



UNDERSTANDING INTERDISCIPLINARY STUDIES

The theme of Part I is understanding interdisciplinary studies as a diverse, dynamic, and growing field. Its six chapters explain what is driving the field's steady advance, offer an integrated definition of this often misunderstood concept, and discuss the intellectual capacities, values, traits, and skills that interdisciplinary studies fosters. The chapters explain the rise of the modern disciplines and the emergence of interdisciplinary studies. They also identify the defining elements of disciplines, describe them as epistemic, social, and organizational communities, and discuss the key concept of disciplinary perspective. Part I closes with a detailed examination of the "DNA" of interdisciplinary studies in terms of its assumptions, theories, epistemology, and perspectives.

CHAPTER 1 OBJECTIVES

This chapter explains why interdisciplinary studies is now considered basic to education, problem solving, professional practice, and innovation. Interdisciplinarity provides a time-tested practical way to address the inherent complexity of real-world problems, including those problems arising in the workplace. The overall objective of this chapter is to spark your interest in interdisciplinary studies and help you appreciate the real-world significance of interdisciplinarity that is set out in the chapters ahead. Related objectives include understanding why interdisciplinary studies is considered basic to education and research, the factors driving the advance of interdisciplinary studies, and the relevance of interdisciplinary studies to your career development.

CHAPTER 1 LEARNING OUTCOMES

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

- Demonstrate an understanding of why interdisciplinary studies is considered basic to education, problem solving, professional practice, and innovation
- Describe the “drivers” of interdisciplinary studies today
- Identify and describe new and emerging interdisciplinary fields of study and their significance
- Explain why systems thinking and contextual thinking are increasingly viewed as important
- Explain why a knowledge society needs *both* disciplinary specialization *and* interdisciplinary breadth
- Explain the academic benefits of pursuing an interdisciplinary studies degree
- Explain the relevance of interdisciplinary studies to your career development



Interdisciplinary Studies in the Real World

1

Most people in higher education no longer see interdisciplinary studies as merely one approach among many. It is the latest big new thing. This chapter explains what all the fuss is about. Now that you are in university and enrolled in an interdisciplinary studies course or theme-based program that is interdisciplinary, you need to understand why interdisciplinary studies matters.

Why Interdisciplinary Studies Matters

We desire to have our lives count for something, to do something meaningful, to make a contribution to society. Thus, we come to the university to learn how to make a difference in the world. There are many ways to do this: educating our children, becoming responsible workers and citizens, protecting the environment, combating poverty, reducing crime and violence, creating new art forms, discovering cures for diseases, developing new technologies, starting new businesses, improving public policies, and promoting peace. To make such a difference, we must prepare for the realities of life in the twenty-first century with its growing complexities and new challenges. This requires developing the abilities to make connections and integrate information from multiple sources, and engage in effective ways of making decisions and solving complex problems. Interdisciplinary studies helps us develop these abilities.

What Is Driving Interdisciplinary Studies Today

For over two decades, major scientific organizations, funding agencies, and prominent educators have advocated the need for interdisciplinary studies. The current interest in interdisciplinarity is widespread and increasing in intensity, motivated by the belief that it is now basic to education and

research. To meet this perceived need, educators have developed a wide range of interdisciplinary courses and “studies” programs. Interdisciplinarity, it is fair to say, is becoming an integral part of higher education.

There are solid reasons for this development with which you, as an educated and responsible citizen, should be familiar. These reasons or “drivers” are the subject of several recent reports by leading scientific and educational organizations and are the focus of this chapter: (1) the complexity of nature, society, and ourselves, (2) the complexity of the globalized workplace, (3) the need for systems thinking and contextual thinking, (4) the changing nature of university research, (5) the public world and its pressing needs, and (6) a knowledge society’s need for *both* disciplinarity *and* interdisciplinarity. Combined, these drivers make a powerful case for interdisciplinary studies.

The Complexity of Nature, Society, and Ourselves

The first driver of interdisciplinary studies is the complexity of nature, society, and ourselves—all amazingly complex systems. A subject or problem is complex when its multiple parts require study by different disciplines. These parts interact in important ways, but the disciplines by their nature fail to study the interactions. For example, the subject of the high cost of gasoline is complex because it has multiple parts, each of which is studied by a different discipline: production of crude oil (Earth science), refining (chemistry), transportation (economics), federal and state clean air requirements (political science), and retail sales (business). However, studying each part in isolation of the others and ignoring their interactions will not explain high gasoline prices. What is required is an interdisciplinary approach that views the production and sales of gasoline as a complex system with multiple interacting parts. The interdisciplinary approach critically analyzes the relevant disciplinary perspectives and integrates their insights to produce a more comprehensive understanding of the problem.

Some real-world problems involving natural systems, man-made systems, and human culture fall largely, if not exclusively, *within* the purview of the natural sciences, or the social sciences, or the humanities, or the fine and performing arts. Others cut across these categories of knowledge.

