals of the course, pedagogy and curriculum, lessons learned, and plans for the future.

[1]Harvard Graduate School of Education

Address correspondence to Howard Gardner, Harvard Graduate School of Education, Larsen 201, Appian Way, Cambridge, MA 02138; e-mail: hgasst@pz.harvard.edu.

THE STRUCTURE OF THE COURSE

Among the scholars thinking about the connections between mind, brain, and education, Bruer (1997) characterized the leap from biology to education as "a bridge too far." This view summarized the fears of many that biological findings were being oversimplified for the public, leading to false claims and overstated implications for education. Bruer encouraged educators to let cognitive psychologists vet the information from neuroscience, genetics, and related fields.

Needless to say, many educators chafed at the idea that they needed a gatekeeper to process information from relevant sciences. It was true that few professionals in any field could evaluate the implications of the new research for education, but psychologists did not necessarily have the best view of the classroom. Situated as we are in a school of education, we decided to develop an alternative to the bridge model: We would train students to evaluate research findings and engage in new forms of integrative thinking. The MBE professionals graduating from this program should be adept at communicating across disciplinary boundaries and making decisions that best serve the educational goal at hand.

We knew we could not accomplish this overarching goal in a standard one-semester course. Several deviations from normal class structure would be necessary, the first of which was to make the course yearlong. At our school, where the Master's program itself takes only 1 year, this status was hard-won.

A second central decision concerned the mode of teaching. Integrative thinking and problem solving require practice. We chose to use an atelier (workshop) model to provide our students with the intellectual space for guided practice. The course provides a wide array of resources relevant to mind, brain, education, most of which resides on the course Web site: background materials, Web links, discussion boards, videos, and podcasts. Students with various degrees of sophistication in the constituent disciplines support one another by sharing resources, readings, critiques, and notes. To accommodate an activity- and discussion-based classroom environment without sacrificing important content elements, we filmed several dozen lectures and put them on the course Web site (for copyright reasons, the Web site is only available to enrolled students). Students watch these video lectures as part of their preparation for the class, thereby allowing more time for in-class interactions.

The MBE program draws a diverse group with backgrounds and experience in special needs education, medicine, biology, cognitive science, counseling, and so forth. The open structure of the class sessions allows us to capitalize on the expertise of the students. Students in our class also join research labs across the university—from neuroimaging to comparative psychology—and thus contribute cutting-edge knowledge to our discussions. Frequently, these cross-disciplinary connections emerge in the students' yearlong projects. In keeping with the workshop model, students devise their own projects and develop them with the guidance of the teaching staff. Projects may entail empirical research, curriculum design, or a theoretically oriented synthesis.

A third decision regarded the products of the course: what students will take away. We loosely describe the end product as a "conceptual toolkit." The toolkit includes (a) an ability to take multiple disciplinary perspectives on issues; (b) specific, research-based knowledge in four domains of learning; and (c) case-based experience that looks at a child as a whole. We discuss each of these dimensions below.

Multiperspectivalism

In a year, it is not possible to become an expert in each of the areas of the course, let alone to master the several disciplines involved in mind, brain, education. We have set a more modest but still ambitious goal. We characterize the course as involving three perspectives or, more familiarly, three "hats": those of the neuroscientist, the psychologist, and the educator. In recent years, we have added a fourth hat: that of the geneticist. We want to give each student the opportunity to try on these hats and to learn to read and speak the language of experts from those four spheres.

Take, for example, the understanding of reading disorders (Fischer, Immordino-Yang, & Waber, 2007). The geneticist explores which aspects of the genome correlate with reading problems, whether these elements are heritable, and how they are manifested in different environments. The brain scientist looks for anatomical and functional differences between the brains of normal (or expert) readers and those individuals who have frank problems in decoding and/or understanding written text. The psychologist builds models of the processes involved in naming, reading of nonsense syllables, rhyming, and other key skills and carries out experiments to see which of these skills is impaired and in which ways. The educator chooses curricula and pedagogy that are appropriate for dyslexics in general or for specific profiles of reading disorders.

The student in our course is exposed to these different perspectives. In the classroom-as-atelier, we ask the student to engage in debates and analyses that call on her to assume these various perspectives, seriatim. "Performances of understanding," as we term them, require students to examine an unfamiliar case—for example, a video clip of a dyslexic child along with her scores on a number of reading tests—and to assume one or more of the perspectives (cf. Wiske, 1998). Students may then debate the merits of their positions and come to recognize the need for a more integrative assessment of the case.

The capacity to wear specific hats is at the core of multiperspectival thinking. Ideally, such thinking entails the capacity to put together the perspectives and come up with an analysis where the whole is greater than the sum of its parts. Ideally, the student also can discuss the limitations of the perspectives and the kinds of work that would be needed to secure a better answer to the problem that has been posed.

