ASSESSING STUDENT WORK AT DISCIPLINARY CROSSROADS

By

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The demand is clear. Whether we seek to take a stance on the stem cell research controversy, to interpret new media art works, or to assess the reconstruction of Iraq, a deep understanding of contemporary life requires an interdisciplinary approach. Such understanding demands that we draw on multiple sources of expertise in order to capture multi-dimensional phenomena, produce complex explanations, or solve intricate problems. The educational corollary of this state of affairs 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. 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 does one assess student interdisciplinary work? How does one determine what constitutes quality work when individual disciplinary standards do not suffice?

Adequately assessing student learning in higher education remains more a matter of collective hope than one of convergent and well-tested practice. The issue is marred by controversies over the purposes, methods, and most importantly, the very content of such assessment. Lack of clarity about indicators of quality is particularly evident in the assessment of student interdisciplinary work—where

both the nature of *interdisciplinary understanding* and its *assessment* remain insufficiently defined. What does it mean to understand an issue in depth 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 our academic institutions are to foster in students deep understanding of complex problems and evaluate the impact of interdisciplinary education initiatives.

In this article, I put forth a definition of *interdisciplinary understanding* and a framework to inform our assessment of student interdisciplinary work. The arguments I present stem from an empirical study conducted by my colleagues and me at the Harvard Interdisciplinary Studies Project. Our project examines interdisciplinary research and educational practices in well-recognized research centers and educational programs such as (but not limited to) the Media Lab at MIT, the Center for Bioethics at the University of Pennsylvania, and Human Biology Program at Stanford University. Assessment of student interdisciplinary understanding was a central focus in our analysis of 50 faculty interview transcripts and more than 50 pieces of student work.

Interdisciplinarity is an elusive concept. Stated definitions in the literature are varied, and so are the enacted definitions that tacitly guide teaching practices in various institutions. The term is adopted to refer to a broad array of endeavors — from a biochemistry 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 very nature of disciplinary authorities. This semantic evasiveness is exacerbated by the fact that current scholarly debates about interdisciplinarity involve social, political, cognitive, and epistemological dimensions alike.

In our research, we have defined *interdisciplinary understanding* as *the capacity to integrate knowledge and modes of thinking in two or more disciplines to produce a cognitive advancement –e.g., explaining a phenomenon, solving a problem, creating a product, 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 a purpose-- not an end in itself. Disciplinary standards are upheld and leverage is gained from combining disciplinary lenses.

Four core premises underlie this proposed definition. First, it builds on a performance view of understanding-- one that privileges the capacity to *use* knowledge over that of *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" (i.e., 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 "disciplined"- i.e. 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 art. An interdisciplinary explanation of a phenomenon like autism differs from a naïve or "common-sense" one in that it builds on insights that have survived the scrutiny of expert communities (e.g., neurology, psychology) given commonly agreed upon methods and validation standards. And while such disciplinary insights are clearly open to further revision, they embody the most reliable accounts of the natural and cultural world available in our societies today.

In 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 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 inform one
another, *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 to study
the autistic brain and begin to *explain* behavior at a neurological level. It is in
epistemic exchanges of this kind, between psychology and biology, that an
interdisciplinary "whole" stands as more than the sum of its disciplinary "parts".

Finally, interdisciplinary understanding is *purposeful.* In it, the integration of
disciplines is not an end in itself but a means for a cognitive advancement—e.g.,
a new insight, a solution, an account, an explanation. In interdisciplinary work,
multiple possible integrations are viable. For example, autism can be explored at
the crossroads of psychology and sociology -- if one were to examine the unique
forms of social discrimination associated with autistic children. It could be

examined through neurology and medical ethics—if one were to consider experimenting with novel medical procedures. The merit of an interdisciplinary integration is to be assessed against the very goal of each interdisciplinary enterprise.

The proposed definition of interdisciplinary understanding is admittedly stringent. Its *performance* criterion distinguishes it from the simpler mastery and recall of information stemming from multiple 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 present 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, serves as a blueprint to examine student interdisciplinary work, to find evidence of a student's accomplishments, and to identify ways of supporting improved understanding.