The Natural Sciences

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 1.1.

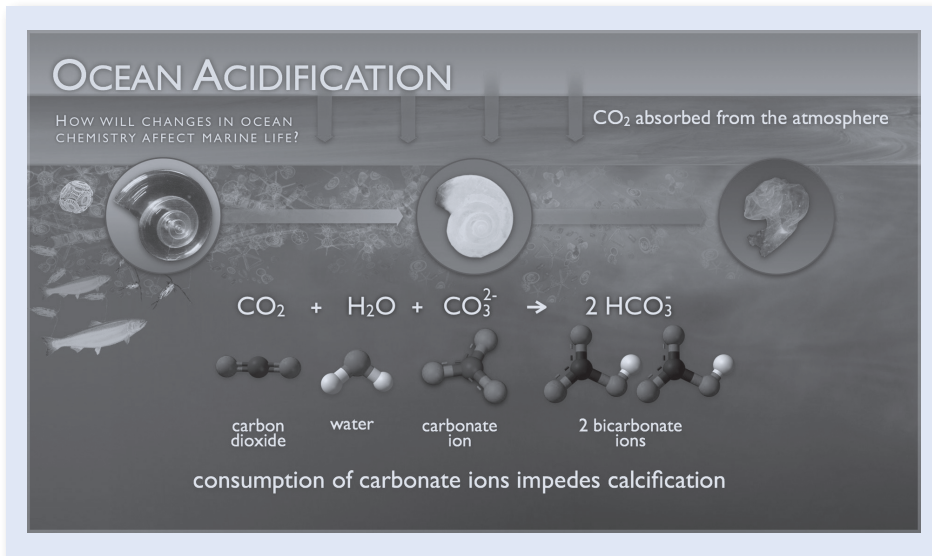


Figure 1.1 Ocean Acidification: Consumption of Carbonate Ions Impedes Calcification

Source: Pacific Marine Environment Laboratory, NOAA

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 which interacted with each other and which 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).

The Social Sciences

Human societies are enormously complex systems. Problems relating to them increasingly require social scientists (which traditionally include anthropologists, economists, political scientists, psychologists, and sociologists) to cross disciplinary lines as they explore the influences of geography, history, cultural traditions, wars, and systems of sacred beliefs on a subject. 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 Humanities

The humanities (art history, history, literature, music education, philosophy, and religious studies) engage the complexity of real-world problems by focusing on expression, effect, values, meaning, and how the stuff natural and social sciences study plays out in human lives (i.e., lived experience). Every generation seeks its own self-understanding. This explains the perpetual reinterpretation of Shakespeare's plays, the writing of new biographies of historical figures, and the creation of new forms of artistic expression, the latter contributing to the ever-expanding variety of phenomena studied by the humanities. 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? What causes civilizations to collapse? Is the American Dream still valid? What does it mean to be a global citizen?

The Fine and Performing Arts

There are real and distinct differences between the fine or performing arts and the humanities. The fine and performing arts involve not only the perfection and execution of skills in order to produce or collaborate on creative work but also the analysis and discussion of existing work in the field. 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. Music is a language for expressing feelings and emotions. The fine and performing arts (art, dance, music, creative writing, theater, and voice) engage the complexity of real-world problems by providing insights that express, interpret, exemplify, or respond effectively to such problems. For example, the fine and performing arts 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.

Problems at the Human–Nature Interface

Many real-world problems cut across the categories of knowledge and, like the problems above, 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 fresh water 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 (see Chapter 4) 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.

The Complexity of the Globalized Workplace

A second driver of interdisciplinary studies is the complexity of the globalized workplace where effective communication requires familiarity with diverse cultures. Today, the need to understand this complexity is more urgent than ever before, especially since the human population has reached the 7 billion mark, further straining our planet's limited resources. In the past decade, the world economy has undergone radical change, raising the question of what knowledge is needed by college graduates in the new globalized workplace. Pulitzer Prize-winning columnist Thomas Friedman and foreign policy expert Michael Mandelbaum (2011) describe this change in their book *That Used to Be Us* (see Box 1.1).

Box 1.1

The merger of globalization and the IT revolution that coincided with the transition from the twentieth to the twenty-first century is changing everything—every job, every industry, every service, every hierarchical institution. It is creating new markets and new economic and political realities practically overnight. This merger has raised the level of skill a person needs to obtain and retain any good job, while at the same time increasing the global competition for every one of those jobs. It has made politics more transparent, the world more connected, dictators more vulnerable, and both individuals and small groups more empowered.

