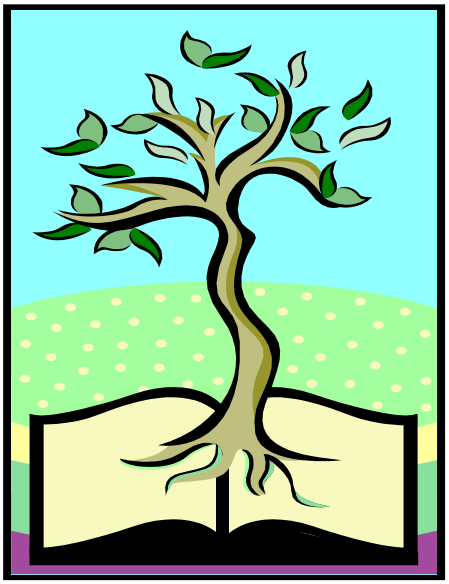
Introduction to Interdisciplinarity

This article defines and explores the key concepts associated with the idea of interdisciplinarity. We will answer the following questions:

- What exactly is a discipline?
- What does "interdisciplinary" mean?
- How do I distinguish an interdisciplinary effort from a single discipline effort, and what are the advantages of an interdisciplinary approach?
- What are the different facets of interdisciplinarity - the different approaches or types of interdisciplinary inquiry and application?

An important point to remember as you are reading this content is that ***you are already familiar with various interdisciplinary approaches to solving problems***, you just haven't "linked" your ideas and observations to the concepts that we will explore. As you think about the definitions of each of the concepts presented here, be sure to consider your own group or project related experiences and how these experiences may be classified in terms of interdisciplinary effectiveness.

The Nature of Disciplines and Interdisciplinarity



What's a "Discipline?"

Take a moment to consider this question. How would you define the term "discipline?"

Before we consider the nature of interdisciplinary inquiry and application, it's probably a good idea to consider just exactly what a "discipline" is. You have already had an opportunity to consider the nature of disciplines and the structure of knowledge in a previous module, but let's drill down a little deeper as a means of setting a context in which you can better understand interdisciplinarity.

One might consider a discipline to be *"a specific area of expertise"* or possibly *"a single domain of knowledge."* If you are considering the term from an academic perspective, you might consider a discipline to be *"a specific field of study"* such as psychology, engineering, theatre, or physics.

All of these definitions would be correct, although the most popular notion would probably be drawn from the academic perspective. Those in academia have spent considerable effort dividing, categorizing, and labeling different fields of knowledge. Universities are divided into colleges, and then further broken down into specific departments - all around the idea of disciplinary boundaries.

Take a moment to check out ASU's list of Colleges & Schools **HERE** (https://www.asu.edu/about/colleges-and-schools). Explore some of these links to the various colleges and schools at ASU to get a feel for how the disciplinary boundaries are drawn. How many disciplines are ***you*** crossing in the pursuit of your undergraduate degree? The answer is *not* simply your chosen major or concentration areas, or a couple of specific disciplines of interest… You'll be taking (or already have taken) many courses across various schools and colleges as you work to fulfill your general education requirements.

Now, let's take a step back. It's interesting to note that early institutions of higher learning were without disciplinary boundaries. Philosophers were interested in the idea of "unity of knowledge" and institutions of higher learning were interested in providing a well-rounded education. As our collective knowledge base began to expand, perhaps disciplinary distinctions were inevitable. The first disciplinary distinctions to arise were theology, law, and medicine.

The Nature of Interdisciplinarity

The Tree Metaphor

One metaphor that I like to use to describe the growth (and possible segmentation) of our collective knowledge is the **tree metaphor**. One notable scholar in the field of interdisciplinary studies, Julie Thompson-Klein, uses the tree metaphor to describe the "problem of knowledge" on which she claims the concept of interdisciplinarity to be centered. She points out that "unity of knowledge" may no longer be possible given the institutional and scientific differentiation of specific disciplines.

