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THE RISE OF THE MODERN DISCIPLINES AND INTERDISCIPLINARITY



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CHAPTER OBJECTIVES

Today, disciplinary dominance is being challenged by interdisciplinarity. In any university (whether physical or virtual), you will definitely encounter the disciplines in the general education core or in a traditional major or in a theme-based multidisciplinary or interdisciplinary studies program. The disciplines are powerful and pervasive approaches to learning and knowledge production. They shape our perceptions of the world, our ability to address complexity, and our understanding of others and ourselves. Less than 200 years old in their modern form, the disciplines have come to dominate the ordering, production, and communication of knowledge. Although we discuss many European thinkers, space does not allow us to trace the institutional rise of interdisciplinarity in every country where there is growing interest in interdisciplinarity.

LEARNING OUTCOMES

By the end of this chapter, you will be able to

- Explain the rise of the modern disciplines and how they have come to enjoy a dominant position in learning and research
- Explain the rise of interdisciplinarity and its diverse practices and applications
- Assess interdisciplinary studies' critique of the disciplines and disciplinary specialization

GUIDING QUESTIONS

- How did the modern disciplines develop and come to have the dominant position in learning and research that they presently enjoy?
- How do we account for the emergence of interdisciplinarity, its great diversity, and rapid growth?
- What, specifically, are interdisciplinary studies' criticisms of the disciplines and disciplinary specialization?

WHY THE PAST MATTERS

One of the most important but overlooked buildings in Washington, DC, is the National Archives. Engraved in its stonework in bold letters is this motto: "The past is prologue." (See Figure 2.1.) This quote from Shakespeare's *The Tempest* (Act III, Scene 1) has a meaning that is both simple and profound: The past affects the present. The motto is appropriate to this building because it holds the three original documents that formed the United States, defined its government, and still inform the exercise of government today: the Declaration of Independence, the Constitution, and the Bill of Rights. It also exhibits other original documents of great importance, including Lincoln's Emancipation Proclamation. These documents communicate the timeless values of "equality," "inalienable rights," and "freedom" that illumine the present and have inspired many other fledgling democracies.

The past, whether it concerns a nation's founding values, the prevailing system of learning and knowledge production, or the emergence of the concept of interdisciplinarity, is relevant for four practical reasons:

- The past shapes our identity and the core of our humanity.
- Probing the past enables us to discover roots, detect change, and discern trends.
- Reflecting on the past enables us to reconstruct cause and effect and act in the world as moral agents.
- Studying the past makes the present comprehensible.

FIGURE 2.1 ■ The National Archives of the United States

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More specifically, understanding the past is relevant to those in the natural sciences whose climate models, for example, must include data on past conditions to place present climate conditions in broad historical context. For those in the social sciences, understanding the past is essential to understanding the root causes of present societal problems. For those in the humanities, a full understanding of objects and texts is possible only by placing them in historical context. For those in the fine and performing arts, the past is always present in new forms of dance, theater, and music. And for those in applied fields such as criminal justice, public health, or business, studying past laws, practices, and business models shows what has worked and not worked.

Understanding why things are the way they are is foundational to learning. The present dominance of the disciplines is rooted in the past. It would be easy to look at the modern academy and assume that it had always been organized around disciplines. But we shall see that disciplinarity in general, as well as the shape of individual disciplines, is the result of fairly recent historical processes. Discovering how the modern disciplines gained institutional structure and power and why they now dominate learning and knowledge production is foundational to understanding why the contemporary university is organized around the disciplines. Studying the past also explains the rise of interdisciplinarity and how this transformational concept has been able to challenge disciplinary dominance and sustain itself as a recognized approach to learning and knowledge production.

THE RISE OF THE MODERN DISCIPLINES

As a preview of this brief probing of the past, we offer a list of the far-reaching effects that the historical shift in knowledge production and teaching toward disciplinarity has produced. Since interdisciplinary studies arose in response to these developments, you should understand the factors that caused knowledge to be divided into disciplines in the first place:

- *Specialization and fragmentation of knowledge production:* Scholars are no longer expected to have a general knowledge of how the world works, but rather to know a lot about an area of specialization.
- *Empiricism:* The basis for new knowledge lies in factual evidence derived from sensory inputs, not in conjecture, faith, or imagination.
- *Professionalization:* The need to apply education to specific sectors of society.
- *Legitimatization:* The granting of academic degrees entrenches disciplinary power.
- *Departmentalization:* The forming of specialized functioning areas in the university.

You should look for these factors as you read the following discussion.

The Origin of the Concept of Disciplinarity

We stress developments in the West because these had a direct bearing on the development of interdisciplinarity. The term *discipline* was introduced as “disciplina” by the Romans. But in both Roman and medieval times, it was applied to a limited set of professions such as the law and medicine, in recognition of the fact that these required the learning of specialized information (Klein, 1990). Note that only some professions received attention in universities of the Middle Ages: Though engineers and artists existed, there were no “disciplines” of agricultural or mechanical or military engineering or theater arts (Saffle, 2005). Not until the 20th century would these fields be absorbed into the academic curriculum of the Western university, and some of them play a role in the history of interdisciplinarity. Outside of the professions, all students received the same broad general education. Students generally pursued this general education before being trained as doctors or lawyers.

The Scientific Revolution of the 16th through 18th centuries is associated with an increased insistence on testing theories through careful observation or experiment. The revolution also became associated with scientific specialization. As the body of received theory and observation in separate fields such as astronomy or chemistry or botany grew, it became increasingly difficult for any one person to keep abreast of more than one field of inquiry. The very first academic journals, which emerged in the 17th century (creations of the British and French Royal Scientific Societies), were general in coverage but nevertheless encouraged increasingly separate discussions of different fields of inquiry. While the idea of science as a unified endeavor was still embraced, in practice most scientists knew only one field of inquiry well. Scientists in particular fields came to develop shared understandings of their theories, methods, and subject matter and

generated specific jargon to describe their activities; it thus became increasingly difficult for scientists to understand fields other than their own.

Between 1750 and 1800, the disciplines consolidated their hold on the teaching and production of knowledge by embracing three new revolutionizing learning techniques: writing, grading, and examinations. These practices were introduced in three new teaching settings: the seminar (beginning in the German universities around 1760), the laboratory (beginning in the French *Grandes Écoles* before the French Revolution), and the classroom (beginning in Scotland around 1760). The doctorate, originating at the Humboldt University of Berlin in the early 19th century, was adopted by Yale University in 1861, and soon thereafter by other American universities. From the United States, the doctorate spread to Canada in 1900, then to the United Kingdom in 1917, and today has become common throughout the world.

The university and the disciplines became an engine of knowledge production that far outstripped any other method of learning devised by any previous civilization. Specialized communities of scientists readily communicated, critiqued each other, and developed deeper understandings of all scientific fields. There would be major advances in understanding across a wide range of disciplines in the 19th and 20th centuries. These practices have been so successful that today, they are used the world over.

The Professionalization of Knowledge

The academic disciplines of today and the modern concept of disciplinarity are largely the product of developments in the late 19th and early 20th centuries. This period saw the formation of new categories of knowledge. Natural philosophy was divided into physics, chemistry, and mathematics, whereas natural history became biology.

By the middle of the 19th century, the social sciences were fragmenting into anthropology and political economy, out of which were formed economics and political science. The disciplines of psychology, sociology, and history soon followed. These disciplines arose to address new social conditions and applied a scientific and distinctively empirical approach to studying the problems of a rapidly industrializing and urbanizing society (Easton, 1991, p. 11).