All of these dramatic changes in the workplace, coming in rapid-fire succession, have left a lot of people feeling up in the air and asking, “Where do I fit in? How do I stay relevant in my job? And what kind of skills do I need to learn at school?” The short answer is that the workplace is undergoing a fundamental restructuring that every educator, parent, and worker needs to understand. (pp. 54, 72)

This fundamental restructuring of the economy and the workplace demands a new type of worker with a new set of skills. This is a person who can understand, use, and integrate knowledge, technology, and methods as well as collaborate with persons from diverse cultural backgrounds with diverse disciplinary training. This person must be able to work with intangible information to produce a tangible product. Most tangible products are the result of integrating information from multiple and diverse knowledge domains, and they require working in teams. For example, designing an “app” for the Apple iPhone requires, at a minimum, the ability to integrate software, art, math, gaming, English grammar, marketing, law, database management, finance, and interpersonal

communication—everything that goes into an application. In other words, designing an app requires a lot more training and creativity than just writing software code.

The world of business is becoming increasingly interdisciplinary because business is transacted within an increasingly fast-paced and complex environment that demands interdisciplinary skills to address this complexity. Among these skills, the ability to integrate knowledge from multiple disciplinary sources is critical. Jan Rivkin (2005), a professor in the Strategy Unit of the Harvard Business School, identifies the skills that are crucial for today's managers (see Box 1.2).

Box 1.2

Integrative skills are crucial. Managers who possess them can spot the core of an innovative strategy, grasp the implications for other parts of the company, and build out the idea relentlessly until it comes to pervade a company's entire value chain. They see, for instance, how improvements in a retailer's information system have implications for store location, store manager autonomy, pricing policy, and vendor relations. (p. 42)

The Need for Systems Thinking and Contextual Thinking

A third driver of interdisciplinary studies is the need for systems thinking and contextual thinking. A component of job complexity is the need to apply systems thinking to complex problems. Reduced to its most basic meaning for the purposes of this book, **systems thinking** is the ability to break a problem down into its constituent parts to reveal internal and external factors, figure out how each of these parts relates to the others and to the problem as a whole, and identify which parts different disciplines address.

Everything we do takes place within systems. Examples of systems in which we operate daily include the environment, the economy, and transportation. It is useful to understand how complex systems function and how their various parts interrelate so we can understand how they affect our lives. We also need to understand the operation of complex systems so we can figure out which public policies to support.¹

An example of a complex system is the U.S. economy. A key component of an economy is its central bank (e.g., the Federal Reserve, the “Fed,” in the United States) and its power to set interest rates. By lowering the prime interest rate, the Fed impacts the U.S. economy in multiple ways, economic as well as noneconomic. First, a lower prime rate lowers the cost of loans to consumers, such as car loans (which has a positive effect on the economy by stimulating car sales and thereby increasing the number of cars produced, which means that manufacturers should eventually have to hire

¹ Systems are arguably simple or complicated, not just complex, but all systems involving humans arguably are complex.

more workers). But a lower prime rate also lowers the interest rate that banks can pay on savings (which is negative because it reduces the interest income that retirees depend on to purchase things such as cars). There are also the unexpected political impacts of a reduction in the prime rate. For example, China (which already holds a substantial amount of U.S. national debt) may be less interested in purchasing more debt because of the lower rate of interest it would receive. So, if you ask the question, “What interest rate *should* the nation’s central bank charge?” answering it requires input from several disciplines including political science (which studies government policies and international relations), economics (which studies consumer behavior), philosophy (which studies ethics and logic), and possibly history (which studies historical patterns).

In addition to being able to apply systems thinking upon entering the globalized workplace, students need to be prepared to apply contextual thinking to complex problems. **Contextual thinking** is the ability to view a subject from a broad perspective by placing it in the fabric of time, culture, or personal experience. This kind of thinking, which is a primary focus of interdisciplinary learning, “is characterized by wholeness, by the relationship between parts, and by the assumption that knowledge changes” (King & Kitchener, 1994, p. 40).

However, contextual thinking is not a primary learning outcome of traditional disciplinary majors. After completing their general requirements (which vary from university to university), many undergraduates specialize or “major” in a traditional discipline. As they proceed in their major, they are prone to develop a **silos perspective**, meaning the tendency to see the university and the larger world through the narrow lens of that major (see Figure 1.2). What a traditional major typically fails to provide is context—the context of the whole system—and the ability to view reality through multiple disciplinary lenses and make connections across different knowledge formations.

In contrast, undergraduates pursuing an interdisciplinary field such as environmental studies, cultural studies, American studies, urban studies, and health management studies are taught to relate the smallest parts of the system they are studying to the whole. A hallmark of interdisciplinary studies is relating the particular to the whole by drawing on multiple disciplinary perspectives that are relevant to a specific problem or question. This feature is one of the reasons interdisciplinary studies is becoming a key component in liberal arts programs across the United States and elsewhere.