ASSESSMENT— THE "BLACK HOLE " OF INTERDISCIPLINARY EDUCATION

Consistently, faculty interviewed in our study met our questions about 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—i.e., presenting real-life problems, making assessment criteria explicit, using rubrics to guide students work, collecting portfolios of exemplary pieces. Yet when probed to address the *substance* of their assessment – i.e. the markers of a good piece of interdisciplinary work - faculty expressed concern. Their shift to metaphoric language "when the whole is more than the sum of the parts," "when it all clicks together" revealed the lack of a conceptual language to refer to core qualities of interdisciplinary work. Confirming this perception, their reported grading practices often combined generic qualities such as "logic of argument", "clarity in presentation", "writing style," with dispositional criteria like students' "effort", "dedication," and "commitment."

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

The assessment framework proposed here builds on the most productive insights emerging 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 student work takes the form of a paper, a thesis, a video, or a work of art, three questions can be used to assess its unique interdisciplinary qualities:

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

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

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

A FRAMEWORK INTRODUCED

Three assessment dimensions are embedded in the questions above: disciplinary grounding, integrative leverage and critical stance. 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 are the very source of expertise that

distinguishes interdisciplinary understanding from naïve common sense. In education circles, two important misconceptions about the nature of disciplines prevail: (a) that disciplines are bounded collections of facts to be memorized as a sign of cultural literacy and (b) 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) A student begins to exhibit disciplinary understanding when he or she has mastered a certain disciplinary *content* base (e.g., moving flexibly between theories, examples, concepts, and findings stemming from disciplinary practice). (b) Disciplinary understanding also demands that students have a sense of the *methods* by which knowledge is developed and validated in a discipline (e.g., experimental design, logical argumentation, source interpretation, close reading of text) and that they capture the dynamism and provisional nature of current disciplinary knowledge. (c) Disciplinary understanding requires an informed sense of the *purposes* that drive disciplinary inquiry, such as a foundational desire to understand human relations, or the need to address a pressing problem. (d) Finally, understanding in a discipline is communicated through prototypical genres – e.g., a research paper, a monument, a bill of law, or a historical narrative—whose communicative codes students would benefit from understanding.

In interdisciplinary work, the act of borrowing 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 (e.g., particular content, methods, purposes or forms of communication). Assessing interdisciplinary student work may begin with a careful consideration of its disciplinary grounding. A disciplinary reading of this kind enables us to unearth the foundational bodies of expertise on which a particular piece of student work stands, and offer informative feedback about the selection and accuracy of disciplinary insights. It may offer an opportunity to detect students' misconceptions and suggest perspectives that might further enrich the work at hand.

INTEGRATIVE LEVERAGE--INTEGRATING DISCIPLINES TO ADVANCE UNDERSTANDING

Yet 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 preferable understanding—an understanding that would have been not possible through single disciplinary means. Integrative insights may adopt multiple forms and enable the advancement of understanding in multiple ways. Using this second assessment criterion involves identifying such points of integration and articulating how they leverage student understanding.

Points of integration (e.g, a new model, metaphor, method) vary, and so do the ways in which they leverage understanding (e.g., deepening explanations, synthesizing, strengthening empirical grounding). For instance, an *integrative model* of a phenomenon like incest taboo may bring together culture and biology -- dimensions typically studied 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.

An artistic representation (e.g., monument, painting) of a historical process (e.g., the Rwandan genocide), may advance understanding of the past by proposing an *interpretive synthesis* that captures and expresses a defining quality of the time. For instance "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, may not involve further philosophical argumentation, but an anthropological account of how different cultures perceive associated 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 viable 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 such work with an epistemological eye. It involves weighing the affordances of one disciplinary perspective against those of another one, and against the overall purpose of the student's enterprise. Assessing the leverage power of an integration requires that we pose the question of how exactly 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

Ultimately, the 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 with regard to the work's self-critical stance—i.e., the work's clarity of goals, considered judgment about the very 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 craft a more comprehensive explanation of cultural differences, it is the very purpose of the work that serves as a guiding light to judge what disciplines ought to be included and how, and what points of integration and leverage might prove most productive. Indeed, the purpose of a piece of work is the very 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--that they point out disciplinary blind-spots, articulate integrative leverages, navigate methodological differences, and decide among competing units of analysis. Exemplary interdisciplinary student work exhibits such form of reflectiveness accompanied by a healthy degree of skepticism about the outcome of the work itself. In such work, students are aware of the limitations of their product or findings and can account for fruitful ways to pursue further understanding.