The disciplines that became known as the humanities—philosophy, classical and modern languages, history, art history, and religious studies—“formed a rump of knowledge” that was left over after the other new specialties were formed (Easton, 1991; Frodeman & Mitcham, 2007, p. 4). Since few humanist scholars protested the rise of disciplinarity and the emphasis on research, the humanities soon accommodated themselves to the new order of knowledge production, although some philosophers would explore the nature of the scholarly enterprise as a whole.

Along with the rise of scientific specialties came increased competition for university resources, so universities began to organize themselves around the disciplines. This academic revolution was led by a small number of visionaries. In 1869, Harvard University President Charles William Elliot introduced the concept of the major and the elective system for undergraduates, which began replacing the general studies degree.

These developments were accompanied by the emergence of new professional societies in the United States. National organizations emerged in history in 1884, economics in 1885, political science in 1903, and sociology in 1905 (Hershberg, 1981). The Modern Language Association

was founded in 1883 (Moran, 2010) and remains one of the leading organizations dedicated to the study and teaching of literature and language. In Britain (and elsewhere) also, the disciplines solidified in the late 19th century, with much dispute over boundaries between disciplines and occasional calls for a broader perspective (Lightman & Zon, 2020).

Disciplinary journals allowed geographically isolated specialists to keep abreast of the latest research and also gave them a forum for presenting their own research. Specialists did not need to consider perspectives other than those of their own specialty (Swoboda, 1979).

As the modern research university took shape, disciplinarity was reinforced in two major ways. First, the disciplines recruited students to their ranks to produce a new generation of teachers and researchers. Second, industries demanded and received specialists from the universities (Klein, 1990). The trend toward specialization, especially in the sciences, was further propelled by increasingly more expensive instrumentation, elaborately equipped laboratories, and highly trained personnel.

The increased emphasis by universities on research in the late 19th century reflected in turn the fact that many of the natural sciences had become economically useful. The link between science and useful technology had been tenuous through much of history, but in the late 19th century, developments in chemistry (dyes and pharmaceuticals) and physics (various electrical products) in particular had direct implications for technology. This era thus marked the transition to an economy increasingly dependent on scientific research and the end of the “tinkerer tradition” of innovators such as Thomas Edison¹ and Henry Ford. A related development that would have far-reaching implications for the future of higher education was the integration that was occurring not between knowledge specialties, but between industry and education (see Figure 2.2). For example, discipline-based studies in service of industrial concerns were

FIGURE 2.2 ■ Scientists in a Chemical Laboratory



Source: Image by ernestoelava from Pixabay

(and remain) a major part of chemistry's history. As for the social sciences and humanities, the Progressive Movement in the United States (1890–1920) held out hope that society could be improved through better understanding; the link between social science and public policy was not as strong as the link between natural science and technology but could be used to justify specialized research in the social sciences and humanities as well. The traditional role of the university in providing a shared body of knowledge to students became increasingly focused on the humanities: The disciplines of history, literature, and philosophy were each called upon to celebrate the inheritance of “Western Civilization.”

Only in the last decades of the 19th century, then, do we see disciplines with three key characteristics: deciding what is taught through the departmental structure, deciding what is good research through dedicated journals managed by disciplinary associations, and deciding who gets hired and promoted through decisions by both departments and journals. It is these three characteristics that we can associate with the word *disciplinarity*. Note that the third characteristic reinforces the first two: Individuals will only be hired and promoted if they broadly concur with the research and teaching emphases of the discipline (see Choi & Richards, 2017).

It should be stressed that disciplines slowly evolve over time as new research questions, theories, and methods are embraced. In the discipline of economics, for example, one can detect several important changes over the last century and a half, including the development of a different approach to the study of the aggregate economy from that used to study individual markets in the aftermath of the Great Depression, insistence on mathematical expression of research results in the early postwar period, and a more recent willingness to relax an assumption that humans behave rationally.

Concerns About Overspecialization

Not everyone, however, saw greater disciplinary specialization as a positive development. Already in the early 1700s, the Italian thinker Giambattista Vico called for a new approach to learning. He claimed that the ascendancy of science and mathematics in the curriculum had led to a neglect of broad education in favor of specialized knowledge. He argued that the “human sciences” such as history, philosophy, and law can achieve knowledge and understanding “from within” and in fact are superior to the natural sciences, which can only describe the external phenomena in nature (Moran, 2010). Nevertheless, Vico's call for less specialization and a more comprehensive approach to learning largely fell on deaf ears. His critique was the forerunner of many critiques, including those that contributed to the formation of the field of interdisciplinary studies 2 centuries later.

Increased concerns regarding overspecialization were linked to concerns that these new disciplines were connected to issues of power and self-interest. Late 19th-century German philosopher Friedrich Nietzsche and early 20th-century Spanish philosopher José Ortega y Gasset saw the new disciplines as symptoms of a more general phenomenon: the growing *interdependence* of government, business, and education. Driving this interdependence was an economic system that increasingly depended on the availability of specialists and professionals. Under this system, the disciplines and the universities served two vital functions: They trained persons for

careers in government and business, and they gave these new professions legitimacy and status by providing them with academic credentials (Moran, 2010).

THE RISE OF INTERDISCIPLINARITY

Once the disciplines were established by the end of the 19th and the early 20th centuries, it was only logical that interest in interdisciplinarity would begin to develop. “Seen in the broad sweep of Western civilization,” writes Newell (2010b), “interdisciplinarity is the latest response to the dominant Western intellectual tradition of rationality and reductionism [i.e., specialization] that is ultimately grounded in dichotomous [i.e., either–or] thinking” (p. 360). Schmidt (2021) identifies three motives for the emergence of interdisciplinarity: a scientific motive to overcome the limits of disciplinary specialization, a public policy motive to address complex challenges, and a psychological motive to address the uncomfortable fact that different disciplines reached different conclusions. These would each play a role at different times in the rise of interdisciplinarity (see also Choi & Richards, 2017).

We will emphasize the United States in what follows since interdisciplinary teaching programs became prominent in that country earlier than elsewhere but should stress that interdisciplinary courses are now common in all countries. Indeed a survey by the *Times Educational Supplement* in 2023 found that interdisciplinary research was more solidly supported in universities in the global south than in North America or Europe—perhaps because disciplines had not become as solidly entrenched in newer universities (Bothwell, 2023). While the history of interdisciplinarity differs across countries, similar forces tended to be at work, though these were shaped by different institutional realities (see Vienni-Baptista & Klein, 2022; we discuss Europe briefly in Box 2.10).

In the United States, the advance of the interdisciplinarity concept began after World War I with the quest for an integrated educational experience by influential education leaders. It gained momentum in the 1960s with the development of experimental colleges (for example, the “Experimental College” at Tufts University); achieved legitimacy as part of the liberal mainstream in the 1980s as honors, women’s studies, and environmental studies programs embraced it; emerged in the 1990s as a small but normal part of university education; and achieved “fad” status in the first decade of the new millennium (p. 361). At each stage, how interdisciplinarity was understood and practiced changed.