Four Throughlines

At the beginning of the year, we assign basic readings that will help students appreciate the multiple perspectives we seek to cultivate. However, without concrete material to work with, many students will be unable to absorb and make use of the theoretical materials. To ground the course in the fundamental concerns of basic education, we defined four domains of learning: numeracy, language and literacy, motivation and emotion, and conceptual change. We spend several weeks discussing the current theories, methods, research, and educational problems relevant to each domain.

The content for each throughline provides a focal point for discussion and a connection to education. During the first term, we ask students to wear primarily the psychology hat to organize and analyze the research in the four domains. We emphasize a few general theoretical approaches—developmental, modular, information processing—to help students assess the empirical evidence and extrapolate the implications of the research for education. The biological hats do not remain on the shelf during this time, but their use is limited to broad methods, imaging techniques, and key ideas like gene expression.

In the second semester, the biological hats assume a primary role. After consideration of the brain at the neural, anatomical, and functional levels, we revisit the throughlines using research from the neuroscience literature. Genetics plays a limited role, although the connections to education are growing (Grigorenko, 2007a, b). The main challenge for both students and staff is to answer the question: What does the biological level add to our understanding of education? The answer is often clearest in the area of learning disabilities, such as dyslexia, where neural evidence can validate or invalidate theoretical views of reading that in turn influence interventions (Fischer et al., 2007; Wolf, 2004). However, by adopting a neuroeducational perspective such as provided by Rose's Universal Design for Learning, we can push students to find integrative solutions for all students (Rose, Meyer, Strangman, & Rappolt, 2002).

Across the throughlines, general tensions emerge, such as domain-general versus domain-specific capacities and nativist versus connectionist accounts, and we encourage students to wrestle with these antinomies in light of the empirical research we cover. As instructors, we try to remain theory and method agnostic so that students may learn to adopt relevant approaches for the problem at hand rather than trying to force the facts into a particular theoretical framework. Students learn to respect the theoretical orientations within different disciplines with an eye toward integration and application. Our students are prepared to ask appropriate questions of the experts in a field and then determine implications for a curriculum and pedagogy.

Case Studies

The throughlines allow us to focus on how learning generally occurs within different content domains. But of course learning can occur very differently across individuals. To address the issue of individual variability, we are developing case profiles that we revisit in each content segment and with multiple perspectives. The goal, in the words of our colleague David Rose, is not to present textbook examples of specific disabilities but rather to capture the "messy realism" of actual students.

One case, for example, is a bilingual 6-year-old who is recognized as creative and highly sociable by her teachers but who is struggling with phonological processing. Our task is to understand how the elements of her profile interact, what educational risk factors we might predict, and how to help this student succeed. While the potential for reading comprehension problems may appear obvious in this case, less obvious are the emotional and motivational implications of failure and low grades that often stem from and may contribute to this kind of language problem. As her affective neural networks become rewired as a function of her difficulties in learning to read, how will this affect her knowledge, creativity, and interest in learning, and how can we find out? The profiles remind us that, as educators, we must look at the whole child in order to leverage strengths as well as address weaknesses of learners.

LESSONS LEARNED

Since we began this course in 2000, similar programs have appeared across the country and abroad. Several universities now have some form of a mind, brain, behavior initiative, with education the most likely field of application. Reflecting back on the development of our course, we can offer some lessons:

The Value of Synthesizing Activities

A relatively new emphasis in our pedagogy grows out of recent interest in synthesizing (Gardner, 2007). We model for students how to sift through a vast literature, decide what is important, and then organize it in ways that make sense for oneself and for others. A good synthesis respects the methods of each discipline, demonstrates the value added of interdisciplinary work, and exhibits caution about the ultimate claims (Boix-Mansilla, 2006).

Two synthesis activities we have used are minute papers and the provision of metaphors for key course concepts.

Minute papers involve short, quick responses to an issue; for example, after a difficult topic has been introduced, students are asked to indicate one facet that they understood and one about which they are still confused. Another activity asks students to create their own metaphors for challenging new concepts; for example, they are asked to contrast "development" and "change" or "assimilation" and "accommodation" by positing metaphors that capture the difference between these two concepts. These performances initially reveal great variability in learning. Over the year, however, performance typically improves. Our student reviews reflect struggle with these activities; students are apprehensive about the synthesizing activities but recognize that they learn from them.

Problems Understanding the Theory-Agnostic Stance and the Nature of the MBE Toolkit

The first term proves most difficult as students unfamiliar with the practice of science look for a single, unifying theory for MBE. We repeatedly emphasize that different theoretical positions are valid for different problems. This problem can become more acute as we add new concepts and tools from other disciplines. The student's key task is to find the frameworks that are "usefully true" for the problem at hand. We have found it helpful to provide early readings on scientific practice from an educational perspective such as those available from the National Research Council (Shavelson & Towne, 2002). Then, we dedicate a class to applying these ideas by comparing a few theories of cognitive development, such as Piaget's and Chomsky's, and evaluating their usefulness for different problems.

