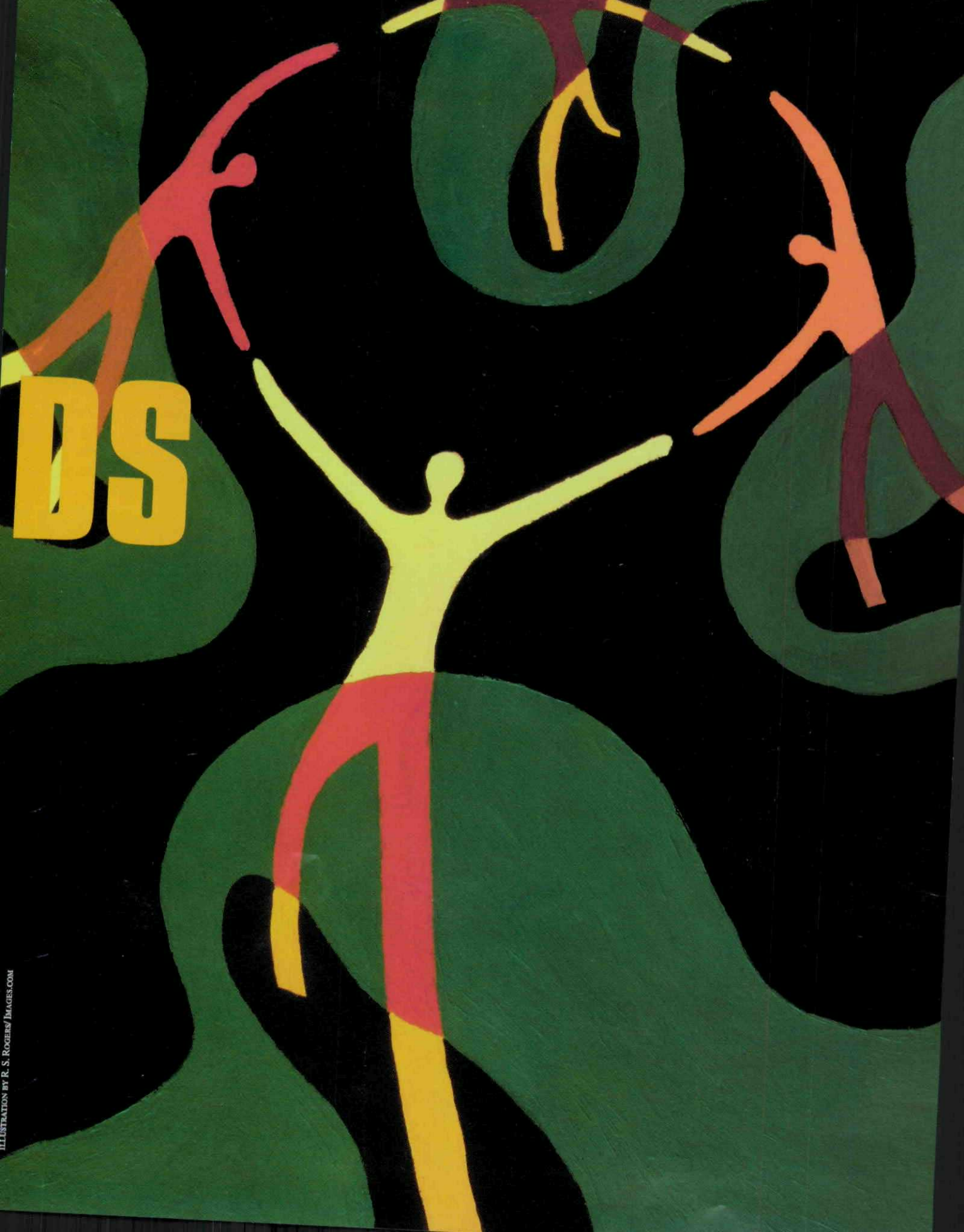


Assessing Student Work at DISCIPLINARY CROSSROAD

BY VERONICA BOIX MANSILLA

The demand is clear. Whether we try to take a stance on the stem cell research controversy, to interpret a work of art in a new medium, or to assess the reconstruction of Iraq, a deep understanding of contemporary life requires knowledge and thinking skills that transcend the traditional disciplines. Such understanding demands that we draw on multiple sources of expertise to capture multi-dimensional phenomena, to produce complex explanations, or to solve intricate problems. The educational corollary of this condition is that preparing young adults to be full participants in contemporary society demands that we foster their capacity to draw on multiple sources of knowledge to build deep understanding.