The Quest for an Integrated Educational Experience

The story of interdisciplinarity in the United States begins with the movement to reform general education after World War I. This effort was a response to two problems besetting American culture and education at the time. The first was the perceived lack of national cultural unity resulting from the massive influx of immigrants in previous decades. The second was the eroding cohesiveness of university education produced by disciplinary specialization (Boyer, 1981). The belief animating the general education reform movement was that both these problems

could be solved by creating an integrated educational experience that prepared students for modern life (see Box 2.1).

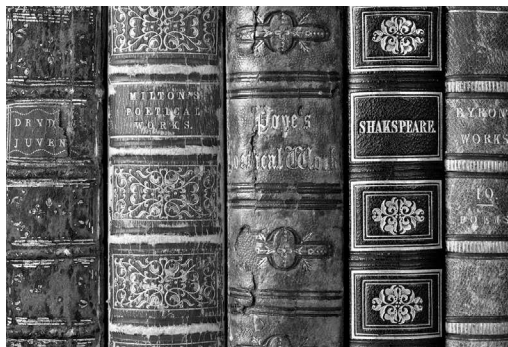
BOX 2.1: GENERAL EDUCATION

Without a general education, human beings tend to be somewhat parochial. We are disinclined to think beyond the scope of direct human experience—to factors or forces that operate on different scales of time or space, that function systematically rather than individually, or that have multiple causes; nor are we inclined to see a problem from other perspectives (be they grounded in cultures, religions, or disciplines). Even well-educated humans have some difficulty moving back and forth between the general and the specific, theory and application, the abstract and the concrete. Interdisciplinary studies provide an approach in which such skills become habits of mind; they fall naturally out of the interdisciplinary process. (Newell, 2010b, p. 361)

There were differing conceptions of the kind of reform needed. One emphasized the importance of passing on the classical and secular ideals of Western culture through a common core of “great books” (see Figure 2.3).

The second conception focused on historically situated problems of society such as racism. John Dewey sought to balance the need to pass on the Western cultural heritage with the need to critique its failings. Dewey advocated engaging students in discussing pressing social and political issues by exposing them to different perspectives (Newell, 2010b, p. 362). What these conceptions held in common was the notion that general education is “the place where all the parts would add up to a cohesive whole” (Hutcheson, 1997, pp. 109–110).

FIGURE 2.3 ■ Examples of Great Books of the Western Intellectual Tradition



Source: iStockPhoto/221A

Interdisciplinarity in the 1960s and 1970s

After World War II, a second general education reform movement emerged, triggered by the 1945 Harvard report *General Education in a Free Society*. The report called for a new general education curriculum based on the sciences and writings of the European humanist tradition. Against the backdrop of the spread of communism and the growing power of the Soviet Union, proponents intended the curriculum to provide a common core of knowledge, beliefs, and values centered on the ideals of freedom and democracy—in short, a national ideology that could oppose Soviet totalitarianism and communist ideology (Bender, 1997).

Against this backdrop of ideological conformity, criticism of the disciplines intensified and focused on two themes. The first was the enormous power that the disciplines had accumulated since the turn of the century. Influenced by Friedrich Nietzsche, French philosopher Michel Foucault argued in the 1960s that the disciplines are not just a way to produce knowledge; they are a sophisticated mechanism for regulating human conduct and social relations. He found the typical examination in a disciplinary course of instruction to be the “quintessential practice that epitomizes both the modern power of knowledge and the modern practice of meticulous disciplinary control” (Hoskin, 1993, p. 277; see Box 2.2).

BOX 2.2: DISCIPLINARY POWER

[Normalization] has become one of the major functions of our society. The judges of normality are present everywhere. We are in the society of the teacher-judge, the doctor-judge, the educator-judge, the “social worker”-judge; it is on them that the universal reign of the normative is based; and each individual, wherever he may find himself, subjects to it his body, his gestures, his behavior, his aptitudes, his achievements. . . .

The carceral [i.e., prison-like] texture of society assures both the real capture of the body and its perpetual observation [and characterizes] the new economy of power. . . . [T]he instrument of knowledge that this very economy needs [and] its most indispensable condition [is the] activity of examination. (Foucault, 1975, pp. 304–305)

Challenge question: How does Foucault’s critique of “normalization” apply to traditional education? How does interdisciplinary studies challenge the “normal” in education today?

The second criticism focused on the deepening isolation of the disciplines from each other. The disciplines had marginalized the notion of holistic thinking in favor of reductionist thinking. Tony Becher (1989) uses the anthropological metaphor of tribes to describe the disciplines, each having its own culture and language (see Box 2.3).

BOX 2.3: DISCIPLINARY TRIBES

Men of the sociology tribe rarely visit the land of the physicists and have little idea what they do over there. If the sociologists were to step into the building occupied by the English department, they would encounter the cold stares if not the slingshots of the hostile natives. . . . The disciplines exist as separate estates, with distinctive subcultures. (Becher, 1989, p. 23)

Interdisciplinarity in the 1960s and 1970s was part of a radical rejection of traditional education. The critique of the disciplines was strengthened by the confluence of three major developments: civil tensions over the issue of race, political tensions over the Vietnam War, and social tensions over marginalized groups. Combined, these tensions and conflicts served as a catalyst from which emerged calls for more holistic forms of education and experimental programs and new thinking about how the academy should relate to society (Mayville, 1978).

Challenge question: *How does interdisciplinary studies and/or the theme-based program you are in challenge disciplinary tribalism with each discipline having its own culture and language?*

This new thinking included calls for radical university reforms, one central element of which was the elimination of the traditional academic disciplines in favor of more holistic notions of training that were closer to the practical problems of life (Weingart, 2000). The reason was obvious: The disciplines and the scholarship that they produced had failed to explain, or had ignored, the great social movements and ideological struggles that characterized the period (see Figure 2.4). To that generation of students and young faculty, “the disciplines seemed increasingly irrelevant or even obstructionist to their quest to understand, address, and solve the great issues of the day” (Katz, 2001). By contrast, interdisciplinarity became a programmatic, value-laden term that stood for reform, innovation, progress, and opening up the university to all kinds of hitherto marginalized publics (Weingart, 2000).

The radicalism of the 1960s and 1970s spawned the creation of new fields such as African American (“Black,” at first) studies, women’s studies, and ethnic studies, and new topics such as environmental studies, development studies, and urban studies. During the 1970s, researchers with an interdisciplinary orientation began tackling social problems such as poverty and homelessness. At the same time, interdisciplinarity became identified with the development of experimental colleges and radical curricular experiments within more traditional institutions. However, within the young field,

FIGURE 2.4 ■ Civil Rights March

Source: ©PhotoQuest/ArchivePhotos/Getty Images

tensions were increasing between those who wanted to embrace the disciplines and then transcend them, and those who rejected the legitimacy of disciplines; and those who sought rigor in interdisciplinarity, and those who saw interdisciplinarity as freedom; and those who strove for intentionality in integration, and those who embraced serendipity. (Newell, 2010b, p. 363)

By the late 1970s, when the social struggles had subsided and mundane academic routine had returned to the universities, the call for interdisciplinarity became much less urgent. “What had seemed progressive only a few years earlier appeared outdated, if not quaint” (Weingart, 2000). Nevertheless, a legacy tradition was established.

