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Exercising Quality Control in Interdisciplinary Education: Toward an Epistemologically Responsible Approach

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This article argues that certain philosophically devised quality control parameters should guide approaches to interdisciplinary education. We sketch the kind of reflections we think are necessary in order to produce epistemologically responsible curricula. We suggest that the two overarching epistemic dimensions of levels of analysis and basic viewpoints go a long way towards clarifying the structure of interdisciplinary validity claims. Through a discussion of how best to teach basic ideas about numeracy in Mind, Brain, and Education, we discuss what it means for an interdisciplinary curriculum to respect both the minds of students and the complexity of the subject matter.

INTRODUCTION

Most people who are involved in education are aware that educational policies and practices entail weighty ethical and social issues. When it comes to education, conflicts arise because different value systems are in play. What is less apparent is that in the educational domain, different epistemological and metaphysical commitments are also constantly pitted against one another. When we choose to teach scientific accounts of human origins instead of religious ones, for instance, or when we favour inquiry-based curricula over direct instruction, we are expressing our epistemological and metaphysical commitments. Beliefs about the nature of knowledge and the structure of the world have *always* formed the backdrop against which education plays out.

It is not possible, in fact, to insulate education from the broader philosophical trends. Commitments to secularism and science in the West, for example, stand in stark contrast to the religious worldviews that prevail in some other areas, and these differences are reflected in the varying educational aims, methods and institutions. More to the point, educational systems are a major channel through which societies actively *perpe-*

tuate—often unreflectively—the philosophical presuppositions that frame what a culture takes as good, true and beautiful (and, by implication, what is seen as bad, false and/or repugnant).

In all spheres, awareness of one's assumptions is better than ignorance or the belief that assumptions are unimportant. As C. S. Peirce observed, the claim that we do not have philosophical commitments is really a sign that we are doing *bad philosophy*. In our view, the claim that we do not have philosophical commitments underpinning our educational institutions and methods is a sign that we are doing *bad curriculum and/or poor pedagogy*. In this paper, we focus on an educational issue that has become a hot topic— interdisciplinary curricula and pedagogy. We explicate what it would mean to take an *epistemologically responsible* approach to interdisciplinary education, one in which epistemological commitments are explicitly integrated into the content and structure of the curricula and pedagogy.

In recent years we have seen a proliferation of interdisciplinary institutions, departments and training programmes, all aimed at meeting a global demand for individuals capable of producing high quality syntheses from disparate sources and types of information. To meet this demand, we believe that educators must develop the competencies that will enable them and their students to create high-quality interdisciplinary syntheses and instil the values that will positively dispose them toward that end. As Gardner explains, 'The *synthesizing mind* takes information from disparate sources . . . and puts it together in ways that make sense to the synthesizer and also other persons . . . [This capacity] becomes ever more crucial as information continues to mount at dizzying rates' (Gardner, 2007, p. 3).

Interdisciplinary syntheses are among the most epistemologically complex endeavours that humans can attempt. This complexity arises primarily from the deep differences of perspective that must be bridged in order to carry out interdisciplinary projects. That is, different methods and disciplines frame different perspectives and thus generate different kinds of knowledge. Interdisciplinarity entails integrating more than one of these perspectives to generate a kind of higher-order knowledge that is more than the sum of its parts. These elements cannot simply be tossed together in an interdisciplinary course (or research programme) like so many ingredients in a salad. Rather, successfully carrying out such a process of perspectival integration requires epistemological sophistication.

In what follows we draw on the work of Piaget and Habermas, two expert interdisciplinarians. These authorities aid in characterising the epistemologically significant differences between methodological perspectives that make interdisciplinary synthesis such a complex educational enterprise. In light of these complexities we propose the value of taking a pluralistic attitude toward various methodological perspectives, one that entails a stance of openness toward all relevant methods to insure that no perspectives are unduly highlighted or unduly marginalised. Specifically, we suggest that a kind of *methodological pluralism* (Dawson, Fischer, and Stein, 2006; Stein and Fischer, forthcoming; Wilber, 1999, 2006) is an appealing quality control strategy for interdisciplinary educational endeavours.