Veronica Boix Mansilla is principal investigator of the Interdisciplinary Studies Project at Project Zero, Harvard Graduate School of Education. She wishes to thank Liz Dawes for her contribution to data analysis and the development of these ideas. She also wishes to thank Howard Gardner, her co-principal investigator, and the researchers in her team, Steven McAlpine, Matt Miller, and Alison Rhodes for their feedback. A special thanks is due to the Atlantic Philanthropies for its generous support of this work. Author retains copyright.



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Undergraduate programs across the nation are increasingly offering interdisciplinary study programs as markers of their commitment to educate individuals for the demands of contemporary life. Yet, as students engage in interdisciplinary learning projects, an unaddressed question looms large: how to adequately assess student interdisciplinary work. How can faculty, trained to be disciplinary experts, properly determine what constitutes quality work when familiar disciplinary standards do not suffice?

Adequately assessing student learning in higher education remains more a matter of collective hope than of convergent and well-tested practice. The issue is marred by controversies over the purposes, methods, and most importantly, the content of proposed assessments.

Lack of clarity about indicators of quality is particularly evident in the assessment of student interdisciplinary work—where both the underlying nature of interdisciplinary understanding and how it might be recognized remain insufficiently defined. What does it mean to deeply understand an issue in an interdisciplinary way? How is it different from deep disciplinary understanding or a superficial merging of viewpoints?

A clear articulation of what counts as quality interdisciplinary work, and how such quality might be measured, is needed if academic institutions are to foster in students deep understanding of complex problems and evaluate the impact of interdisciplinary education initiatives.

In this article, I propose a definition of interdisciplinary understanding and a framework to inform the assessment of student interdisciplinary work. The arguments presented stem from an empirical study my colleagues and I conducted at the Harvard Interdisciplinary Studies Project.

Our project examines interdisciplinary research and educational practices in well-recognized research centers and educational programs like the Media Lab at MIT, the Center for Bioethics at the University of Pennsylvania, and the Human Biology Program at Stanford University. Assessment of student interdisciplinary understanding was a central focus of our analysis of 50 faculty interview transcripts and more than 50 pieces of student work.

INTERDISCIPLINARY UNDERSTANDING—A DEFINITION

Interdisciplinarity is an elusive concept. Stated definitions in the literature are varied, as are the enacted definitions that tacitly guide real teaching practices. The term is employed to describe a broad array of endeavors ranging from a bio-

chemistry student learning about gene regulation, to a faculty member using the visual arts to introduce a mathematical concept, to a student's post-structuralist critique of the nature of disciplinary authority. This semantic elusiveness is exacerbated by the fact that current scholarly debates about interdisciplinarity involve social, political, cognitive, and epistemological dimensions.

In our research, we have defined "interdisciplinary understanding" as the capacity to integrate knowledge and modes of thinking drawn from two or more disciplines to produce a cognitive advancement—for example, explaining a phenomenon, solving a problem, creating a product, or raising a new question—in ways that would have been unlikely through single disciplinary means.

In this formulation, the integration of disciplinary perspectives is a means to an end, not an end in itself. Disciplinary standards are upheld and leverage to achieve the end in question is gained by combining disciplinary lenses.

Four core premises underlie my proposed definition. First, it builds on a performance view of understanding—one that privileges the capacity to use knowledge

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over that of simply having or accumulating it. From this perspective, individuals understand a concept when they are able to apply it—or *think with it*—accurately and flexibly in novel situations.