Interdisciplinarity Acquires Academic Legitimacy in the 1980s and 1990s

In the early 1980s, interdisciplinarity began to acquire academic legitimacy when, for example, the National Collegiate Honors Society declared that “honors” was “synonymous” with interdisciplinarity, thus linking it with quality and rigor. Women’s studies programs asserted that they were interdisciplinary by their very nature, which, in this instance, linked interdisciplinarity with critiques of the academy in general and the disciplines in particular. Environmental studies also embraced the interdisciplinary impulse by seeking to pull together insights from a variety of disciplines to form holistic conceptions such as ecosystems (Newell, 2010b, p. 362).

While such developments helped to legitimize interdisciplinarity, they also encouraged “divergent views about the relationships between the disciplines and interdisciplinarity (are they complementary or antagonistic?) and perpetuated the impression that the nature of interdisciplinarity is self-evident” (Newell, 2010b, p. 362). To counteract this thinking and clarify the nature and practice of interdisciplinarity, interdisciplinarians founded professional associations such as the Association for Integrative Studies (AIS), which changed its name to the Association for Interdisciplinary Studies in 2013. The AIS founded a journal, *Issues in Integrative Studies* (which changed its name to *Issues in Interdisciplinary Studies* in 2013), that for over 3 decades has facilitated a focused conversation about the form that interdisciplinary teaching and research should take.

In the 1990s, two developments converged to affect interdisciplinarity in both a positive and a negative way. The first was that interdisciplinarity received further legitimacy as educators widely viewed it as part of a package of curricular and pedagogical innovations. These included collaborative learning, multicultural education, learning communities, inquiry- and problem-based learning, writing across the curriculum, civic education, service learning, and study abroad. While the antagonism between interdisciplinarity and the disciplines was being reduced, a second, more subtle, development occurred: Interdisciplinarity was being accepted by a wider range of discipline-based faculty who were unfamiliar with its origins and character. By the new millennium, the historic roots of interdisciplinarity were lost and the range of conceptions of interdisciplinarity had grown wider and fuzzier (Newell, 2010b, p. 363). Many faculty naively assumed that “we are *all* doing interdisciplinarity.” This “anything goes” attitude prompted one critic of interdisciplinarity to complain in the prestigious *Chronicle of Higher Education* that interdisciplinarity has become “so fuzzy that a university’s commitment to it is close to meaningless” (Wasserstrom, 2006, p. B5).

We have stressed above the emergence of interdisciplinary *teaching* in the 20th century. But this development—and especially the casual acceptance of interdisciplinarity by many in disciplines—owed much to an increased recognition of the value of interdisciplinary *research*. As we saw in Chapter 1, there has been an increased recognition in recent decades that a range of complex problems—climate change, inner-city poverty, racism—require interdisciplinary analysis. The development of interdisciplinary teaching would always have been a challenge within the modern research-oriented university (and indeed often proceeded fastest in smaller liberal arts colleges which prioritized teaching) unless supplemented by an interest in interdisciplinary research. But as university presidents and research-granting agencies came to laud interdisciplinary research, the incentive grew to claim that one was interdisciplinary without reflecting on what this means.

Those faculty who embraced an “anything goes” attitude to interdisciplinarity were largely unaware of the burgeoning literature that was clarifying the nature of interdisciplinarity and identifying best practices for the performance of both interdisciplinary research and teaching. A flurry of highly visible national reports by prestigious groups and path-breaking books and articles by key interdisciplinary scholars reveal the details of an emerging consensus about the fundamentals of the field that Newell summarizes in Box 2.4.

BOX 2.4: FUNDAMENTALS OF INTERDISCIPLINARITY

An interdisciplinary study has a specific substantive focus that is so broad or complex that it exceeds the scope of a single perspective; interdisciplinarity is characterized by an identifiable process that draws explicitly on disciplines for insights into the substantive focus; those insights must be integrated; and the objective of integration is instrumental and pragmatic—to solve a problem, resolve an issue, address a topic, answer a question, explain a phenomenon, or create a new product. (Newell, 2010b, p. 363)

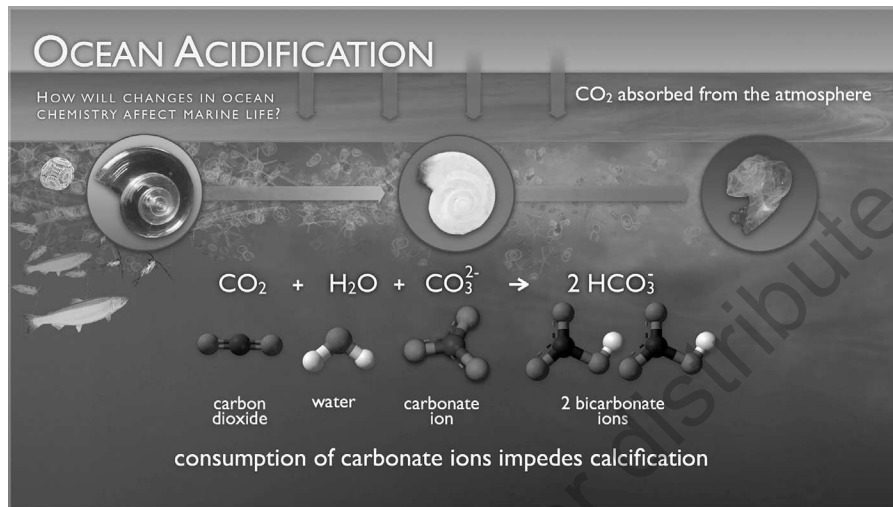
Interdisciplinarity Practice in the New Millennium

Developing competence in interdisciplinarity includes not only understanding the historical roots of the field but also being familiar with current interdisciplinary advances in the following academic sectors. We discuss developments in both interdisciplinary teaching and research here but focus on implications for interdisciplinary learning.

Natural Science

Investigations of real-world problems of interest to the natural sciences have become increasingly interdisciplinary. Real-world complexity often defies using a single disciplinary approach and requires drawing on research and using tools from multiple natural science disciplines (e.g., physics, chemistry, biology, and Earth science) and possibly other disciplines and fields interested in the problem. Complex natural systems such as the Earth's climate cannot be fully understood without considering all major subsystems that contribute to it, including ocean currents, the formation and destruction of polar ice caps and mountain glaciers, solar radiation, land use, land cover, and the processes governing the transportation of microscopic particles, such as carbon, through the air. Investigating questions such as climate change, for example, also involves understanding the role that increased carbon dioxide emissions play in the grand system of Earth's climate. One aspect of this system is the relationship between these emissions and increasing ocean acidification, as shown in Figure 2.5.

We noted earlier an increased connection between natural science and technology in the late 19th century. In the late 20th century, there has been increased collaboration between life sciences and medicine and between physical sciences and engineering (Klein, 2010, p. 17). For example, Elias Zerhouni, former director of the National Institutes of Health, reports that what is needed to understand the molecular events that lead to disease is the integration of disciplinary expertise and new technologies (2003, pp. 63–64). Klein (2010) cites three boundary-crossing developments occurring in the sciences and technology: (1) the quiet daily flow of borrowing methods, concepts, and tools between disciplines; (2) the application of “knowledge from one discipline in order to contextualize another, akin to the engineering profession’s

FIGURE 2.5 ■ Ocean Acidification: Consumption of Carbonate Ions Impedes Calcification

Source: Pacific Marine Environment Laboratory, NOAA

inclusion of social contexts of practice”; and (3) “the emergence of new communities of practice” where individuals and groups work together to solve problems of mutual interest (pp. 18–19).

A prime example of interdisciplinary natural science with technological implications is the human-genome mapping project described in Box 2.5.