To ground our philosophical discussion we focus on how one might teach educators about the complex interdisciplinary topic of *numeracy*. Specifically, we offer several reflections on how to best approach this topic in the field of Mind, Brain and Education (MBE), an emerging area of interdisciplinary research and practice. Our aim is to provide a sense of the advantages of an epistemologically responsible pedagogical approach to interdisciplinarity education.

THE RISING IMPORTANCE OF QUALITY CONTROL FOR INTERDISCIPLINARY EDUCATION

The recent proliferation of high-profile research centres, doctoral programmes and undergraduate majors might seem to suggest that we can simply pursue interdisciplinarity with a 'business as usual' attitude—that is, that interdisciplinary work is simply an extension of disciplinary work that happens to span multiple content domains. The opinion of those who reflect upon and research interdisciplinary endeavours is more guarded, however. There is a growing consensus among analysts that interdisciplinary work gives rise to its own unique 'quality control' challenges (Boix-Mansilla, 2006; Gibbons *et al*., 1994; Klein, 1990; Weingart, 2001). That is, while disciplines have their own internal standards of quality control, these criteria cannot be automatically applied to interdisciplinary endeavours that transcend the boundaries of the disciplines they subsume. As Klein (1990) observes, 'there are no standards of excellence for interdisciplinary work in general' (p. 94). This fundamental difference between disciplinary and interdisciplinary work applies both to research and to education, and it suggests that interdisciplinary synthesis is a distinct (and relatively new) mode of knowledge production that is not as well understood as disciplinary research. Given the potential power (for good or ill) of the fruits of interdisciplinary research in such domains as genetics, cognitive neuroscience and materials science, quality control in interdisciplinary work is a pressing issue.

The task of characterising the epistemological structure of interdisciplinary problem spaces is not easy, as it requires at a minimum the integration of philosophical and sociological analyses. Most contemporary efforts in this direction have taken up the sociology of knowledge (Boix-Mansilla, 2006; Gibbons *et al*., 1994; Klein, 1990), offering empirical accounts of how knowledge production tends to proceed at the interdisciplinary level or of how 'successful' interdisciplinary educational efforts achieve their results. To supplement these approaches we pursue a different strategy that is informed by two philosophical characterisations of the epistemological structure of interdisciplinary problem spaces. The result is a set of epistemological distinctions that can be used to organise, compare and contrast perspectives rooted in particular research methods. In the end these epistemological considerations lead us to suggest that interdisciplinary researchers, educators and students should adopt a pluralistic attitude toward different methodological perspectives.

EPISTEMOLOGICAL CHALLENGES IN INTERDISCIPLINARY EDUCATION: FROM NUMBERS TO NEURONS

We frame the discussion that follows with reference to some advanced efforts toward interdisciplinary synthesis that foundered upon the very terrain we are mapping here. Over the past decade the eminent French neuroscientist Jean-Pierre Changeux engaged in two ambitious interdisciplinary conversations, one with a mathematician (Changeux and Connes, 1998) and one with a philosopher (Changeux and Ricoeur, 2000). These conversations were attempts to advance knowledge by bringing together and synthesising diverse and sophisticated perspectives on issues of great importance (from mathematics to morality and from physics to politics). But instead of reading like constructive dialogues, these conversations often read like a set of juxtaposed monologues. In both cases the two experts find it difficult to avoid privileging the methodological perspectives they hold dear. And all too often the result is disciplinary ships passing in the epistemological night.

Specifically, the mathematician and the neuroscientist continually focused on different *levels of analysis* when discussing the nature of numbers and their use. As we will see below, informed by Piaget's reflections on interdisciplinarity, symbol systems and synapses are *both* relevant when looking into the nature of mathematics, but they are understood via distinct methods at different levels of analysis. The conversation between Changeux and Connes (1998), while provocative, is beset by their attempts to establish the primacy of their respective levels of analysis. They both claim some kind of explanatory priority and argue that their own approach is most fundamental. It becomes clear that only courteous 'dissensus' will prevail. Indeed a powerful lesson from the conversation is what it teaches us about the complexity and challenges of attempting synthesis across different levels of analysis.