A liberal education fosters both systems thinking and contextual thinking. It develops the “integrative arts” necessary for meeting the challenges of our globalized world (Schneider, 2004). A liberal education helps you to learn how to learn, draw on multiple sources of knowledge, apply theory to practice in various settings, critically analyze information, integrate diverse and even conflicting

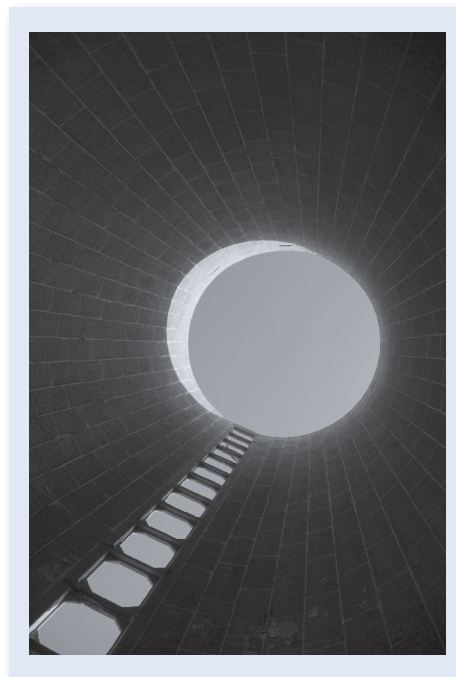


Figure 1.2 View From Inside a Silo

Source: iStockphoto

points of view, collaborate with others in problem solving, and understand issues and positions contextually. A liberal education that emphasizes integrative and interdisciplinary learning—the ability to make connections—is well worth pursuing (Huber, Hutchings, & Gale, 2005, pp. 4–5).

The Changing Nature of University Research

A fourth driver of interdisciplinary studies is the changing nature of university research. Leaders of major U.S. scientific organizations are emphasizing the importance of increased interdisciplinarity. The reason, explains Rita Colwell (1998), former director of the National Science Foundation (NSF), is that “interdisciplinary connections are absolutely fundamental” because “it is at the interfaces of the sciences where the excitement will be most intense.” The new NSF director, Subra Suresh, has prioritized the push for more interdisciplinary research since his arrival in October 2010. Emphasizing more interdisciplinary research is both financially and scientifically sensible, says Columbia University Professor Mark C. Taylor, because graduates are becoming too specialized to find employment due to the unsustainable nature of department-based hierarchies (Baskin, 2012). In 2012, the NSF dispatched one of its top officials and University of Michigan Professor Myron P. Gutmann to college campuses to promote the need for greater interdisciplinary research if they wish to win NSF grants. Gutmann notes that such research has yielded rapid advances in various fields, such as health care applications of atomic-scale science and the study of extreme weather events through analysis of both natural and social variables (see Box 1.3).

Box 1.3

The social, behavioral, and economic sciences—famously known as the “SBE sciences”—increase fundamental understanding of human social development and interaction and of human behavior, as individuals and as members of groups and more formal organizations. Our sciences contribute knowledge that has societal relevance and can inform critical national areas such as job creation, health care, education, public safety, law enforcement, and national security, among others. NSF’s SBE directorate is unique in that it houses a mosaic of related programs enabling fundamental research in cross-cutting topics by combinations of economists, political scientists, sociologists, psychologists, linguists, neuroscientists, anthropologists, and other social and behavioral scientists. This focus on fundamental research allows us to collaborate effectively with our colleagues in other directorates and federal agencies to address problems that range from coastal flood response to the needs of an aging population, to preparing our military with the insights they need to understand behavior in a changing world. (Gutmann, 2011)

Similarly, the U.S. National Institute of Health (2012) describes how interdisciplinary connection making is essential to the advancement of health research (see Box 1.4).

Box 1.4

Health research traditionally has been organized much like a series of cottage industries, lumping researchers into specialty areas, where their efforts remain disconnected from the greater whole by artificial barriers constructed by technical and language differences between different disciplines and departmentally based specialties. But, as science has advanced over the past decade, two fundamental themes are apparent: The study of human biology and behavior is a wonderfully dynamic process, and the traditional divisions within health research may in some instances impede the pace of scientific discovery.

The broad goal for the [Interdisciplinary Research] Program, therefore, is to change academic research culture, both in the extramural research community and in the intramural program at the NIH, such that interdisciplinary approaches are facilitated. The . . . Program includes initiatives to dissolve academic department boundaries within academic institutions and increase cooperation between institutions, train scientists to cultivate interdisciplinary efforts, and build bridges between the biological sciences and the behavioral and social sciences. Collectively, these efforts are intended to change academic research culture so that interdisciplinary approaches and team science are a normal mode of conducting research and scientists who pursue these approaches are adequately recognized and rewarded. (Overview section, para. 2)

Increasingly, the significant advances in knowledge production are occurring at the interdisciplinary borderlands between established disciplines and fields.

Interdisciplinary Borderlands

This perceived need to cross disciplinary boundaries in order to advance scientific progress is reflected in the results of the national survey of interdisciplinary programs at 222 colleges and universities conducted in 2006 by the Social Science Research Council (SSRC) (see Table 1.1).