Finding the Balance Between Breadth and Depth of Content

We all feel that there are certain essential things that students should be exposed to, but this conviction can lead to a proliferation of discussions that leave students overwhelmed and unable to integrate the information. We also know that it is better to hone a syllabus to emphasize a few key ideas that can be traced throughout the year. While this is a common problem for all courses, it is particularly true for a multidisciplinary endeavor.

A Yearlong Course

Teaching students the basic facts of multiple disciplines could probably be accomplished through a semester-long survey course. However, to integrate and synthesize information from multiple disciplines in any meaningful way requires a yearlong commitment at a minimum.

Staff Continuity

From the earliest manifestation of the course, we asked our teaching fellows to stay with the course for multiple years. The first year on staff is an apprenticeship, with typically less teaching and grading responsibility. This introductory year on staff allows apprentices to revisit the materials and deepen their own synthesis of the content. Each staff member also continues to develop his or her own expertise in chosen research areas. Each year, we draw on the knowledge and skills of the teaching staff to shape course activities and presentations. A multiyear commitment asks much of the staff, but we believe this structure pays dividends to the project as a whole.

CONCLUSION

Though we feel that the course has hit its stride, we continue to refine it each year. The refinement occurs as a result of feedback from students solicited at regular intervals, new findings in the several contributing fields, and the involvement of new lecturers, teaching fellows, and students with a helpful gamut of backgrounds. We also continue to add to our library of resources—privileged or copyrighted materials available only to our students via the Harvard intranet, as well as materials accessible on the HGSE "usable knowledge" Web site: http://www.uknow.gse.harvard.edu.

Since the inception of the course, other programs have been launched in the general area of neuroeducation. Each of these programs, and its constituent courses, will appropriately reflect the interests and expertise of students and instructors at the respective institutions. No doubt, we and others will benefit from the opportunity to learn more about these parallel offerings. Indeed, one motivation for the present publication is our desire to enter into exchanges with colleagues who are involved in analogous undertakings.

For the most part the initial architects of the MBE enterprise have been senior scholars. But the future of the field clearly lies in the hands of those students and young scholars who are motivated to undertake fresh lines of research as well as interventions that hold promise. A major vehicle for attracting such students is the courses that are being offered at colleges and universities. As the courses improve, the quality of researchers and practitioners is likely to be enhanced; and these full-blown neuroeducators will, in turn, contribute to further improvement in curricula and pedagogy.

REFERENCES

Boix-Mansilla, V. (2006). Quality assessment of interdisciplinary research: Toward empirically grounded validation criteria. *Research Evaluation*, *14*, 17–29.

Bruer, J. (1997). Education and the brain: A bridge too far. *Educational Researcher*, *26*, 4–16.

Fischer, K. W., Immordino-Yang, M. H., & Waber, D. P. (2007). Toward a grounded synthesis of mind, brain, and education for reading disorders: An introduction to the field and this book. In K. W. Fischer, J. H. Bernstein, & M. H. Immordino-Yang (Eds.), *Mind, brain, and education in reading disorders* (pp. 3–15). Cambridge, UK: Cambridge University Press.

Gardner, H. (2007). *Five minds for the future*. Boston: Harvard Business School Press.

Grigorenko, E. (2007a). How can genomics inform education? *Mind, Brain, and Education*, *1*, 20–27.

Grigorenko, E. (2007b). Triangulating developmental dyslexia: Brain, behavior and genes (chap. 5). In D. Coch, G. Dawson, & K. W. Fischer (Eds.), *Human behavior, learning and the developing brain: Atypical development*. New York: Guilford.

Rose, D., Meyer, A., Strangman, N., & Rappolt, G. (2002). *Teaching every student in the digital age: Universal design for learning*. Alexandria, VA: ASCD.

Shavelson, R. J., & Towne, L. (Eds.) (2002). *Scientific research in education*. Washington, DC: National Academy Press.

Wiske, M. S. (Ed.). (1998). *Teaching for understanding*. San Francisco: Jossey-Bass.

Wolf, M. (2004). Novel connections: The neuronal basis of the reading brain, the pedagogical basis of reading intervention, and the conceptual basis for the evolution of an idea. *Mind, brain and education usable knowledge conference, 7-8.* Harvard Graduate School of Education. Retrieved March 2, 2007 from http://www.gse.harvard.edu/usableknowledge/mbe/sessions/papers/WolfM_Novel_Connections.pdf