The philosopher and the neuroscientist fare no better. When Ricoeur and Changeux (2000) debate, they must translate across different *basic viewpoints*. While the neuroscientist directs his gaze to objectify and explain human morality from a scientific perspective, the philosopher is preoccupied with disclosing the meaning and value of our ethical precepts. For Ricoeur and Changuex their allegiance to two radically distinct basic viewpoints ultimately results in a polite and respectful stalemate. Despite their efforts, neither can subsume the other's viewpoint within his own. Ultimately they point longingly to Spinoza and the speculative possibility of some third discourse capable of transcending (and integrating) the epistemologically distinct realms of *mind* and *body*, *fact* and *value*.

The dialogues highlight two epistemological issues, which we characterise as differences between *levels of analysis* and differences between *basic viewpoints*. We now turn to explicating these two types of epistemological issues in the context of interdisciplinary pedagogy, focusing on teaching the topic of *numeracy* in the field of Mind, Brain and Education.

Levels of Analysis

Levels-of-analysis issues are ubiquitous. How do we explain the prevalence of simple but common mathematical fallacies, for instance? Examples of these are the gambler's fallacy (the false belief that the probability of a random event is dependent upon the events preceding it, e.g. that a coin flip is more likely to turn up 'heads' if three prior flips had turned up 'tails') and ignorance of regression to the mean (i.e. ignorance of the fact that those with extreme scores on any measure are, for statistical reasons, unlikely to stay as extreme across repeated re-tests). Why are they common? Well, it depends upon one's level of analysis. A cognitive psychologist will focus on issues such as the cerebral constraints on computation and the built-in tendencies toward the use of heuristics at the level of individual cognition, while a social or cultural theorist will focus on phenomena at a higher level of analysis, such as the legacy of certain symbols systems and the prevalence of certain educational tools (e.g. the errors of those who use an abacus differ from the errors of those who use an electronic calculator). Both explanatory approaches are valid, but they operate at different levels of analysis.

Bringing together constructs from different levels of analysis can certainly provide a more comprehensive view of a phenomenon, but this is easer said than done. As Piaget (1970) notes, for example, we face a kind of chicken-and-egg-problem when looking to combine the individual and social levels of analysis. Clearly the capabilities of individuals determine which mathematical fallacies are likely to be common, yet cultural forms (language, symbols and tools) shape the development of individual capabilities from day one. So how do we integrate these perspectives when neither can necessarily be considered to have some kind of explanatory priority?

Piaget suggests that in cases like this we should focus on the methods associated with each level of analysis. By doing so we call attention to the different perspectives in play and avoid ungrounded speculation about *what is really the case* with the phenomenon in question. We are led to see that we only know the phenomenon in light of certain perspectives, and the validity of each perspective should not be denied in so far as it is the result of inter-subjectively tested methods. Moreover, given the internal validity of each perspective, the respective methods should maintain their autonomy; after all, most researchers can do 'normal science' if left to their own devices. The suggestion for interdisciplinary researchers and educators, therefore, is that they should adopt a kind of multi-perspectival view of a phenomenon, in which they adopt the various views of disciplinary 'insiders'—that is, they ought to view the phenomenon while wearing a set of different methodological or disciplinary 'hats' (Blake and Gardner, 2007; Gardner, 2007).

Some theorists might work towards building synoptic models about *what is really the case out there;* this was, in fact, what Piaget was trying to accomplish with his ambitious models of cognitive development. Such models, Piaget argues, would explicate ways in which different levels of analysis could mutually enrich each other, but he also notes that our ability to validate such models will typically depend upon the emergence of methodological innovations. That is, once we realise that we only know phenomena in light of methodologically grounded perspectives, we must admit that developing new kinds of knowledge—including the kinds that emerge as a result of interdisciplinary synthesis across levels of analysis—often requires new methods. Biochemistry is the classic example of an emergent form of knowledge following upon specific methodological innovations (for example, chromatography and molecular dynamics simulations).