In sum, the third criterion proposed, *critical stance*, sheds light on yet another dimension of students' understanding: students' meta-disciplinary awareness and 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 a careful (and meta-disciplinary) judgment about the process of integration, and whether it offers evidence of self-critique.

To examine how the proposed framework can be used to illuminate key dimensions of student understanding, I now turn to an analysis of an example of student work.

LOOKING CLOSELY AT A PIECE OF STUDENT WORK

Yohko Murakami was a student in Human Biology at Stanford University. For more than thirty years, this undergraduate interdisciplinary program has invited students to bring together social and natural sciences to examine human phenomena such as 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 US 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 context to study children's theory of mind in other cultures, Yohko set out to develop more culturally-sensitive measures of theory of mind, and compare Japanese and American children's use of this capacity. To that end, Yohko's thesis brought together insights from psychology, linguistics, and anthropology.

Applying the proposed assessment framework as a lens to shed light on key aspects of Yohko's interdisciplinary effort involves asking: To what degree was her work grounded in carefully selected and adequately employed disciplinary insights? Were disciplinary insights clearly integrated to advance her understanding? Did her work exhibit a clear sense of purpose, reflectiveness and self-critique? In other words, it 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 – e.g., 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 yielded by key experimental designs (the *content* and *methods* dimensions of disciplinary understanding). We may also notice her convincing rationale for the importance of understanding theory of mind as our primary cognitive tool to understand others and interact with them (the *purpose* dimension). We may come to appreciate her ability to communicate her findings in a genre typical of experimental psychology—where research questions are made explicit, hypotheses put forth, experimental design carefully justified (*form*).

INTEGRATIVE LEVERAGE   As expected, Yohko's paper moved beyond accurate employment of independent disciplinary insights, to propose integrations that

advanced her understanding of cultural differences in children's developing sense of "theory of mind". Applying this second assessment criterion to her work involves identifying her chosen points of integration and 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 indicators of an individual's degree of certainty. Insights stemming from psychology, linguistics, and anthropology meet at the heart of this construct. Her focus enables her to conduct a comparative linguistic analysis of Japanese and American use of epistemic terms, capture culturally-specific ways to reveal degrees of certainty, and 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 uncertainty as denoted by "epistemic terms", her work would have lacked the very object of her study.

CRITICAL STANCE   In a case of work like Yohko's, this third criterion highlights the degree to which the goals of her 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 to Yohko's description of how experimental protocols designed for English-speaking children may be complemented

with more culturally attuned ones to produce more valid accounts of cognitive development. Furthermore, employing a *critical stance* assessment criterion in a piece of work like Yohko's, may 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.

TO CONCLUDE

Rooted in an empirical analysis of experienced faculty insights about desirable qualities of interdisciplinary work, and standing on the shoulders of a long research tradition in cognition and instruction, this proposed assessment framework can be applied to shed light on particular dimensions of student work and thus enable us 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 genres of performances (papers, plays, artwork). The specific type of performance determines 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 students' thinking is made sufficiently

visible to provide evidence of their developing understanding.

While generic enough to address a myriad of disciplinary combinations, the three

proposed criteria are also specific to the unique challenges of integrative work – i.e.,

proficient selection and representation of disciplinary knowledge and modes of

thinking; disciplinary integrations that leverage understanding, and a self-critical

stance toward the proposed integrations. By sharpening the focus of our lens to

interpret students' interdisciplinary understandings and support their further

development , we may better prepare them for informed participation in today's

knowledge society… and in tomorrow's decisively interdisciplinary knowledge world.