For example, we understand the psychological construct “theory of mind” (that is, an individual’s recognition of others’ mental states, beliefs, and intentions) when we can use the concept to explain why a given child might be unusually empathic, or how a political campaign manager makes strategic decisions. From this vantage point, understanding the concept of “theory of mind” is a high order cognitive endeavor that goes beyond simply having an accurate definition of the term.

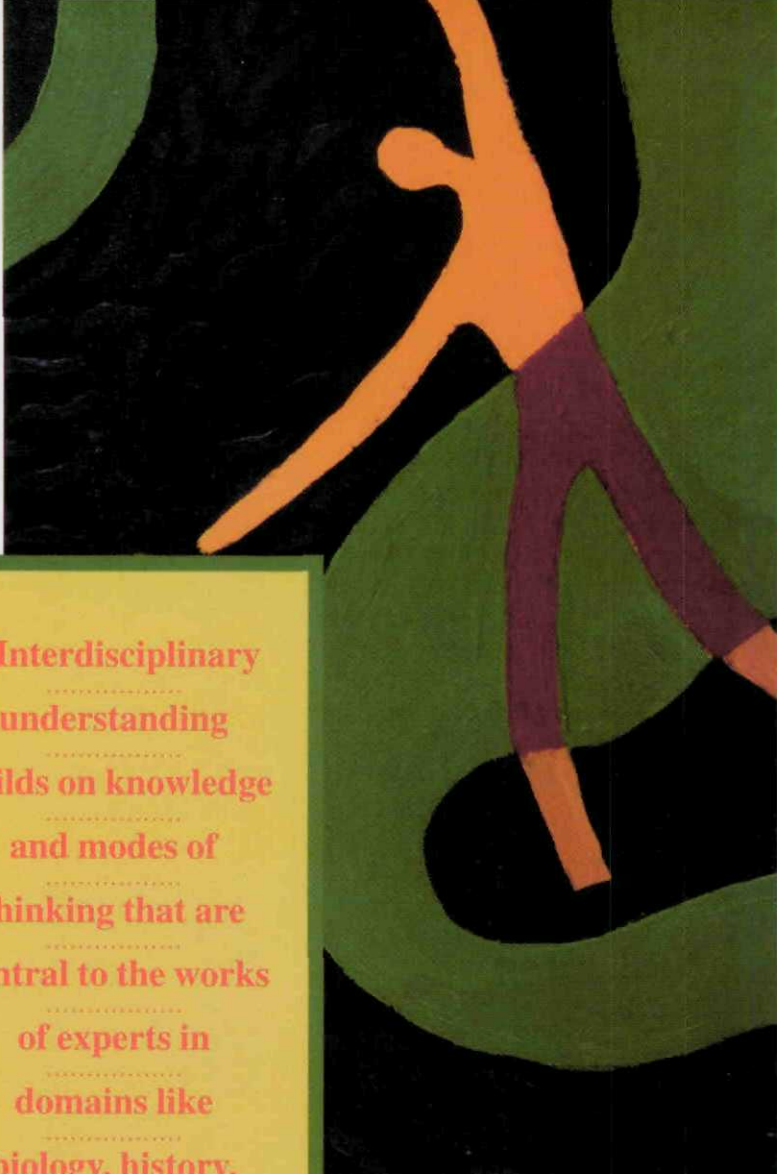
A second premise underlying the proposed definition is that interdisciplinary understanding is highly “disciplined”—that is, *deeply informed by disciplinary expertise*. In our formulation, interdisciplinary understanding builds on knowledge and modes of thinking that are central to the work of experts in domains like biology, history, literature, or the visual arts.

An interdisciplinary explanation of a phenomenon like autism, for instance, differs from a naive or “commonsense” explanation in that it builds on insights that have survived the scrutiny of expert communities such as neurology or psychology using commonly agreed upon methods and validation standards. And while such disciplinary insights are clearly open to further revision, they embody the most reliable and up-to-date accounts of the natural and cultural world available.

When highlighting the foundational role of disciplines in interdisciplinary understanding, it is not the particular distinctions among chemistry, biology, and biochemistry that concern me. Such distinctions are part of a rapidly changing knowledge landscape. Instead, I emphasize the distinction between genuine disciplinary insights and common sense—our more intuitive and untested takes on the world. Indeed, interdisciplinary understanding differs from naïve common sense precisely in its ability to draw on disciplinary insights.