BOX 2.5: THE HUMAN-GENOME MAPPING PROJECT

The human-genome mapping project was a complex undertaking that depended on extensive collaboration across many fields, including the biological and computational sciences. Basic questions of life—how living beings grow, how the brain functions, why many animals need to sleep, how retroviruses function—share the characteristic of complexity, and understanding them, even in part, depends on multiple disciplines. Gaining such understanding will almost certainly require deep expertise, both at the subsystem level and at the interdisciplinary level, and the integration of these two levels. It is important to note that depth in research is not confined to single-discipline investigations. Statistical mechanics, for example, unites physicists and mathematicians in studies of substantial depth. (Kafatos & Eisner, 2004, p. 1257)

The implication of increased boundary crossing for interdisciplinary studies is this: You need to *understand how different disciplines view the object or phenomenon under study*. For

example, an organism “is simultaneously a physical (atomic), chemical (molecular), biological (macro-molecular), physiological, mental, social, and cultural object” (Klein, 2010, p. 20).

In natural science and technology, then, we see three broad trends:

- Much of scientific interdisciplinary work today is instrumental and motivated by practical problem-solving (Weingart, 2000).
- Disciplines have become more porous and multidisciplinary (Repko & Szostak, 2020).
- Faculty are incorporating new knowledge about genetics, cognition, and the cosmos into the science curriculum and organizing courses around complex technical and social problems and topics. They are also including introductory courses that integrate elements of mathematics, physics, chemistry, and biology (Klein, 2010):

In one interdisciplinary science program, students studied the possible environmental consequences of a large tract of farmland and forest near their university being developed as a subdivision and shopping center. The subject was appropriate for interdisciplinary study because it had multiple parts that interacted with each other and that required studying both the parts and the system as a whole from multiple disciplinary perspectives: the pond and stream that watered and drained the site (Earth science and hydrology); the trees and plants that absorbed carbon dioxide and produced oxygen (chemistry); and wildlife that depended on the pond, stream, and forest (biology and ecology). (*Note:* One could also integrate social science insights into such a project.)

The Social Sciences

The social sciences (which traditionally include anthropologists, economists, political scientists, psychologists, and sociologists) deal with systems, issues, problems, and questions that are even more complex. This has resulted in the development of a large and growing number of interdisciplinary fields and programs that span the social sciences and connect to the natural sciences and the humanities. In 2011, the National Science Foundation (NSF) and Directorate for Social, Behavioral, and Economic Sciences (SBE) issued a report on research priorities. Among its conclusions were the following:

- “Future research will be interdisciplinary, data-intensive, and collaborative” (p. 5).
- “Interdisciplinary training [is needed] in new research methods, including integration and synthesis across data, methods, and disciplines” (p. 5).
- The NSF/SBE will concentrate “on more focused planning activities” that will “enhance interdisciplinary research” with initial preference given to four areas: population change; disparities; communication, language, and linguistics; technology, new media, and social networking (p. 5).

The problems social scientists study are usually concerned with the cause(s) of something or the effect(s) of something on other things. Examples of hypothetical student research involving

primarily the social sciences include the cause(s) of childhood obesity, the effects of undocumented immigration on health care and education, and the cause(s) of gang formation.

The two most influential developments in the social sciences since the end of World War II are area studies (e.g., the Middle East) and quantitative research methodology (i.e., measurement using numerical data and statistical analysis). These movements reveal the intent to develop a comprehensive understanding of concrete patterns of social life, the hope that scientific knowledge can help solve domestic social problems, and the expectation that social science can become an effective source of objective knowledge that can inform government policy (Calhoun & Rhoten, 2010).

Area studies and quantitative research methodology can be seen as occupying opposite ends of a continuum. On one end, area studies with its focus on people as embedded in culture, institutions, and history represent the humanistic approach to social science; on the other, quantitative research methodology with its focus on statistics and data sets represents the scientific approach.

Area studies such as American studies bring together different disciplinary perspectives in order to achieve a richer, more complete view of a society or culture in its particular historical or geographical setting. By bringing together all relevant knowledge of its particular focus, area studies attempt to be holistic. By contrast, quantitative research methodology does not attempt to illuminate the whole but rather to identify causal relationships within individual aspects of society. It insists that the study of these specific causes can and should be based on numerical information (Calhoun & Rhoten, 2010).

“Globalization” is a topic that has attracted considerable attention in recent decades. The concern here is with how different regions of the world interact increasingly in the economic, political, and cultural spheres. Connections among economic, political, and cultural interactions can only be explored in an interdisciplinary fashion. Sociologists may study the effect of American movies on French culture, while economists explore the reasons for the increasingly global marketing of songs and movies, and political scientists examine the political responses to these transformations.

Interdisciplinary fields in the social sciences typically focus on issues of public concern. For example, business is a “social problem” in that social science can contribute insights into management education and offer methods on how to research organizational behavior.

Three implications for interdisciplinary learning follow from this discussion:

- The pursuit of a comprehensive view of social life requires understanding different disciplinary perspectives.
- The pursuit of innovation must be based on developing learning skills and borrowing tools from other disciplines.
- The pursuit of a truly comprehensive understanding of a particular social problem that is of public concern requires integrating insights from relevant disciplines (Calhoun & Rhoten, 2010).

The New Humanities

In contrast to the natural and social sciences, the humanities (art history, history [Box 2.7], literature, music history, philosophy, and religious studies) are not necessarily attracted to the study of systems or the identification of cause–effect relationships, although they are often interested in how culture is shaped by prevailing political, social, and economic influences. They analyze the end products of artistic endeavors (symphonies, operas, ballets, paintings, sculptures, videos, novels, and poems) that express the human experience. The humanities explore and find ways to articulate the emotions, probe values, ponder meaning, ask “big” questions, unleash imagination, or critique the human condition. The humanities engage the complexity of real-world problems by focusing on expression, effect, values, meaning, and how the things natural and social sciences study play out in human lives (i.e., lived experience). Because human beings, human culture, and human experience are all exquisitely complex, the humanities benefit greatly from interdisciplinary study. One leading author explains interdisciplinary practice in the humanities (see Box 2.6).

BOX 2.6: INTERDISCIPLINARY HUMANITIES

[The humanities disciplines are] paying increasing attention to . . . the contexts of aesthetic works and the responses of readers, viewers, and listeners. . . . Close reading of a text or technical analysis of a painting or a musical composition may be combined with psychoanalytical, sociological, semiotic, deconstructionist, or feminist approaches. Disciplinary categories [have] broadened to encompass more subject matter, conditions of artistic production, social science methods and concepts, and previously marginalized groups and other cultures. This development [is] reinforced by heightened interests in history, sociology, politics, and an anthropological definition of culture. (Klein, 2010, pp. 30–31)

Examples of topics, themes, and questions that require drawing primarily on the humanities include the following: How have significant aspects of the human experience been articulated using different media, and how has this process changed over time? How is alienation or loneliness represented in contemporary art? Is the American Dream still valid? How might artificial intelligence (AI) affect society? Such questions draw upon multiple humanities disciplines.