Table 1.1 Top 10 Interdisciplinary Majors and Percentage of Institutions Offering Major

Top 10 Interdisciplinary Majors	Percentage of Institutions Offering Major
Intercultural studies*	13.08
Latin American studies*	16.82
African American and Africana studies***	21.50

(Continued)

Table 1.1 (Continued)

Top 10 Interdisciplinary Majors	Percentage of Institutions Offering Major
International relations*	28.04
Asian and East Asian studies*	31.78
Biochemistry and molecular biology**	33.64
American studies*	36.45
Neuroscience and psychobiology**	36.45
Women's and gender studies***	44.86
Environmental studies and science** (could also be ***)	63.55

Source: Rhoten, Boix Mansilla, Chen, & Klein (2006)

Note that of the top 10 interdisciplinary majors, more than half are in global or area studies (*), three follow a biology-plus model (**), and the most popular are in areas often considered advocacy/activism fields (***). Also striking is that two thirds of respondents expected to increase interdisciplinary offerings over the next five years. "The most commonly cited motivation was research, based on the belief that the kinds of questions students and faculty are investigating today often require the expertise of scholars from more than one discipline" (Klein, 2010, p. 43).

The Natural Sciences

The natural sciences are actively engaged in addressing problems that extend beyond the confines of a single discipline. A prime example is the human-genome mapping project described in Box 1.5.

Box 1.5

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 & Eisener, 2004)

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).

The Social Sciences

The social sciences 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 Directorate for Social, Behavioral and Economic Sciences (SBE) of the National Science Foundation (NSF) issued a report on research priorities for the next decade. Among its conclusions were the following:

- “Future research will be interdisciplinary, data-intensive, and collaborative”
- “Interdisciplinary training [is needed] in new research methods, including integration and synthesis across data, methods, and disciplines”
- 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).

An example of one new field that spans the natural sciences, social sciences, and humanities is aural architecture, pioneered by Barry Blesser (see Box 1.6). This refers to auditoriums, places of worship, or digital simulations of virtual spaces that are sonically complex.

Box 1.6

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, archeologists, 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)

The Humanities

In contrast to the natural and social sciences, the humanities are not necessarily attracted to the study of systems or the identification of cause-effect relationships. Rather, they tend to concern themselves with artifacts (music, plays, operas, paintings, sculpture, ballets, videos, installations, etc.) that express emotions, probe values, exemplify experience, ponder meaning, unleash imagination, or critique the human condition. 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 1.7).

Box 1.7

[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)

The Fine and Performing Arts

The fine and performing arts produce many of the artistic artifacts that are studied by the humanities. 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. The arts provoke more than assert, shape instead of direct, ask rather than answer. For example, through dramatic writing (i.e., the monologue), a play can focus creatively on AIDS-related topics such as prejudice, morality, death, sexuality, religion, discrimination, legal barriers, responsibilities, and special populations. The theater, says Pauline Gagnon (1998), is uniquely able to illuminate prejudice and discrimination and serve as a powerful “means of personalizing the universal” (pp. 7–8).

The Public World and Its Pressing Needs

The public world and its pressing needs is a fifth driver of interdisciplinary studies. The need to resolve problems of a general public interest is noted by the National Academies (2005) (see Box 1.8).

Box 1.8

Human society depends more than ever on sound science for sound decision making. The fabric of modern life—its food, water, security, jobs, energy, transportation—is held together largely by techniques and tools of science and technology. But the application of technologies to enhance the quality of life can itself create problems that require technological solutions. Examples include the buildup of greenhouse gases (hence global warming), the use of artificial fertilizers (water pollution), nuclear power generation (radioactive waste), and automotive transportation (highway deaths, urban sprawl, and air pollution). (p. 34)

These public interest problems cannot be adequately addressed by individual disciplines because they require drawing on expertise from multiple disciplines: Should we genetically modify plants and animals? Is an affordable university education a civic right? What is the meaning of populist movements such as the Tea Party and Occupy Wall Street?

When addressing problems of general public interest, it is often necessary (and even preferable) to draw on expertise from public stakeholders. Such a **stakeholder** is a person or entity outside the academy who is interested in and may have a material stake in the outcome of a particular societal issue. For example, community development projects in urban areas typically recruit expertise from relevant disciplines as well as from community institutions and interest groups. They join forces around complex societal issues of mutual concern such as homelessness, gang violence, affordable housing for low-income families, green spaces for recreation, public transportation, small business development, and venues for artists and musicians.

Revolutionary Insights and Generative Technologies

The public is demanding revolutionary insights and generative technologies. We live in times when change in the human and natural world is more rapid and interrelated than ever before, giving rise to ever more complex problems.

Revolutionary insights are those ideas that have the capacity to transform how we learn, think, and produce new knowledge. Interdisciplinarity is potentially revolutionary because it can transform how and what we learn, how we think about difference and conflict, and how we produce new knowledge and gain new insights. Revolutionary insights most often come from combining ideas from quite different areas of human understanding, and are thus inherently interdisciplinary.