In the absence of such specialised innovations, however, the multi-perspectival strategy of wearing different disciplinary 'hats' seems preferable to both speculation and oversimplification. Specifically, this kind of pluralism toward methods and approaches gives researchers access to diverse types of potentially useful information derived from multiple levels of analysis. Instead of privileging certain levels over others, we should adopt a kind of *methodological pluralism*1 (Dawson, Fischer and Stein, 2006; Stein and Fischer, in prep.) that can be used to assemble a more sensitive, nuanced and complete picture of a phenomenon than would be possible within any single discipline.

EXCURSUS ON LEVELS OF ANALYSIS: MATHEMATICS IN MIND, BRAIN AND EDUCATION

Mind, Brain and Education is an emerging domain of research and practice that aims to bring together biological, psychological and educational perspectives with the goal of improving educational practices. An explicit purpose of the MBE field is to generate, apply and disseminate usable knowledge (Blake and Gardner, 2007; Fischer, Immordino-Yang, and Waber, 2007). Needless to say, this is a highly complex interdisciplinary endeavour, and integrating perspectives across different levels of analysis is an important challenge faced by members of the field. For example, understanding the nature of mathematical competencies requires bringing together a complex set of perspectives (Dehaene, 1997). From neurons in networks to symbol systems in societies, there are many perspectives from which one can study the development, organisation and performance of mathematical competences. If we take seriously the lessons about levels of analysis distilled from Piaget in the previous section, then we should be seeking some kind of multiperspectival (or pluralistic) view concerning different *methods and practices* employed to study mathematical competencies. That is, we should pursue an approach wherein each method is explicitly respected and made the object of considered judgments.

Take a phenomenon like *developmental dyscalculia* (Kosc, 1974; Stanescu-Cosson *et al*., 2000), which simply cannot be approached from a single level of analysis. The evidence from brain research on this phenomenon suggests that this disability in basic mathematical competence is due to an atypical biological substrate, which points ultimately to causes at the level of genetics (Geary, 1993). But amelioration of the disability through educational intervention requires a focus at a much higher level of analysis - that of behaviour, strategies and motivations. Moreover, it is also clear that certain symbol systems and cultural contexts differentially affect how the disability manifests (Dehaene, 1997). The phenomenon clearly spans multiple levels of analysis, from genetics and brain 'up to' behaviour and culture.

Importantly, understanding dyscalculia *requires* bringing these different perspectives together. For example, studies show that the symbol system used in China for naming the integers 1 through 20 seems naturally to mitigate the effects of the disability, while the symbol system used in America to name the integers seems to make it worse (Wilson and Dehaene, 2007). If both culture and genes play a role in the manifestation of this learning disability, then anything less than an interdisciplinary approach spanning multiple levels of analysis leaves us missing something. In the light of the epistemological issues raised above, we suggest that a focus on the affordances and limits of different methodological perspectives is preferable to either the presentation of a catalogue of findings (i.e. a survey course) or the development of a speculative synthetic model (i.e. a course driven by a specific theory).

A catalogue of findings about dyscalculia, however synoptic and however well framed, does not properly reveal the complexity of the interdisciplinary problem space. When the science is good, neuroscience finding X, psychology finding Y and educational research finding Z can all be considered valid. But this collection of 'facts' at different levels of analysis conceals the various epistemological systems underlying each method, which is where educative tensions and conflicts lie. In other words, simply covering the topic by surveying the range of findings ignores epistemological issues such as the chicken-and-egg-problem noted above (i.e. that it is not clear which level of analysis should receive explanatory priority). Moreover, while students may come away with a sense of *what* experts believe about the topic, they will lack a sense of *why* and *how* it is that experts have come to hold those beliefs.

The same kind of epistemological naiveté accompanies approaches that offer a speculative explanatory model of dyscalculia in order to synthesise research at different levels of analysis. Syntheses are valuable but premature ones can be misleading. We should hesitate to paint a picture of *what is really the case* with dyscalculia and thus avoid teaching the topic in terms of some explanatory model that *foreshadows* the integration of methods across various level of analysis. As noted above, new knowledge often requires new methods. We oversimplify the process of interdisciplinary knowledge production if we teach an interdisciplinary topic in terms of ideas that cannot be methodologically operationalised. A theory driven class can easily fall prey to what Whitehead (1925) referred to as the *fallacy of misplaced concreteness*. By confusing our constructs with reality, we lose sight of the distinct methods and practices that set different levels of analysis apart.