As our collective knowledge base expands, the "tree of knowledge" becomes magnificently brachiated (each new branch representing a new discipline or field of inquiry, growing outward as knowledge in that area increases). But consider this: Has this tree of knowledge become dismembered, with each branch completely separate from the others, or are the branches still connected? Does the tree continue to grow upward in one direction as the branches continue to grow outward?

A number of prominent educators and psychologists have noted the potential negative effects of dismemberment. With too many branches, there is a significant risk of a "crisis of disunity" – the possibility that experts on each branch will lose touch with the "big picture." Additionally, researchers in one field may be completely unaware of research in similar fields that could significantly aid them in their quest for new knowledge. This problem potentially breeds significant inefficiencies and lost opportunities in knowledge production. We find cases where similar disciplines are researching similar phenomena and not sharing relevant and critical information. This is a classic case of the "right hand not knowing what the left hand is doing!".

Key Point: The field of interdisciplinarity attempts to address this dismemberment between disciplines, this crisis of disunity, this "problem of knowledge" - by

exploring ways in which diverse domains of knowledge may be "integrated" or put together in such a way that the result is greater than the sum of the individual parts.

This is an exciting prospect, especially when you consider that most of the truly fantastic discoveries of the last century were made by people who were ***NOT*** firmly ensconced in the mainstream of their own disciplines. True innovators are always on the "edge" of their disciplines: looking for ideas in places that their peers do not; reformulating questions and looking for unique connections; borrowing ideas from seemingly very different fields; doing things a little differently…

Key Concepts Defined – Intradisciplinary

Intradisciplinary

The first term that we will explore is not really an interdisciplinary concept at all. The root ***"intra"*** means "within," so an "***intra***disciplinary" effort would involve only one discipline. An example might be a group of mathematicians working to solve an equation, or an electrical engineer developing a schematic diagram for some type of electrical device.

Not all projects require an interdisciplinary approach, but as mentioned earlier, as projects or problems become more complex in nature, it is more likely that an ***inter***disciplinary approach (not an ***intra***disciplinary approach) will yield the best solution.

Key Concepts Defined – Cross Disciplinary

Cross Disciplinary

The next concept associated with interdisciplinarity that we will explore is the term "**cross disciplinary.**"

Cross disciplinary could be defined as: ***Viewing one discipline from the perspective of another.***

A cross disciplinary approach allows one to view something from a different disciplinary perspective – using a different lens. It's a "one-way street."

Some examples of might include the following:

- **The psychology of investing.** A financial advisor looks outside of her traditional discipline of finance and investing to explore the psychological aspects of how and why people make the investment decisions that they do.

- **The mathematics of music.** A musician studies the nature of a sonnet from a mathematical perspective, identifying the specific "formulas" involved, as a means of gaining a clearer understanding of how the composition is structured.

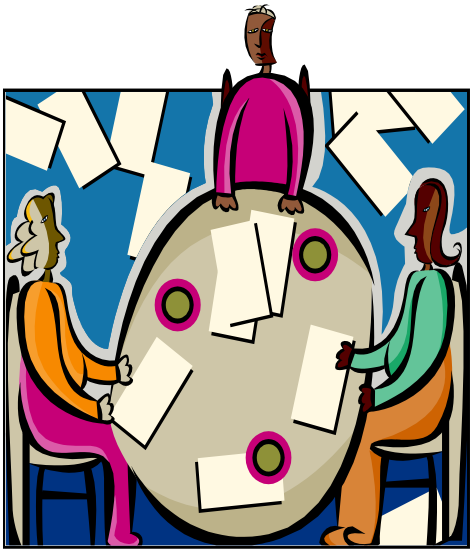
- **Sociology of the classroom.** A teacher studies sociological concepts with the hopes of bringing more order to his classroom.

- **Business of art.** An artist investigates the value and marketability of her work by employing certain business / marketing strategies.

Key Point: Cross disciplinary thinking is important because, by looking at our own disciplinary interests from a different perspective, we gain additional insight into the nature of our own discipline. Our expertise grows through the connections that we make – we take an integrative step in our quest for

unity of knowledge. Cross disciplinary thinking ***builds a bridge*** between two previously separate domains of knowledge, and forms the foundation for effectively ***borrowing*** the concepts and ideas from another discipline to help inform our own.