Generative technologies are those whose novelty and power not only find applications of great value but also have the capacity to transform sectors of the economy, develop new sources of wealth, and create new jobs and professions. Recent generative technologies include Apple's

iPhone and iPad. The release of the iPhone in June 2007 and the iPad in April 2010 launched a multibillion-dollar “come out of nowhere” industry that employs thousands. The “apps” industry was pioneered by hundreds of ordinary individuals, each of whom had an idea for a particular app. Generative technologies increasingly come not from a particular discipline but from knowledge and expertise drawn from several disciplines and new instrumentation in the sciences.

Successful Intelligence and Integrative Thinking

It is tempting to suppose that revolutionary insights and generative technologies come only from a gifted few such as a Bill Gates, a Steve Jobs, or a Mark Zuckerberg, or from massive government programs such as the Manhattan Project that produced the atomic bomb. Not so. Revolutionary insights and generative technologies require what Robert J. Sternberg (1996) calls “**successful intelligence**.” Sternberg, one of the world’s leading researchers and authorities on intelligence, says that successfully intelligent people think well in three different ways: creatively, analytically, and practically.

Sternberg describes the three types of intelligence that together make for “successful intelligence”:

- **Creative intelligence** formulates ideas and makes connections.
- **Analytical intelligence** breaks a problem down into its component parts, solves problems, and evaluates the quality of ideas.
- **Practical intelligence** applies an idea in an effective way, whether in business or in everyday life.

What makes for successful intelligence, says Sternberg, is keeping these three ways of thinking in balance and knowing how and when to use each way of thinking. This ability can be learned.

The problem with traditional education, he argues, is that it appears to privilege analytical intelligence. This type of intelligence may be less useful to persons in their working lives than are creative and practical intelligence. Education, he says, needs to be preparing students to live in a world where what matters is successful intelligence, not just inert, analytical intelligence. The reason lies outside the classroom; problems are of the real-world variety, and these require thinking creatively and practically. For example, analytical intelligence is required to know the market for a product, but creative intelligence is what produces products in the first place and keeps them coming (Sternberg, 1996, pp. 136, 141).

Interdisciplinary learning fosters the development of all three components of “successful intelligence.” First, it helps to build the creative thinking tools of observing, imaging, abstracting, recognizing patterns, forming patterns, analogizing, empathizing, modeling, transforming, and integrating. Second, it stresses the importance of breaking a problem down into its component parts and connecting each part (if applicable) to a discipline. Third, it values applying the result of the interdisciplinary project in a way that is practical and critical.

Producing revolutionary insights and generative technologies requires the ability to think integratively as illustrated in Figure 1.3. **Integrative thinking**, a defining characteristic of interdisciplinary learning, is the ability to knit together information from different sources to produce a more comprehensive understanding or create new meaning. Integrative thinking is a subject of Howard Gardner’s *Five Minds for the Future* (2008).

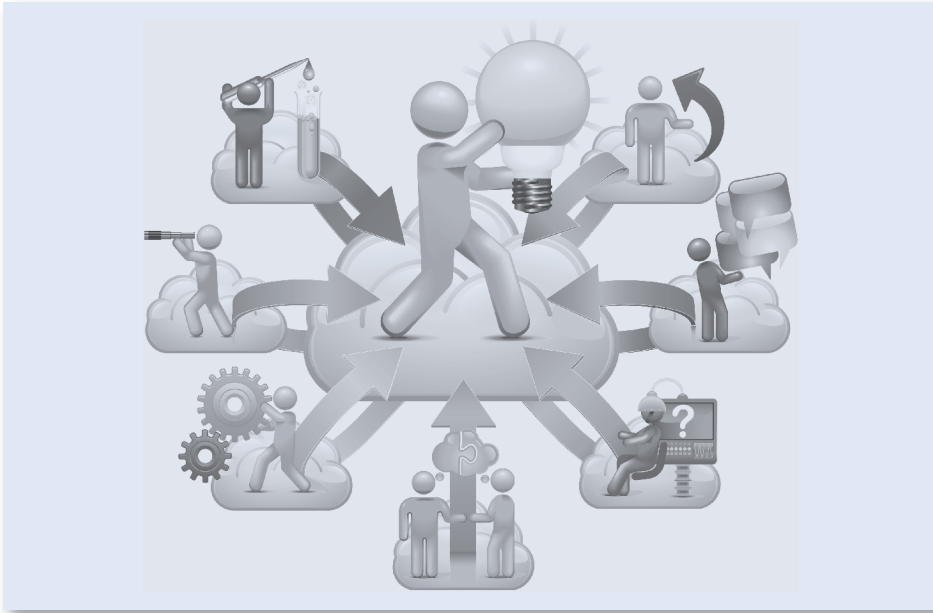


Figure 1.3: Integrative Thinking

Source: iStockphoto

The mind that is able to integrate and communicate complex ideas is one of the five minds that the fast-paced future will demand as described by Gardner in Box 1.9.