In recent years, the humanities have embraced what Klein (2010) calls “the new generalism,” which challenges both the modern system of disciplinarity and the older humanities model of unified knowledge and culture. She describes “the new generalism” as “not a unified paradigm” but “a cross-fertilizing synergism in the form of shared methods, concepts, and theories about language, culture, and history” (p. 30). The new humanities, reports Klein (2010), is doing the following:

- It is *deconstructing* (i.e., disassembling) disciplinary knowledge and learning while *raising political questions* concerning their value and purpose. This trend is especially evident in cultural studies, women’s and ethnic studies, and literary studies.

- It is paying increasing attention to the *contexts* of aesthetic works and the response of readers, viewers, and listeners to them.
- It is combining psychoanalytical, sociological, semiotic, deconstructionist, and/or feminist approaches.
- It is broadening the meaning of “the humanities.” This category of disciplines now encompasses social science methods and concepts, as well as previously marginalized groups and other cultures.
- It is heightening interest in history, sociology, politics, and an anthropological definition of culture.

A new and rapidly growing subfield within the new humanities is digital humanities, which investigates how new technologies influence and reflect scholarship (especially) in the humanities and artistic expression. Three examples illustrate the creativity, diversity, and importance of this field. John Sparrow combines the creative talents of the fine artist with the manipulation of digital data to transform old texts into new art in interactive works like *Birdsong Compliance* (<http://itchaway.net/poetry/birdsong-compliance/>). Second, an image was produced by the OPTE project (<http://www.opte.org/>) representing the Internet connections of one computer in one month during 2003. Although the purpose of the project was to map Internet growth and identify gaps in the infrastructure, as well as analyze the effects of natural and man-made disasters on Internet usage, the images produced were so startling and beautiful that they were displayed at the Museum of Modern Art in New York, thus challenging (as modern art does constantly) the boundaries between knowledge domains. Third, early attempts at digital imaging to preserve copies of deteriorating ancient manuscripts leveraged imaging technologies from medicine and aviation before it became more commonplace in the late 1990s (Prescott, 2012).

One area of the humanities where a systems approach may prove invaluable is the growing field of media studies. The last century has witnessed a series of technological developments—radio, television, Internet, smartphone, and more—that have changed the way that people receive (and increasingly produce) information and entertainment. These technologies are shaped by cultures, institutions, and governments, and in turn have a huge effect on how people live. Media studies grapples with this series of complex transformations and explores the question of how individuals and societies do and could interact with new media. (Note that here, as elsewhere, there is scope for an even broader interdisciplinary purview with insights from social and natural science.)

These changes have several implications for interdisciplinarity in general and for programs that focus on the humanities and on the fine and performing arts (see the next section) in particular:

- They blur the limits of the conventional distinction between disciplinary and interdisciplinarity.
- They involve **informed borrowing**, selecting one path to understanding while “bracketing” others. In photography, “bracketing” involves taking numerous versions of the same photograph using various exposure settings.

- They invite learners, listeners, viewers, or readers to actively participate in constructing the more comprehensive understanding themselves rather than to passively accept one produced by an expert.
- While instrumental interdisciplinarity is still important in the humanities, critical interdisciplinarity is more often embraced.

BOX 2.7: PAST AND FUTURE

History, though situated within the humanities in most universities, straddles the boundary with social science: It does pursue causal explanations (though often avoiding the word causation as it does so), and in doing so naturally engages the phenomena studied by social scientists. History increasingly employs methods from the natural and social sciences in addition to the humanistic close reading of historical documents (see e.g., <https://phys.org/news/2021-10-ceremonial-ancient-chaco-canyon-home.html>). The field of world history in particular has appreciated its interdisciplinary nature and recognizes one of its main purposes as understanding how politics, culture, economy, technology, and other phenomena (often termed “themes” in the world history literature) interact (its other main purpose is to detail cross-societal influences in history). One key lesson of world history is that all major historical transformations—the rise of agriculture, urbanization, industrial revolution, and many more—are characterized by interactions among phenomena studied in different disciplines. That is, political transformations do not have just political causes or effects, and the same is true of economic, technological, cultural, and other types of transformation. This lesson provides a powerful justification for interdisciplinarity: Our future will also be characterized by important transformations that will almost certainly be cross-disciplinary in nature and we are more likely to both see these coming and grapple well with them if we pursue interdisciplinary research and teaching. (see Szostak, 2021a, b)

The Fine and Performing Arts

There are real and distinct differences between the fine and performing arts and the humanities. The fine and performing arts (art, dance, music performance or composition, creative writing, and theater) produce many of the artistic artifacts that are studied by the humanities. They thus stress the perfection and execution of skills in order to produce or collaborate on creative work but also analyze and discuss the strengths and weaknesses of existing works of art. In contrast, the humanities often *study* the work produced by fine and performance artists (and, increasingly, productions from a much wider sphere of artistry) and discuss and interpret the purpose and meaning of these productions; perhaps considering how these works fit into historical, social, political, or cultural contexts; how particular works reflect or anticipate major shifts in political power and/or major catastrophes (wars, revolutions,

and genocides, for example); how and why particular works are innovative; and the effects of works on their respective audiences.

The fine and performing arts engage the complexity of real-world problems by providing insights that express, interpret, exemplify, or respond effectively to such problems. For example, they can contribute to our understanding of anger among minority youth by analyzing the anger motif expressed in rap lyrics. And they can sensitize us to the plight of AIDS victims by creating a theatrical or film production that dramatizes the life of a person with AIDS. The arts are concerned with techniques of expression that elicit responses, especially subjective or emotional ones, to aspects of the human condition in all its complexity. There has been increased interest in recent years in connecting different art forms.

Problems at the Human–Nature Interface

Many real-world problems cut across the categories of knowledge and, like the problems mentioned earlier, are the kinds of problems that interdisciplinary studies is uniquely equipped to address. Almost all environmental problems (as distinct from natural disasters such as volcanic eruptions) take place where the human and natural worlds meet and interact. For example, the problem of the causes of freshwater scarcity involves drawing on disciplines from the natural sciences *and* the social sciences. Certain problems arising from our interactions with each other require that we cut across disciplinary categories. For instance, issues relating to social justice require drawing on disciplines in the social sciences *and* the humanities. And the issue of reconciling how to clone humans with what it means to be human involves drawing on disciplines in the natural sciences *and* the social sciences *and* the humanities. These types of complex issues have given rise to numerous interdisciplinary fields that are designed to engage in border-crossing activity to develop understandings and offer solutions that are more comprehensive than those generated by single disciplines.

An example of one new field that spans the natural sciences, social sciences, and humanities is aural architecture, pioneered by Barry Blesser (see Box 2.8). This refers to auditoriums, places of worship, or digital simulations of virtual spaces that are sonically complex. We might also mention here the medical humanities, which explores the role that experiences of producing or appreciating art can play within healing processes (see Box 2.9).