Key Concepts Defined – Multidisciplinary



Multidisciplinary

The next concept associated with interdisciplinarity that we will explore is the term "**multidisciplinary.**"

Multidisciplinary could be defined as: ***Several disciplines focused on one problem or issue - each discipline offers a unique perspective or contribution with respect to the problem or issue at hand.***

A multidisciplinary approach allows for different disciplinary contributions to come together around a specific goal.

Some important distinctions need to be made at this point:

- Multidisciplinary efforts are generally ***group efforts***.
- Experts from their respective fields provide their contributions with respect to the problem, issue, or goal at hand ***without meaningful interaction***.
- Generally, someone is responsible for ***"integrating"*** the disciplinarily diverse contributions ***around some "end product or goal."***
- The lack of meaningful interaction between participants means that, while multidisciplinary efforts are certainly ***group work***, they are ***not teamwork***.

In order to gain a clear understanding of the differences between a multidisciplinary approach and in interdisciplinary approach, we will first consider the term "interdisciplinary" and then contrast the two approaches using several examples.

Key Concepts Defined – Interdisciplinary

INTERDISCIPLINARY

The next concept associated with interdisciplinarity that we will explore is the term "**interdisciplinary.**"

Interdisciplinary could be defined as: ***Several disciplines collaborating around one problem or issue – contributors work together to arrive at an optimum solution to the problem or issue.***

Like a multidisciplinary approach, an interdisciplinary approach allows for different disciplinary contributions to come together around a specific goal. However, ***unlike a multidisciplinary approach***, an interdisciplinary approach ***seeks to integrate the individual contributions in a meaningful way***.

At this point, it would be helpful to explore the term ***"integration"*** in a little more detail. One might define integration as ***"bringing interdependent parts of knowledge into harmonious relationship."***

Another way to look at the process of integration would be to consider it as a team process, where individual contributors learn from each other - about how their own unique perspective / assumptions / contributions effects the others. The process of integration helps answer the following questions:

- How can we, as experts in our own fields, work together to arrive at the optimum solution to the problem at hand?

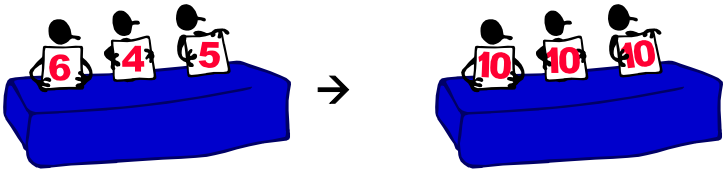
- How can I change my own assumptions about the problem based on what I learn from the new perspectives and expertise that other team members will contribute?

- How will your unique perspective or contributions help me develop an even greater understanding of my own field - by learning how our contributions "fit together" around the problem at hand?

Key Point: The primary distinction between a multidisciplinary approach and an interdisciplinary approach is as follows: Interdisciplinary efforts attempt to integrate efforts form individual contributors in a meaningful way. Based on this notion, an interdisciplinary approach is generally superior to a multidisciplinary approach – especially if the problem or issue at hand is complex in nature.

It should also be noted that the term "synthesis" may be used synonymously with the term "integration" in the interdisciplinary inquiry literature.

Evolution of Interdisciplinary Thinking in Industry



THE QUALITY MOVEMENT

One of the best examples of our efforts to evolve from multidisciplinary thinking to interdisciplinary thinking can be found in the "quality movement" that really started to take off in the United States in the early 1980's. Companies (primarily manufacturers at that time) began to realize that in order to compete effectively in a more global marketplace (against countries such as Japan, which was turning out high quality products for

reasonable prices), they needed to be able to innovate and bring quality products to market in a timely manner.