Interdisciplinary understanding, as here defined, stands on a third premise: it involves the *integration* of disciplinary views. In interdisciplinary work, disciplinary perspectives are not merely juxtaposed. Rather, they actively inform one another, thereby leveraging understanding. For instance, in exploring the phenomenon of autism, the psychological concept of “theory of mind” (a missing construct among autistic individuals) enables us to characterize expected patterns of behavior in a child.

In turn, such patterns provide adequate categories with which to study the autistic brain and begin to explain behavior at a neurological level. It is in epistemic exchanges of this kind, in this instance between psychology and biology, that an inter-



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disciplinary “whole” stands as more than the sum of its disciplinary “parts.” Finally, interdisciplinary understanding is *purposeful*. Within it, the integration of disciplines is not an end in itself but a means to achieve a cognitive advancement—for example, a new insight, a solution, an account, or an explanation.

In interdisciplinary work, many possible integrations are viable. For example, autism can be explored at the crossroads of psychology and sociology by examining the unique forms of social discrimination associated with autistic children. Or it could be investigated at the crossroads of neurology and medical ethics—if one were to consider experimenting with novel medical procedures. The merit of an interdisciplinary integration should be assessed against the specific goal of each interdisciplinary enterprise.

This definition of interdisciplinary understanding is admittedly stringent. Its *performance* criterion distinguishes it from simply being able to master and recall information drawn from multiple disciplinary sources. Its emphasis on *disciplinary grounding* positions it in sharp contrast to intuitive common sense. Its call for *integration* and *leverage* proves more demanding than multidisciplinary juxtapositions. Its emphasis on

purposefulness sets it apart from a view of integration as an end in itself—a view often prominent in interdisciplinary curricula.

A rigorous account of the nature of interdisciplinary understanding—the epistemological foundations on which it stands and the cognitive challenges it presents—provides a blueprint for examining student interdisciplinary work, to find evidence of accomplishment, and to identify ways to support improved understanding.

ASSESSMENT—THE “BLACK HOLE” OF INTERDISCIPLINARY EDUCATION

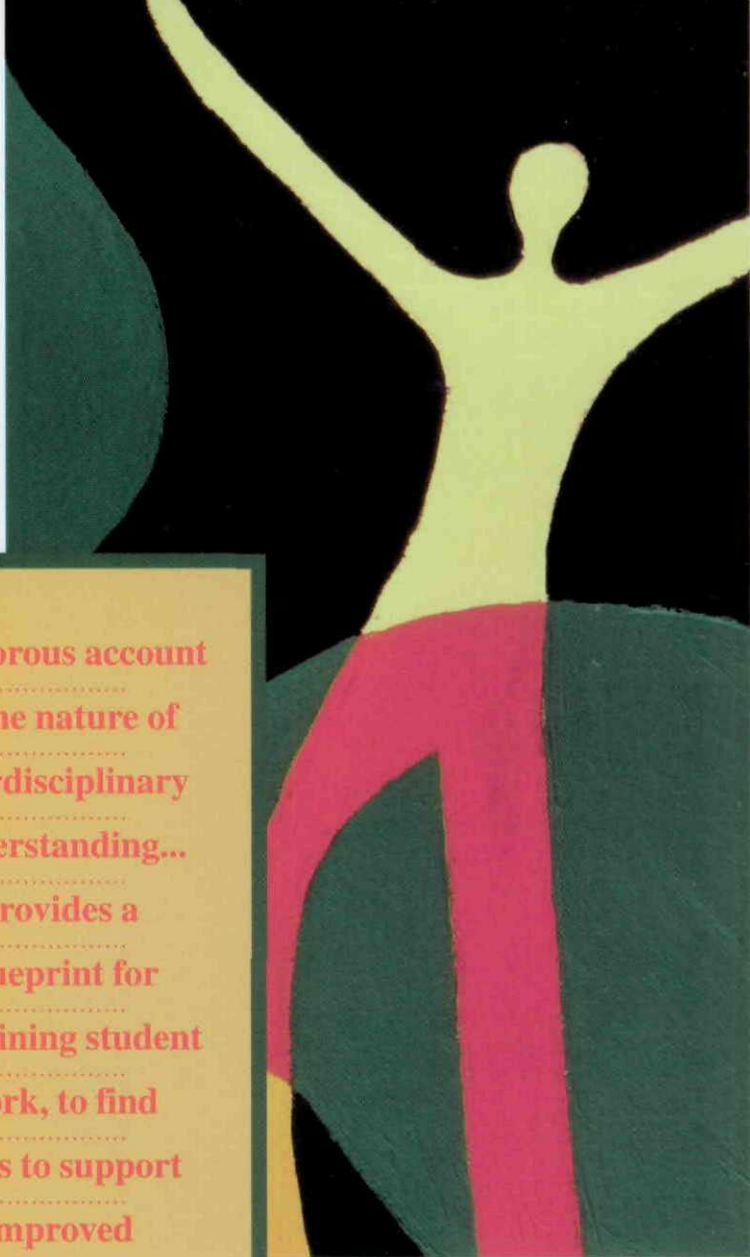
The faculty we interviewed in our study met our questions about their assessment of interdisciplinary student work with understandable doubt and self-criticism. Echoing the pedagogical discourse of the last decade, some referred to the *process* by which they assessed student understanding—for example, presenting real-life problems, making assessment criteria explicit, using rubrics to guide the evaluation of student work or collecting portfolios of exemplary instances.