In contrast, if we approach the research and practice surrounding dyscalculia by focusing on the methods and practices in play, we can get across the same content while preserving the rich texture of epistemological issues that characterise the topic. Exposing students to a plurality of methodological perspectives is just another way of teaching for a kind of deep conceptual understanding (Gardner, 2000). For example, by looking into the methods of behavioural genetics and neuroscience used to research dyscalculia, we can explore the idea that there are individual differences in genetically canalised brain maturation processes, some of which account for certain specific elements of dyscalculia, while at the behavioural level we can focus on the methods of observation and controlled intervention that allow us to make claims about the remedial effects of certain educational initiatives. Crucially, a focus on the methods allows educators to draw attention to the limits and benefits of different *perspectives* as opposed to just the insights afforded by different *findings*.

To summarise, an epistemologically responsible approach to interdisciplinary topics that span multiple levels of analysis should proceed via some kind of methodological pluralism. The manner in which this is executed is less important than the general approach. Whether it is via the analysis of case studies, the undertaking of individualised projects, or simple didactic instruction, we suggest that the goal of complex interdisciplinary education should be to inculcate a reflective stance toward a plurality of methodological perspectives. By explicitly respecting and considering a variety of methods, we can expose the educative tensions between different perspectives that arise when teaching about topics disclosed at different levels of analysis. We can also call attention to the conflicts and inconsistencies that characterise knowledge production at the highest levels.

BASIC VIEWPOINTS

Alas, differences between levels of analysis are not the only challenges we face when looking at the epistemological structure of interdisciplinary problem spaces. Differences of *basic viewpoint* are also ubiquitous. In contrast to levels of analysis, which tend to differ in obvious ways, basic viewpoints are extremely abstract and differences between them are therefore subtler. Nonetheless, they often point toward deeper epistemological fault lines.

In the case of common mathematical fallacies, for example, there is a clear difference between describing their genesis or prevalence, on the one hand, and evaluating their impact, on the other. When offering descriptions, we appeal to empirical research and theoretical models that address the phenomenon objectively. We might conclude that certain mathematical fallacies, such as the gambler's fallacy, are found in 90% of the population and that their emergence is best explained in terms of certain common psychological processes. When offering evaluations, in contrast, we appeal to the normative frameworks and cultural traditions that provide us with our basic commitments, preferences and values. We might thus conclude that the aforementioned common mathematical fallacies inhibit the general population from properly understanding complex scientific and economic issues in the public sphere. This intellectual weakness, in turn, undermines some of the conditions necessary for a truly democratic society, which we value highly. Accordingly we might suggest that common mathematical fallacies be counteracted with certain specific educational initiatives.

Importantly, these two basic viewpoints (description and evaluation) are more often than not connected. Any ameliorative initiatives taken in response to the negative consequences of common mathematical fallacies should be based upon knowledge of the psychological processes in question. By the same token the research providing this usable knowledge has likely been undertaken in the light of evaluative commitments about the value of scientific research and the knowledge it is likely to yield, the importance of the negative social consequences of rampant mathematical ignorance, etc.

Related though they may be, these two basic viewpoints cannot be deduced from one another. The description of a common mathematical fallacy does not come with a label denoting its value. Some such beliefs are benign or even helpful, like certain estimation heuristics that work fine with small numbers in everyday situations. Likewise, knowing something's value does not serve to explain it. Shaking our heads at rampant mathematical fallacies in the public sphere (e.g. misuse of statistical data, etc.) will never help explain them, although it might motivate us to undertake research that will.