This realization helped fuel the move toward a more integrated approach to product development. It began quietly with initiatives such as "quality circles" where people from different departments ***(i.e., different types of expertise – different disciplines)*** would get together to discuss opportunities and challenges that they were currently facing with respect to meeting organizational goals. These quality circles generally explored ways in which each department's efforts impacted the other departments, and how they might work more effectively together. This is ***integrative thinking*** at work.

Today integrative initiatives such as Six Sigma, balanced scorecard, **TQM**, continuous process improvement, employee empowerment, cross-functional teaming, matrix organizations, etc. can be found in one form or another in virtually every company larger than a couple of dozen people.

As a budding integrative learner and "interdisciplinarian in training," your goal is to develop the ability to recognize opportunities for successful integration, and then bring the appropriate resources and tools to bear to create the results you desire.

Contrasting Multidisciplinary Versus Interdisciplinary Work

The following table may help clarify the difference between a multidisciplinary approach and an interdisciplinary approach:

Multidisciplinary	Interdisciplinary
Group work - Little meaningful interaction between group members	Teamwork – Significant meaningful interaction between team members
Unique perspectives of each group member not shared with the group – everyone just contributes their part – individualistic thinking.	Unique perspectives of each team member shared with all – team members explore how each contribution impacts the others – systems thinking.
High level knowledge of entire project or problem not necessary – no need to see the "big picture."	High level knowledge of entire project or problem critical in order to understand how individual contributions will come together in the most effective manner.

Multidisciplinary	Interdisciplinary
Doesn't require any skill outside of each group member's own disciplinary expertise.	Requires that team members effectively employ transferable skills such as flexibility, good communication and listening skills, and tolerance for diverse perspectives.
Assembled – no attempt at gaining some form of unity of knowledge.	Blended – seeks unity of knowledge, evaluating individual contributions in terms of the whole.
Tree metaphor – individual branched remain separate, unaffected by other branches – disunity.	Tree metaphor – each branch understands its relationship with the other branches, branched share the same sap, feeding each other – unity.
The total is the sum of the individual parts.	New ideas / strategies / theories / methods not possible under any of the single domains of knowledge are created and explored. The total is greater than the sum of the individual parts – synergy.

Multidisciplinary Versus Interdisciplinary - Examples

The following table provides three examples and an analogy to further help illustrate difference between a multidisciplinary approach and an interdisciplinary approach:

Multidisciplinary	Interdisciplinary
Example 1 – Designing and manufacturing an aircraft: Lack of meaningful interaction between contributors (electrical engineers, mechanical engineers, production experts, avionics experts, maintenance experts, etc.) yields sub-optimum designs – such as poor maintenance access, manufacturing problems, reengineering efforts. Results – significant time and money spent correcting problems, ECO's (Engineering Change Orders), higher manufacturing costs, low efficiencies.	**Example 1 – Designing and manufacturing an aircraft:** Meaningful interaction between contributors helps identify potential problems before major rework efforts are required. Individual contributors become more knowledgeable about their own fields by virtue of experiencing how their efforts interrelate with (integrate with) the efforts of others on the team. Results – a better designed product, produced ahead of schedule and under budget!

Multidisciplinary	Interdisciplinary
Example 2 – Developing a complex software application: Programmers work to the specification, developing only the modules / subroutines that relate to their assigned task – little integration. Possible result – an application that locks up your system at the slightest inconsistency or provocation.	**Example 2 – Developing a complex software application:** Design team works closely on how individual modules / subroutines relate to the whole. Each team member understands the overall scope and goals of the project. Communication, interaction, and integration between each program element is carefully considered. Result – a better designed product.

Multidisciplinary	Interdisciplinary
Example 3 – A multidisciplinary course: In academia, a multidisciplinary course would involve being exposed to a number of different disciplinary perspectives without any attempt made to integrate, or "tie together," the material. For example, a Western Civilization course which covers diverse topics such as art, literature, history, science, etc… It's left up to the student to integrate the information (which probably will not happen unless, of course, the student is in the BIS program – since integrative thinking is a skill that is learned, not a natural ability).	**Example 3 – An interdisciplinary course:** An interdisciplinary course, on the other hand would seek to make meaningful connections between individual disciplinary perspectives – and in doing so, arrive at a unique viewpoint not possible within the context of thinking purely along disciplinary lines. For example, an Architectural Design course in California might discuss ideas from the disciplines of architecture, seismology, physics, and mechanical engineering in an integrative manner that would help architects-in-training develop more earthquake resistant structures.