Box 1.9

Against all odds, individuals seek synthesis. . . . [The] most ambitious form of synthesis occurs in *interdisciplinary work* [emphasis added]. Biochemists combine biological and chemical knowledge; historians of science apply the tools of history to one or more fields of science. In professional life, interdisciplinarity is typically applied to a team composed of workers who have different professional training. In a medical setting, an interdisciplinary team might consist of one or more surgeons, anesthesiologists, radiologists, nurses, therapists, and social workers. In a business setting, an interdisciplinary or cross-functional team might feature inventors, designers, marketers, the sales force, and representatives drawn from different levels of management. The cutting-edge interdisciplinary team members are granted considerable latitude on the assumption that they will exit their habitual silos and engage in the boldest forms of connection making. (p. 54)

The rapidly changing workplace that Gardner describes highlights the need for interdisciplinary studies. Increasingly, workplaces need people who are educated in multiple disciplines, who know how to gather and integrate knowledge from those disciplines, and who know how to apply that knowledge to complex problems. Because the pace of job destruction and job creation is increasing, students entering today's workforce will not only need to change jobs several times in the course of their working life but also need to change careers. According to Andrew Ross (2012), "No one, not even in the traditional professions, can any longer expect a fixed pattern of employment in the course of their lifetime." This means that you must learn to be flexible and develop a broad range of cognitive and technical skills that you can apply as your jobs and careers change. Interdisciplinary learning provides you with the cognitive abilities and values that will enable you to integrate information and synthesize new solutions.

A Knowledge Society Needs *Both* Disciplinarity and Interdisciplinarity

A sixth driver of interdisciplinary studies is the awareness that a knowledge society needs *both* disciplinarity and interdisciplinarity. Science and society now recognize that disciplinarity and interdisciplinarity are not mutually exclusive but complementary within a knowledge society (Frodeman & Mitcham, 2007, p. 1).

A **knowledge society** is one in which the development and creative application of knowledge is the primary engine of economic growth, prosperity, and empowerment of all developing sectors of society. According to Robert Frodeman and Carl Mitcham (2007),

Knowledge *production* today has a tendency to swamp knowledge *use systems* [emphasis added] at both the individual and institutional levels. Overwhelmed by knowledge, we find it increasingly difficult to make good decisions—or, Hamlet-like, any decision at all. . . . [P]oliticians, [for example], when faced with difficult problems, often call for more research as a way to stall for time. (p. 2)

In addition to data overload, Frodeman and Mitcham assert that our knowledge society is increasingly characterized by a disconnect between knowledge production and knowledge utilization (see Box 1.10).

Box 1.10

This disconnect is in part the result of the sheer volume of information being produced. Disciplines pursue more and more specialization and detail, crowding out awareness of ends or purposes. Interdisciplinary efforts are often characterized as shallow, but this is true only in comparison with the [silo] narrowness of depth in disciplinary detail and

specialization. It's equally the case that the disciplines are unable to offer any width and breadth of contextualization. Moreover, no epistemological justification is offered for why we should prioritize the vertical as compared to the horizontal dimensions of knowledge. In what sense does a PhD know something more valuable than a person with three masters? As important as disciplinary depth is, [equally important is] knowledge of the overall topographic landscape of human affairs. (pp. 2–3)

The Academic Benefits of Pursuing an Interdisciplinary Studies Degree

Fortunately, once close-minded disciplines and applied fields are beginning to recognize that interdisciplinarity is necessary for four practical reasons. (1) Interdisciplinary studies are uniquely equipped to ask questions about complex issues that transcend the confines of single disciplines. (2) By placing complex issues in a broad context, interdisciplinary studies raise additional questions that often challenge societal values. For example, addressing environmental sustainability raises questions about human freedom and responsibility and the proper roles of the public and private sectors. (3) Interdisciplinarity offers a process that enables you to effectively integrate knowledge drawn from relevant disciplines. *This process enables you to go as deep into as many disciplines as is necessary or appropriate to grasp the essentials of the problem, to see the problem in the broadest possible context, to integrate expert insights into it, and construct a more comprehensive understanding of it.* (This process is the subject of Part III of this book.) (4) Pursuing interdisciplinary studies empowers you in three ways:

- a. To deal with complex societal problems. Interdisciplinary courses and programs typically focus on complex subjects such as the environment, sustainability, rights, politics, justice, and public health. These are *civic issues* in that they impact society as a whole. Interdisciplinary pedagogies (i.e., methods of teaching) prepare you for civic engagement by creating a classroom experience that encourages openness, dialogue, and mutual respect. Civic engagement flows from a sense of empathy and ethical consciousness.
- b. To effectively translate your education to new contexts, new problems, and new responsibilities. Civic engagement means using political as well as nonpolitical means to affect the quality of life in a community. Civic engagement is advanced as you appreciate diversity, tolerate ambiguity, and develop a sense of responsibility for the community *as a whole*.
- c. To think and act *effectively* on complex problems without getting overwhelmed or cowed by disciplinary experts or resorting to digging in your heels. It is OK to acknowledge that people with whom you disagree make valid points because you know how to proceed toward integration in the face of disagreement.