These remarks should make clear that relations between basic viewpoints are not the same as relations between levels of analysis. In many areas of inquiry it is the case that knowledge gained at one level of analysis can be used to deduce *the kind of thing* that must be occurring at lower levels. For example, the sociological and historical fact that strategies and techniques for calculation are passed down from generation to generation suggests that there must be some kind of process making this possible, which would be best described at psychological levels of analysis (if not at the physiological, molecular, or even genetic levels). As noted above, these kinds of inferences cannot be made between different basic viewpoints; descriptions do not entail values. Similarly, unlike different levels of analysis, different basic viewpoints are not potentially competing accounts that raise issues of explanatory priority or inter-theoretical reduction. They do not address the same phenomena in terms that are conflicting in scope, scale, or complexity. Rather, different basic viewpoints stand in *supplementary* relations and reflect historically deep-seated and thus seemingly irreplaceable forms of language use and practice (Habermas 1970; 1971; 1984; see also Sellars, 1963).[2]

Reminiscent of Piaget's approach to levels-of-analysis issues, Habermas proposes to handle differences between basic viewpoints by adopting a kind of methodological pluralism. Habermas continually stresses the importance of respecting the differences between basic viewpoints and finding ways to ensure that the dimensions they denote are not overlooked in our pursuit of synoptic interdisciplinary models and usable knowledge.

To avoid these kinds of errors educators should explicate the *distinctness* of different basic perspectives at the same time that they reveal their complex inter-animations.

BASIC VIEWPOINTS IN MIND, BRAIN AND EDUCATION

As noted before, Mind, Brain and Education (MBE) is a complex field of interdisciplinary research and practice and dyscalculia is a complex phenomenon that cuts across multiple levels of analysis. We argue here that the research and practice in MBE also implicates fundamentally different *basic viewpoints*, orthogonally related to the issues about levels of analysis already discussed. Seemingly straightforward shifts between these basic viewpoints can raise subtle yet complex epistemological challenges that require equally careful handling.

Consider, for example, the way that neuroimaging research on learning disabilities is often presented—with fMRI images of 'normal' brain function juxtaposed side-by-side against images of the 'abnormal' activity patterns characteristic of subjects diagnosed with a particular condition such as dyscalculia. Such comparative images might be used simply to support clinical descriptions of group differences and explanations of their underlying causes—when cognitive neuroscientists share their research findings with each other in academic journals or at professional conferences, for instance.

When presented in an educational context, in contrast, these same side-by-side images of 'normal' and 'abnormal' activity patterns can very easily take on a normative edge, inviting educational researchers and practitioners (not to mention the public at large) to think of the 'normal' brain state as the educational objective and the 'abnormal' state as a deviation from that ideal requiring remediation through structured intervention. Pushing the reasoning one step further, it might seem to follow that those dyscalculia interventions are best that tend to produce the most typical brain activation patterns in dyscalculic subjects in the short term. Under this assumption such activities will condition the neural circuitry in ways that will over time make it scan—and behave—in increasingly normal fashion. While this perspective might turn out to be valid, it is also possible that dyscalculic patients can become experts while making use of entirely different neuronal structures and processes.

As soon as we shift from a scientific discussion of dyscalculia and its causes to an educational dialogue about desirable vs. undesirable learning outcomes, we have switched out of a descriptive and explanatory basic viewpoint and into an evaluative and normative one. It is important to be clear about what is at stake here. The basic viewpoints in question mark the difference between what we think *is* the case (e.g. explanations of dyscalculia offered by behavioural genetics) and what we think *ought* to be the case (e.g. educational and cultural norms about mathematical competencies). The viewpoints also mark the difference between what is *possible* (e.g. knowledge from scientists concerning which interventions would be technically effective) and what is *preferable* (e.g. values held by communities that set limits on which interventions would be ethically acceptable).

The same basic viewpoints are implicated in teaching about usable knowledge in genetics (Grigorenko, 2007). Teaching students about the genetic component in disabilities like dyscalculia entails grappling with more than a basic knowledge of the findings and methods in genetics. Fundamental ethical issues are implicated in all discussions of how genetic information can be put to use. When we are discussing usable knowledge in genetics, the basic viewpoints that frame scientific endeavours (e.g. explanation and description) must be supplemented by the basic viewpoints that frame our pursuit of values, justice and self-understanding (Habermas, 2003). As an example, consider the case of teaching about dyscalculia and its increasingly clear genetic aetiology. As soon as we discuss the topic in terms of genetic markers for use in identification and remediation, we have switched out of a descriptive and explanatory basic viewpoint and into an evaluative and moral one.