But when probed to address the *substance* of their assessment—that is, the actual markers or characteristics of a good piece of interdisciplinary work—they expressed concern. Their shift to metaphoric language—“when the whole is more than the sum of the parts” or “when it all clicks together,” for example—revealed their lack of a conceptual language to describe core qualities of sound interdisciplinary work. Confirming this perception, their reported grading practices often combined generic qualities like “logic of argument,” “clarity in presentation,” or “writing style,” with dispositional criteria like students’ “effort,” “dedication,” and “commitment.”

For some faculty, the lack of a conceptually sound framework with which to assess interdisciplinary work was a source of deep concern. Among program administrators, similar concern was exacerbated by the need to determine the impact of interdisciplinary programs on student learning. How can we account, they asked, for what is unique about interdisciplinary work, but is often overlooked by only subjecting students (and programs) to discipline-based evaluations?

The assessment framework proposed here builds on the most productive insights that emerged from our interviews. Informed by a tradition of work in cognition and instruction at Harvard Project Zero, the framework integrates faculty insights around three core questions about student interdisciplinary understanding as exhibited in a piece of work whether it takes the form of a paper, a thesis, a video, or a work of art:

- Is the work grounded in carefully selected and adequately employed *disciplinary insights*?



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- Are disciplinary insights clearly integrated so as to leverage student understanding?

- Does the work exhibit a clear sense of purpose, reflectivity, and self-critique?

Three assessment dimensions are embedded in the above questions. In what follows, I further define these dimensions and illustrate how each might be used to shed light on a piece of student work.

Disciplinary Grounding. Disciplinary insights in history, mathematics, or the visual arts are not in conflict with interdisciplinary understanding. Rather, they constitute the foundation of expertise that distinguishes interdisciplinary understanding from naïve common sense.

In many education circles, two important misconceptions about the nature of disciplines prevail—first, that disciplines are bounded collections of facts to be memorized; and second, that they embody sanctioned knowledge not subject to revision. Against this view, a conception of disciplinary understanding that highlights its multidimensionality and dynamism is in order.

Disciplinary understanding is best conceptualized as a four-fold enterprise. A student begins to exhibit disciplinary understanding when he or she has mastered a certain disciplinary *content* base (for example, being able to move flexibly among theories, examples, concepts, and findings stemming from disciplinary practice).

Disciplinary understanding then demands that students have a sense of the *methods* through which knowledge is developed and validated in a discipline (for example, understanding experimental design, logical argumentation, source interpretation, or close reading of texts) and that they grasp the dynamism and provisional nature of current disciplinary knowledge.