Jigsaw Puzzle Analogy:	***Jigsaw Puzzle Analogy:***
In a multidisciplinary effort, group members would bring along their own puzzle pieces - that relate to the part of the puzzle that they are personally responsible for. Group members could assume they know what the finished puzzle is supposed to look like, but the person actually assembling the puzzle finds that the pieces don't fit together perfectly. Or possibly there are not enough or too many pieces. In any case, the end product is not perfect…	In an interdisciplinary effort, team members would all know exactly what the finished product is supposed to look. Team members still bring along their own puzzle pieces - that relate to the part of the puzzle that they are personally responsible for. But the entire team would work together to find all the right pieces required to complete the puzzle. Team members may even work together to modify some pieces to ensure that all of the pieces fit together perfectly, thus ensuring that the end product looks good.

Key Point: Interdisciplinary approaches to solving problems are critical across virtually all industries, although the term "interdisciplinary" is alien to many people. By understanding the value of an interdisciplinary approach to problem solving and the different interdisciplinary approaches that organizations use, by using examples and analogies to illustrate your points, and by knowing how key transferable skills relate to interdisciplinary effectiveness, you are developing the ability to talk intelligently about your degree program, and your value / marketability as an interdisciplinarian.

Key Concepts Defined – Transdisciplinary

Transdisciplinary

The final concept associated with interdisciplinarity that we will explore is the term "**transdisciplinary.**"

Transdisciplinary could be defined as: ***Starting with a specific problem, issue, or opportunity, and then bringing the appropriate resources / knowledge to bear without initial consideration of disciplinary boundaries.***

A transdisciplinary approach is driven by the desire to create; a specific goal or "desired end result" drives the selection and application of specific domains of knowledge, tools, and techniques.

This is certainly the most difficult of the interdisciplinary concepts to define and understand. Not surprisingly, it's also the most difficult to achieve.

Some interdisciplinary scholars define transdisciplinary as "beyond the disciplines," claiming that transdisciplinary efforts "start with the issue or problem, and through the process of problem solving, bring to bear the knowledge of those disciplines that contributes to a solution of resolution." Furthermore, from an academic perspective, very few institutions attempt transdisciplinary work due to the fact that the problem solving skills, broad knowledge base, and resource development skills what would be required of the stakeholders.

However, consider the reality that a transdisciplinary approach to problem solving and innovation may be ***the most effective approach to addressing the major issues currently confronting society.***

If that is indeed the case, then it would certainly be worthwhile to attempt to gain a deeper insight into this concept.

Transdisciplinary Approaches to Innovation

Transdisciplinary Applications

Let's look at a couple of examples to see if we can understand how a transdisciplinary approach might be considered to be "the most common approach to the major issues that confront society."

Example 1: *The budding entrepreneur*

Imagine that you get an idea for a fantastic product that just about everyone could use. The product is somewhat complicated to produce and you certainly don't have the expertise to bring this product into existence by yourself.

In this case, you are ***starting with a specific problem, issue, or opportunity*** (the first part of the definition of transdisciplinary). You then begin to assess what skills you will need to get this product developed. You are now embarking on a "problem solving process." You, at this point, would need to employ some *problem solving skills* – clearly defining and describing what the product is and why it will be of value, assessing the resources required to bring the product to bear, considering potential obstacles, and developing a plan-of-action to accomplish your objectives.

In assessing the resources required, you determine that some of the skills you need to get your product to market would include the following: electronics design skills, packaging / manufacturing skills, patent acquisition skills, project management skills, marketing skills, financing acquisition skills, etc.