Interdisciplinary Studies and Your Career Development

The previous discussion of what is driving interdisciplinary studies today has eight important implications for how you prepare for your future career and life in a complex, fast-changing, and globalized world where the ability to work with multiple cultures and forms of knowledge are primary skills. First, your preparation needs to include how to recognize and deal with complexity of all kinds, especially job complexity. Interdisciplinary studies enables you to make connections, integrate information from multiple sources, and engage in effective ways of making decisions and solving complex problems.

Second, you need to learn how to work effectively in professional settings with others who have been trained in particular disciplines. Interdisciplinary studies develops your ability to understand the disciplinary perspectives of coworkers in terms of how they view a particular object, phenomenon, or behavior. Through interdisciplinary studies, you will develop greater empathy for diverse perspectives and an awareness of the diversity of disciplinary approaches to the problem.

Third, you need to develop critical, not just empathetic, understanding. This involves not only seeing strengths and weaknesses of each disciplinary perspective, but also judging their relevance or appropriateness to the issue at hand. A key intellectual capacity fostered by interdisciplinary studies is how to engage in perspective taking.

Fourth, your preparation also needs to include the ability to view a problem as a complex system that operates in a particular context. Interdisciplinary studies fosters the development of systems thinking and connection making. It teaches you how to break a problem down into its disciplinary parts to appreciate how they are interrelated, and conceive of a solution to the problem that is more comprehensive (i.e., interdisciplinary) than those derived by single disciplinary approaches.

Fifth, you need to know how to engage in “informed borrowing,” which involves drawing on the expert views of all relevant disciplines and doing it in a way that shows you understand not only *what* experts are saying but *why* they are saying it. This skill is integral to the interdisciplinary process of approaching complex problems.

Sixth, you need to be able to integrate diverse and conflicting views and information about a complex problem in order to formulate a more comprehensive approach to and resolution of the problem. Interdisciplinary studies facilitates the development of your creative, analytical, and practical intelligence, which is essential to the integration process.

Seventh, preparing to live and work in a knowledge society requires that you develop the capacity to assess social values, ideological stances, belief systems, and public policies as these have bearing on particular problems. Interdisciplinarity addresses real-world problems *and* challenges those social values, belief systems, and public policies connected to these problems.

Finally, interdisciplinary studies will help you make a difference in the world. Making a difference involves developing the necessary knowledge, skills, and personal networks in the classroom and then applying these to the world outside the university. If you are to contribute *knowledgeably* to political conversation, for example, you need to understand that the thinking, perceptions, and proposed policies of civic leaders often reflect their academic training. A public official or stakeholder who majored in economics or business is likely to view the construction of a new light rail transportation system primarily in economic terms and thus tend to minimize or ignore the social or environmental impacts of building the system. This reality makes it all the more important for

you to understand how the scholarly enterprise works, learn how disciplines “think,” and be able to identify the strengths and limitations of their perspectives.

CRITICAL THINKING QUESTIONS

1. How is globalization affecting your education and how you are preparing for life after university?
2. Why is the ability to engage in systems thinking, contextualization, perspective taking, and integrative thinking important when it comes to addressing complex problems?
3. Why is interdisciplinary connection making essential to the advancement of knowledge?
4. After reading Box 1.8, explain how the humanities can aid our understanding of problems traditionally considered to fall within the research domain of the sciences, such as genetically modifying animals or public funding for educating special needs children.
5. How does interdisciplinary studies foster the development of creative intelligence?
6. Identify a generative technology (other than the iPhone or iPad) and explain how it is likely the product of integrating knowledge from multiple sources.
7. Explain why major funding agencies that support faculty research and thus shape the agenda of higher education are increasingly emphasizing the importance of interdisciplinarity.

APPLICATIONS AND EXERCISES

1. From your reading of this chapter, comment on this statement: “Today’s graduates will *not* be entering a career that lasts a lifetime but a lifetime of multiple careers.” How should you prepare academically for this new reality?
2. Other than the economy and the university, what other system is impacting your life?
3. Of Sternberg’s three types of “successful intelligence,” which type(s) do you believe you already possess and which do you believe you need to develop further?
4. If you know what career or profession you plan to pursue, describe how it has changed in recent years. Identify the critical skills that the career/profession requires. If you are undecided about your future career or profession, select one that you think might interest you. In either case, do you feel that your present abilities and skills “fit” the job or profession? How might the abilities and skills that interdisciplinarity fosters improve the “fit”?
5. Identify an unresolved complex problem at your place of work (or the place of work of someone you know) and explain how an interdisciplinary approach could possibly aid its resolution.
6. Much has happened in our world since the list of popular majors appearing in Table 1.1 was constructed. Given the realities of the world today and the trends discussed in this chapter, what changes in this list do you anticipate five years from now?