Disciplinary understanding requires an informed sense of the *purposes* that drive disciplinary inquiry (for example, a foundational desire to understand human relations or the need to address a pressing medical problem). Finally, disciplinary understanding is communicated through prototypical *genres* (for example, a research paper, a monument, a bill of law, or a historical narrative) whose communicative codes students should understand.

In interdisciplinary work, the act of deploying disciplinary insights is necessarily selective. It involves not only deciding which disciplines might best inform the question at hand but also what specific aspect of each discipline might prove most useful (for example, particular content, methods, purposes, or forms of communication).

Assessing interdisciplinary student work thus begins with careful consideration of its disciplinary grounding. An initial disciplinary reading of this kind enables us to unearth the foundational bodies of expertise on which a particular piece of student work rests, and to offer informative feedback about the selection and accuracy of the disciplinary insights the student employs. It may also offer an opportunity to detect misconceptions and to suggest perspectives that might further enrich the work at hand.

Integrative Leverage. In interdisciplinary work, students are asked to go beyond careful selection and accurate representation of disciplinary insights. Quality work *integrates* these perspectives to generate a new and preferred understanding—one that would not have been possible using a single discipline.

Integrative insights can take many forms and can help advance understanding in multiple ways. Applying this second assessment criterion to a piece of student work involves identifying such points of integration and articulating how they leverage student understanding.

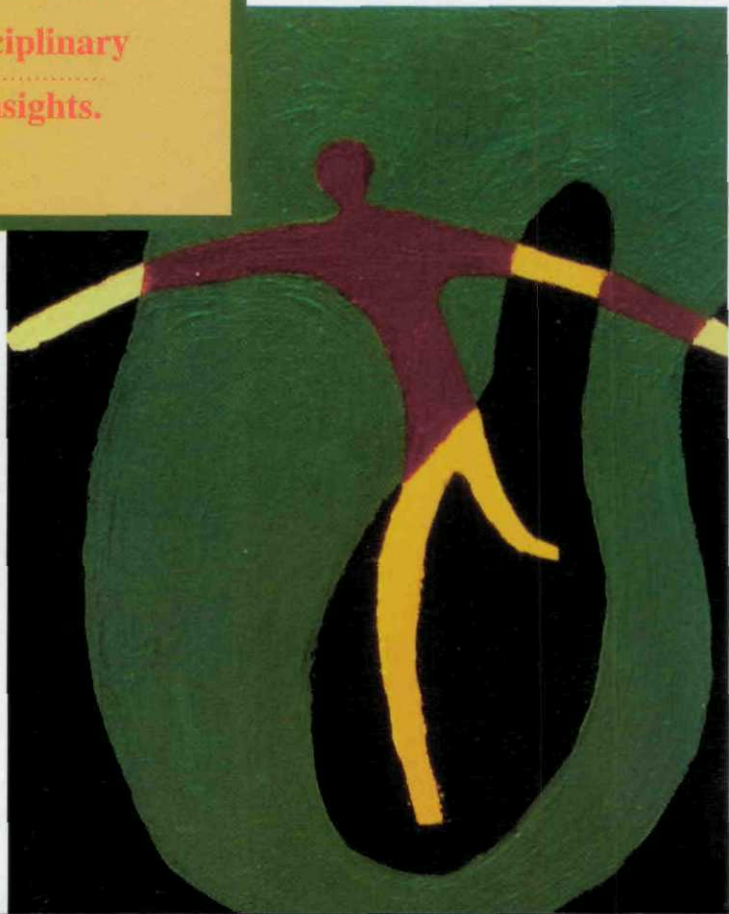
Particular points of integration in a piece of student work (for example, a new model, metaphor, or method) may vary widely, and so do the ways in which they leverage understanding (for example, deepening explana-

tions, synthesizing representations, or strengthening empirical grounding). An *integrative model* of a phenomenon like incest taboo for instance, may bring together culture and biology—topics typically addressed by independent disciplines. By shedding light on the interaction between culture and biology, the model leverages our understanding toward a *more comprehensive explanation* of this human phenomenon.