BOX 2.8: AURAL ARCHITECTURE

I had not appreciated the artistic, social, historical, and philosophical context of my isolated activities. . . . I could have framed the discussion solely in terms of the physical and mathematical properties of sound waves that contribute to the aural experience of a concert hall. . . . Rather, I have chosen to explore the broad phenomenon of auditory spatial awareness without regard to a single discipline [or] culture. . . . In dealing with a musical space, a composer sees one aspect of the phenomenon, whereas architects, archaeologists, anthropologists, audio engineers, psychophysical scientists, and blind individuals see other aspects. When we have access to multiple views, each with its own biases and limitations, we acquire

greater understanding of the phenomenon. . . . The union of diverse viewpoints, like multiple shadows from an object that we cannot see, allows us to form an image of the phenomenon, which by definition always remains inaccessible. (Blesser & Salter, 2007, pp. ix–x)

BOX 2.9: ART THERAPY

According to Kievisiene et al., (2020) “Art therapy is a form of emotional support focusing on [. . .] psychological distress, difficult feelings, thoughts” related to a medical situation and its treatment (p. 2). The article goes on to explain that “integrative oncology” is a widely adopted term in the medical literature for the “combination of complementary medicine therapies” used alongside traditional medical treatments (p. 2). Art therapy is not restricted to those suffering with diseases such as cancer; it is widely used with individuals who have experienced traumatic events. In such situations, as Cohen-Yatziv and Regev (2019) explain, “Art therapy is a form of psychotherapy that uses art media as its primary mode of expression and communication. Within this context, art is not used as a diagnostic tool but as a medium to address emotional issues which may be confusing and distressing.” (p. 101)

The implication for interdisciplinary learning is that it will often be necessary to draw on disciplines from across the natural sciences, social sciences, and humanities.

BOX 2.10: INTERDISCIPLINARITY IN EUROPE

We have emphasized the United States in our historical discussion. Wernli and Darbellay (2017) provide a broadly similar review of the rise of first disciplines and then interdisciplinarity in the European context. They describe how the modern research university arose in Europe from the 17th century and became focused (very successfully for a while) around disciplines. They describe how in recent decades a set of complex societal issues has driven increased interest in interdisciplinarity by universities, governments, and the European Union. They conclude that universities need to reform their governance structures to facilitate interdisciplinarity.

INTERDISCIPLINARITY'S CRITICISM OF THE DISCIPLINES

Interdisciplinarity emerged as a much needed supplement to and corrective of disciplinary monopoly on learning and knowledge production. But what is it *exactly* about the disciplines that so concerns advocates of interdisciplinarity? The answer to this question is found in the

discussion of the interdisciplinary criticism of the disciplines. This criticism touches on six (overlapping) limitations of disciplinary specialization. Competence in interdisciplinary studies includes your understanding of these limitations.

Specialization Can Blind Us to the Broader Context

Disciplinary specialization can blind us to the broader context. **Context** refers to the circumstances or setting in which the problem, event, statement, or idea exists. This criticism is implicit in a bit of dialogue found in *The Little Prince* by Antoine de Saint-Exupéry. (Excerpt translated from the French by Richard Howard. Copyright © 1943 by Houghton Mifflin Harcourt Publishing Company. Copyright renewed 1971 by Consuelo de Saint-Exupery; English translation copyright © 2000 by Richard Howard, reproduced by permission of Houghton Mifflin Harcourt Publishing Company. All rights reserved.):

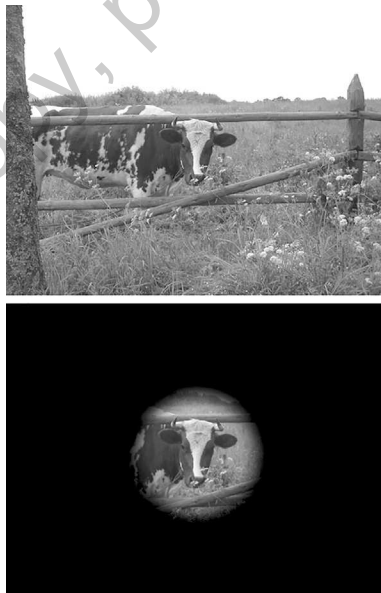
“Your planet is very beautiful,” [said the little prince]. “Has it any oceans?”

“I couldn’t tell you,” said the geographer. . . .

“But you are a geographer!”

“Exactly,” the geographer said. “But I am not an explorer. I haven’t a single explorer on my planet. It is not the geographer who goes out to count the towns, the rivers, the

FIGURE 2.6 ■ Tunnel Vision



Source: Tunnel vision imitation by Скампецкий http://en.wikipedia.org/wiki/File:Tunnel_vision_sc.png licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license. <https://creativecommons.org/licenses/by/3.0/deed.en>

mountains, the seas, the oceans, the deserts. The geographer is much too important to go loafing about. He does not leave his desk.” (pp. 45–46)

The lesson of this story is that specialization—that is, “not leaving [your] desk” to see what’s outside your area of specialization—can blind you to the broader context of a situation. Specialized thinking makes it less likely that you will be able to answer the larger, more important, practical questions of life. Advocates of interdisciplinary learning believe that *specialization alone* will not enable us to master the pressing problems facing humanity today. The more specialized the disciplines become, the more necessary interdisciplinarity becomes.

Specialization Tends to Produce Tunnel Vision

Disciplinary specialization can produce consequences much like what tunnel vision produces. In natural eyesight, tunnel vision means that the eye has only a small area of focus, with the rest of the field of view beyond the lens being unfocused or blurry, as shown in Figure 2.6. When it comes to approaching a complex problem, the specialist is able to focus only on the part of the problem that is familiar to the specialist, not on other parts that fall outside the specialist’s area of expertise.

Focusing on only part of a complex problem can produce serious unintended consequences. For example, the experts who designed the system of hydroelectric dams on the Columbia and Snake River systems were certain that these dams would not harm the many salmon species that spawned in the rivers’ tributaries. But the experts were wrong. Today, despite the extensive building of fish ladders and other costly efforts to mitigate the effects of these dams on the native fish populations, several species are on the verge of extinction, and an industry that employed tens of thousands of workers is in ruins. In this world of specialists, even highly educated individuals can be unaware of the social, ethical, economic, and biological dimensions of a policy or an action. Indeed, a person may know a great deal about a particular subject but be unable to calculate its possible impacts.

Specialization Tends to Discount or Ignore Other Perspectives

Interdisciplinarity faults the disciplines for sometimes failing to consider other perspectives. **Perspective in an interdisciplinary sense** refers to a discipline’s unique view of that part of reality that it is typically most interested in. For example, psychology sees human behavior as reflecting the cognitive constructs *individuals* develop to organize their mental activity. “Individuals” is italicized to emphasize that psychology is for the most part not interested in groups as sociology is, or in religious institutions and faith traditions as religious studies is. So when cognitive psychology studies a complex behavior such as terrorism, it studies only the mental life of individual terrorists, not groups of terrorists, and not their religious beliefs because it tends to discount the influence of religion on individual behavior. Consequently, when investigating the causes of terrorism, psychology tends to discount or even ignore the perspectives of sociology, economics, or religious studies.

Specialization Can Hinder Creative Breakthroughs

Specialization can sometimes hinder creative breakthroughs by its inability to bring previously unrelated ideas from other disciplines together. **Creative breakthroughs** often occur when different disciplinary perspectives and unrelated ideas are brought together (Sill, 1996). Noted British scientist and novelist C. P. Snow (1964) says, “The clashing points of two subjects, two disciplines, two cultures—or two galaxies, so far as that goes—ought to produce creative changes. In the history of mental activity that has been where some of the breakthroughs came” (p. 16). Root-Bernstein (1989) analyzes the sources of major (mostly natural) scientific breakthroughs and argues that those with familiarity with multiple fields tend to make the greatest discoveries. He mentions several Nobel laureates. Louis Pasteur was trained as a chemist and taught physics before effectively founding the field of microbiology.