Despite the great value and promise of scientific approaches to education, it is a grave error to confuse discourses about the technical effectiveness of an intervention with discourses about which interventions are ethically acceptable. Not all knowledge that can be used ought to be used (Stein and Fischer, in prep). That is, to see the full complexity of the interdisciplinary problem space, we must differentiate basic viewpoints in terms of their unique methods and practices before we integrate them in light of our interdisciplinary ambitions. Giving full voice to the basic perspectives in play is an important part of moving towards a more epistemologically responsible approach.[3]

But recognising the full range of basic viewpoints that are in play is not enough. In light of our proposed focus on the *methods and practices* that constitute different basic viewpoints, we can note the liabilities of approaches that offer prefabricated conclusions as a way of covering different basic viewpoints. The complement to offering a catalogue of scientific findings is an approach, equally problematic pedagogically, where we offer a set of ethical guidelines, codes and conclusions as a way of 'covering' that basic viewpoint. A possible university course, like Bio-ethics-of-learning-disabilities-101, is epistemologically naive if the focus is merely on outlining all the positions. Students may come away with a sense of *what* ethicists think, but not a sense of *how* ethicists think. The latter can only be acquired by engaging with the methods and practices that ethicists use when they make complex decisions under conditions of uncertainty. Moreover, by characterising different basic viewpoints as sets of methods and practices instead of as catalogues of findings and conclusions, we give a more accurate view of how knowledge is produced at the cutting edge of inquiry, where models and principles from different basic viewpoints compete for acceptance.

Overall, the foregoing discussion is meant to illustrate how a methodological pluralism should guide approaches to interdisciplinary education. We have sketched the kind of reflections we think are necessary in order to produce epistemologically responsible curricula. The two organising dimensions of *levels of analysis* and *basic viewpoints* provide a basis for a rough taxonomy of interdisciplinary endeavours. Some implicate only level-of-analysis issues, such as efforts at integrating different types of explanatory frameworks that set out from the same basic viewpoint. Others must grapple with both level-of-analysis issues and differences of basic perspectives, such as most efforts in the human sciences that involve biological or materialistic explanations and all efforts that aim to produce applications. We saw this clearly with the example of dyscalculia. Indeed, teaching any complex topic that is socially relevant will almost always entail that we grapple with both levels of analysis and basic viewpoints. We suggest that the contours of the approach we have offered can be useful in a variety of interdisciplinary educational initiatives.

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NOTES

[1]This approach is comparable to Wilber's *integral methodological pluralism* (Wilber 1999; see also Stein, 2007), which also entails a kind of openness, cooperation, and symbiosis between various methods.

[2]This idea is the contemporary expression of certain perennial efforts in philosophy that can be traced from Wilber, Habermas and Sellars, back though C. S. Peirce to Kant, and ultimately to the Greeks. The search for *philosophical categories* has been a search for the most basic or primordial distinctions that frame our knowledge and action in the world. Here we find those indelible distinctions around which philosophical (and scientific) debates still revolve: distinctions like those between the *mental* and the *material* (Chalmers, 1996; see also Changeux and Ricoeur, 2000), the *natural* and the *normative* (Sellars, 2006; see also Damasio, 2003), the *subjective* and the *objective* (Nagel, 1986; see also Damasio, 1999), the Good, the True, and the Beautiful (Gardner, 2000). When we confront differences of basic viewpoint, we confront these types of extremely general and fundamental distinctions.

[3]It is worth noting here that discussing basic viewpoints in terms of the difference between *descriptions* and *evaluations* has monopolised our treatment because we think this is the clearest, least controversial, and most important example of a difference between basic viewpoints. The list in the second endnote covers a larger set of basic viewpoints, some of which are relevant to this discussion. For example, an *objective* account of dyscalculia would differ from a *subjective* account. The former would cover the psychology and neuroscience of the learning disability, while the latter would involve the phenomenology of being someone with that learning disability (see: Nagel, 1986; Damasio, 1999; and Thompson, 2007).

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