Similarly, an artistic representation (a monument or painting, for example) of a historical process (for instance, the Rwandan genocide) may advance understanding of the past by proposing an *interpretive synthesis* that captures and expresses a defining quality of the time. To illustrate, “the fling of a machete” may serve as a synthetic visual metaphor to capture the unprecedented pace at which the violence of the Rwandan genocide unfolded before a paralyzed international community.

Occasionally, interdisciplinary work may involve intertwining forms of inquiry that stem from different domains. For example, a critique of the “individual autonomy” imperative in Western medical philosophy might not pursue further philosophical argument but instead employ an anthropological account of how different cultures perceive constructs like “individualism,” “choice,” and “quality of life.” Such an approach yields an *empirically grounded* critique of “autonomy” as a universal principle in medical ethics—a critique that would not have been pos-

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sible through philosophical inquiry alone. In sum, articulating the leverage in understanding afforded by the integration of disciplinary perspectives in a piece of student work involves interpreting the work with an epistemological eye. It involves weighing the affordances of one disciplinary perspective against those of another, and against the overall purpose of the student's enterprise.

Assessing the leveraging power of an integration requires that we pose the question of exactly how the combination of disciplinary perspectives is contributing to the advancement of student understanding of the phenomenon at hand or conversely, what would be lost if a particular perspective were excluded.

Critical Stance. The ultimate success of an interdisciplinary enterprise must be measured against its goals and its ability to withstand critique. Producing quality interdisciplinary work is not a simple matter. It involves redefining problems, exchanging

methods, translating categories, and testing outcomes against multiple and often conflicting standards of quality.

The process is defined by epistemic compromises. With this complexity in mind, interdisciplinary student work must also be assessed in terms of the work's self-critical stance—its clarity of goals, conscious judgments about the process of integration, and healthy skepticism about its outcomes.

The goal of quality interdisciplinary student work is not to enhance independent disciplinary insights or reach integration *per se*, but to produce a cognitive advancement that uses both disciplines and integrations as its tools. Whether students seek to develop a new technological product or to craft a more comprehensive explanation of cultural differences, the purpose of the work must serve as a guiding light to judge which disciplines ought to be included and how, and what points of integration and leverage might prove most productive. Indeed, the purpose of the work is the measure against which one decides "what works."

Disciplinary coordination imposes important cognitive demands on students. It requires that they develop a sense of their work at a meta-disciplinary level—to identify disciplinary blind-spots, to articulate integrative leverages, to navigate methodological differences, and to decide among competing units of analysis.

Exemplary interdisciplinary student work exhibits such forms of conscious reflectiveness about method, accompanied by a healthy degree of skepticism about the outcome. In exemplary work, students are aware of the limitations of their product or findings, and propose fruitful ways to pursue further understanding.

This third criterion, critical stance, sheds light on yet another dimension of students' understanding: their meta-disciplinary awareness and their critical view of the overall composition of a piece of

integrative work. The criterion helps us explore the degree to which the work exhibits clarity of goals, whether it embodies careful judgment about the process of integration, and whether it offers evidence of self-critique.

In sum, rooted in an empirical analysis of experienced faculty insights about the desirable qualities of interdisciplinary work, and standing on the shoulders of a long research tradition in cognition and instruction, this proposed assessment framework can shed light on particular dimensions of student work, and thus enable faculty to diagnose and support student understanding in informed and evidence-based ways.

The proposed criteria are generic enough to be applicable to a broad range of disciplinary combinations and performance genres (for example, papers, plays, or artwork). The specific type of performance determines



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LOOKING CLOSELY AT A PIECE OF STUDENT WORK

Yohko Murakami is a student in Human Biology at Stanford University. For more than 30 years, this interdisciplinary undergraduate program has invited students to bring together social and natural sciences to examine human phenomena like lactose intolerance, the incest taboo, or sustainability. Yohko's honors thesis examined the interaction between language, culture, and children's "theory of mind." Specifically, she carried out a comparative study of how young children in Japan and the United States interpret the level of expertise of adults who teach them new words to describe objects in the world.