Moran (2010) reports that “interdisciplinarity has produced some of the most interesting intellectual developments in the humanities over the past few decades” (p. 180). These include areas of literary theory such as narratology, the analysis of narratives, led by thinkers such as Gérard Genette, whose work spans the late 1960s to the early 2000s. Narratology considers all stories equally worthy of study, from Shakespeare to gossip, and attempts to deconstruct each narrative into its component parts, often revealing emergent and interestingly consistent patterns. Narratology is interdisciplinary because it integrates what it draws from texts outside of those studied traditionally as part of a literature or even a popular culture class. Any exchange where a story is shared is worthy of study. Also, its methods draw on disciplines that include anthropology, linguistics, literature, and sociology.

Jacques Derrida (a French philosopher active from the 1960s to his death in 2004) and the poststructuralist theory with which he is closely associated also emerged from the interdisciplinary humanities. Derrida challenged the ability of language to communicate consistent and verifiable statements about reality and human existence because of the unstable relationship that exists between a word in any language and what it represents to the users of that language. Poststructuralism, and its close relative, postmodernism, had dramatic and wide-reaching effects on numerous disciplines, both inside and outside of the humanities (though it unfortunately led some to doubt the very possibility of enhanced human understanding; see Szostak, 2023). It challenged all scientific and objective attempts to articulate reality, including the assumptions that had dominated and underpinned knowledge since the Enlightenment. The implication is that interdisciplinarity is more likely than specialization to advance the production of knowledge.

Specialization Fails to Address Complex Problems Comprehensively

The nature of a complex problem is that, like a diamond, it has many facets. Interdisciplinarity faults disciplinary specialization for its tendency to focus on a particular facet or component of a complex problem rather than addressing the problem comprehensively. For example, climate change has many facets: biological, chemical, political, and economic. Biologists may address climate change from a biological perspective and hypothesize about the effect of increased production of carbon dioxide, a greenhouse gas, on ocean temperatures and coral reefs. While this

specialized research is necessary and helpful, it does not provide a comprehensive understanding of climate change. Such an understanding would have to also consider the effects of climate warming on, say, the supply of fresh water for agriculture and food prices in particular regions. Each disciplinary contribution can be valuable, but none of them provides the truly comprehensive perspective on the problem that the public and policymakers really need. On too many issues of public importance, the disciplines tend to talk past each other. Disciplinarians act as though the part of the problem they analyze is the whole problem and simply ignore other aspects.

Specialization Imposes a Past Approach on the Present

Critics of disciplinary specialization point out that it is a product of a bygone era that was very different from today's world of increasing complexity and rapid social change. The structure of the disciplines and their silo approach to learning and problem-solving reflect the form and the level of knowledge achieved in an earlier historical period. Consequently, it is unreasonable to expect that the disciplines *by themselves* will be capable of providing the comprehensive understandings of, or solutions to, contemporary issues and social problems.

Conversely, the rise of interdisciplinary research and learning reflects the need to ask new questions, try new approaches, produce new technologies, and develop new intellectual orientations. We can never entirely dispense with the disciplines as a means of organizing knowledge, says Moran (2010), but we can use them to create new intellectual configurations of knowledge. Critics of the disciplines readily admit that interdisciplinarity *by itself* is no panacea for the world's problems. Rather, they believe that the disciplines *and* interdisciplinary studies working together might produce creative breakthroughs that would otherwise not be possible using traditional approaches. (We might, though, imagine changes to disciplinary practices that would render them more flexible and open to interdisciplinary insights; we return to this question in the next chapter.)

Summary of the Interdisciplinary Criticism of Disciplinary Specialization

Most interdisciplinarians do not seek the end of the disciplines; they fully appreciate the invaluable contributions that specialization has made in the production of knowledge. They believe, however, that although the disciplines are useful for producing, organizing, and applying knowledge, a purely specialized approach to learning and knowledge production comes at a very high price:

- Specialization can blind us to the broader context.
- Specialization tends to produce tunnel vision.
- Specialization tends to discount or ignore other perspectives.
- Specialization can hinder creative breakthroughs.
- Specialization fails to address complex problems comprehensively.
- Specialization imposes a past approach on the present.

For these reasons, interdisciplinary learning strives to balance disciplinary specialization with interdisciplinary integration. Happily, most interdisciplinarians and many disciplinarians view the disciplines and interdisciplinarity as complementary ways to learn, produce knowledge, and solve complex problems.

REVISITING THE BASIC INCOME

Like disciplinarity and interdisciplinarity, the idea of a basic income has its own history. Thomas More in his 16th-century novel *Utopia* urged a guaranteed basic income for all. Over the next centuries, his idea was picked up by social revolutionaries in several countries. As with interdisciplinarity, though, the idea really caught on in the 20th century with the development of various forms of government welfare. Some critics have argued that it might be both easier and more just simply to provide a basic income guarantee. Others have argued that such social experiments are perhaps better suited for countries such as Brazil where social welfare programs are less well developed.

We noted in Chapter 1 that many disciplines have something useful to say about the feasibility and desirability of a basic income. It would be an example of tunnel vision to merely perform a financial calculation without considering how people would react psychologically to a basic income and whether politicians would actually eliminate old programs as this new one was introduced. (Advocates of basic income may exaggerate our ability to eliminate existing programs: We might still need programs for the disabled, mentally ill, and other groups.) We must not only account for the perspectives of different disciplines on the feasibility of basic income, but engage ethical perspectives: Is a basic income a path to human freedom, or will it guide people toward laziness? The present set of welfare programs reflects in part the fact that we have tackled different aspects of poverty separately with public housing, public health care, food subsidies, and so on; a basic income requires us to consider various distinct characteristics of poverty together—and how the poor can and should interact with the rest of society.

Challenge question: How would each of the six critiques of disciplinary specialization be applied to a basic income?

CRITICAL THINKING QUESTIONS

1. Of the several concerns about overspecialization that the chapter discusses, which ones seem most applicable today, and why?
2. Explain why interdisciplinarity is advancing in the natural sciences, the social sciences, the humanities, the fine and performing arts, and the applied fields.

3. From your reading of Chapters 1 and 2, describe the relationship between interdisciplinarity and the disciplines.
4. If your university has a General Education program, does it provide guidance on interdisciplinary integration, or just leave students to try to draw connections across diverse courses? What advantages can interdisciplinarity bring to general education?

APPLICATIONS AND EXERCISES

1. Reflect on how an important past event has shaped your self-understanding or has motivated you to pursue an undergraduate degree.
2. Explain how your brief study of the origins of the disciplines and the rise of interdisciplinarity has made the system of learning you are experiencing at your college or university more comprehensible.
3. Select an article on a controversial public policy issue from a major publication such as the *New York Times*, the *Wall Street Journal*, or some other publication recommended by your instructor. Ask these questions of the author of the article, being careful to provide “in text” evidence to support your analysis:
 - a. Does the author place the issue in a broad context? How?
 - b. Does the author suffer from tunnel vision?
 - c. Does the author discount or ignore other perspectives on the issue?
 - d. Does the author propose a creative solution to the issue?
 - e. Does the author address the issue comprehensively?
 - f. How might an interdisciplinary approach improve the author’s treatment of the issue?

(*Note:* This can be pursued as a group project.)

KEY TERMS

Context	Informed borrowing
Creative breakthroughs	Perspective in an interdisciplinary sense

NOTE

1. Edison was a transitional figure, extolling the scientific credentials of his employees and funding the journal *Science*, but remaining suspicious of the direct impact of science on technology.