Dissatisfied with the application of protocols developed in English-speaking contexts to study children's theory of mind in other cultures, Yohko set out to develop more culturally sensitive measures of theory of mind, and to compare Japanese and American children's use of this capacity. To that end, Yohko's thesis brought together insights drawn from psychology, linguistics, and anthropology.

Applying the proposed assessment framework to key aspects of Yohko's interdisciplinary effort involves asking the following questions: To what degree is her work grounded in carefully selected and adequately employed disciplinary insights? Are disciplinary insights clearly integrated to advance her understanding? And does her work exhibit a clear sense of purpose, reflectiveness and self-critique? In other words, assessing this piece of work involves examining the work's disciplinary grounding, integrative leverage, and critical stance.

Disciplinary Grounding. We may begin to assess a piece of work like

Yohko's by defining the areas of expertise on which it is grounded—in this case psychology, linguistics, and anthropology. In examining her work's foundation in the discipline of psychology, for instance, we may notice how her accurate definition of the concept of theory of mind is supported with accumulated empirical evidence gained through well designed experiments (the *content* and *methods* dimensions of disciplinary understanding).

We may also note her convincing rationale for the importance of understanding theory of mind as our primary cognitive tool for understanding other people and for interacting with them (the *purpose* dimension). We may finally note her ability to communicate her findings in a genre typical of experimental psychology, where research questions are made explicit, hypotheses advanced, and experimental designs carefully justified (*form*).

Integrative Leverage. Yohko's paper moves beyond accurate employment of independent disciplinary insights to propose integrations that advance her understanding of cultural differences in children's developing theory of mind. Applying the second assessment criterion to her work involves first identifying her chosen points of integration and then considering the degree to which her understanding was leveraged by her particular combination of insights. For instance, we may notice her productive focus on what she calls "epistemic terms" ("know," "think," "guess," "might," "maybe") as linguistic signals of an individual's degree of certainty. Insights stemming from psychology, linguistics, and

anthropology meet at the heart of this construct. Her approach enables her to conduct a comparative linguistic analysis of Japanese and American use of particular epistemic terms, to capture culturally specific ways to reveal degrees of certainty, and to design a culturally sensitive experimental protocol to study children's theory of mind.

Shorn of a *linguistic* analysis of "epistemic terms," her work would have lacked viable indicators of mental states and would not have permitted cross-linguistic comparisons. Shorn of an *anthropological* interpretation, discursive differences in the use of "epistemic terms" would have remained unexplained. Shorn of a *psychological* understanding of levels of certainty as denoted by specific "epistemic terms," her work would not have addressed the purposes of her study.

Critical Stance. This third criterion highlights the degree to which the goals of Yohko's cross-cultural study of theory of mind development are clearly stated and disciplinary insights and integrations are put to the service of advancing such goals. The criterion points our assessment focus to her description of how experimental protocols designed for English-speaking children may be complemented by culturally attuned protocols that yield more valid accounts of cognitive development. Applying the *critical stance* criterion may also call our attention to the appropriately tentative language with which she suggests a plausible culture-specific explanation of her findings—an indicator of the kind of thoughtfulness and healthy skepticism that defines quality work. ☞

what aspects of student understanding are made most visible in each case. For example, a research paper invites explicit reference to knowledge production and testing, whereas a piece of art requires an accompanying reflection if a student's integrative process is to be made explicit. Assessing student interdisciplinary understanding demands that the student's thinking is made sufficiently visible to provide evidence of developing understanding.

While generic enough to address a myriad of disciplinary combinations, the three proposed criteria are also specific to the unique challenges of assessing integrative work. For ex-

ample, they demand explicit and distinct judgments about the proficient selection and representation of disciplinary knowledge and modes of thinking, the disciplinary integrations that leverage understanding, and adoption of a self-critical stance toward proposed integrations. By sharpening the focus of our lens to interpret interdisciplinary understandings rigorously and to support their further development, we may better prepare students for informed participation in today's knowledge society and in tomorrow's decisively interdisciplinary world of knowledge. ☐

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