At this point, you're not considering the specific disciplines that might encompass the skills you require – you're just trying to problem solve, to figure out what kinds of things need to be done to accomplish your objective. You're concerned with ***bringing the appropriate resources / knowledge to bear without initial consideration of disciplinary boundaries*** (the second part of the definition of transdisciplinary).

The above example, then, could be considered a transdisciplinary approach to accomplishing an objective.

Example 2: *Universal Healthcare*

The idea of providing quality healthcare services to all people regardless of their ability to pay has been a topic of debate for decades. For societal issues and complex problems such as this, emotions and differences of opinion typically run quite deep. A multifaceted issue such as this is certainly not something that could be adequately approached by one person, one organization, one discipline, or one political party.

The exact resources that will be needed to approach this issue will be (to some extent) a function of how the problem is defined – what the desired end result is. Like the previous example, we must ***start with the specific problems and issues at hand*** (the first part of the definition of transdisciplinary). What's the opportunity given the current political climate? What exactly should the plan provide? How much will it cost? Where will the money come from?

Interestingly, with complex social issues such as this, the initial problem solving process is likely to be a small team effort, with team members selected by the powers that be based on individual skills, knowledge, beliefs, and abilities that likely transcend traditional disciplinary boundaries (this, in itself is transdisciplinary).

This small leadership team or steering committee will be responsible for determining the exact nature and extent of the healthcare problem, potential approaches / strategies that could ultimately be proposed, and the types of expertise and skills that will be required to pull a proposal together (and get it passed). Although considerably more complex, the "problem solving process" itself is not unlike that of the budding entrepreneur in the previous example – clearly defining and describing what the end result or final plan should be and why it's the best approach, assessing the resources required to get the plan developed and passed through congress, considering potential obstacles, and developing a plan-of-action to accomplish the stated objectives.

The resources required for a problem of this scope might include politicians, healthcare professionals, economists, leaders / experts from pharmaceuticals, hospital, and home health, and insurance industries, statisticians, etc.

As in the previous example, the initial task force or steering committee isn't considering the specific disciplines that might encompass the skills you require – they're just trying to problem solve, to figure out what kinds of things need to be done to accomplish the desired objectives. They are concerned with ***bringing the appropriate resources / knowledge to bear without initial consideration of disciplinary boundaries*** (the second part of the definition of transdisciplinary).

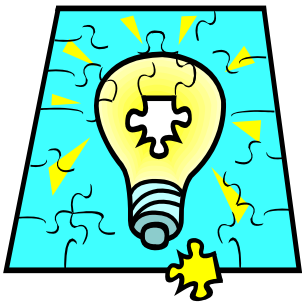
Therefore, the above example could also be considered a transdisciplinary approach to accomplishing an objective.

Key point: It can be seen from the above examples that a transdisciplinary approach isn't really that difficult to understand, and that, indeed, transdisciplinary approaches to solving problems are frequently employed. A transdisciplinary approach is most likely when specific resources are not already in place (as with the entrepreneur) or when the issue or opportunity isn't "owned" by anyone in particular (e.g., healthcare, environmental issues, etc.).

An interdisciplinary approach, on the other hand, is most likely when specific resources are already in place. For example, if the research and development group in a large organization comes up with a new product idea, the organization already has a pool of resources to draw from to help bring that product into reality. Therefore, an interdisciplinary approach is fine. The only danger here is that the effort slips inappropriately into the "multidisciplinary" zone.

Transferable skills such as flexibility, good communication and listening skills, and tolerance for diverse perspectives are critical for both interdisciplinary and transdisciplinary endeavors.

Jigsaw Puzzle Analogy Revisited



Multidisciplinary / Interdisciplinary / Transdisciplinary

As a final comparison between the three group-related concepts of interdisciplinarity, the jigsaw puzzle analogy developed earlier will be brought back to include the transdisciplinary concept.

Multidisciplinary	Interdisciplinary	Transdisciplinary
Jigsaw Puzzle Analogy: In a multidisciplinary effort, group members would bring along their own puzzle pieces - that relate to the part of the puzzle that they are personally responsible for. Group members could assume they know what the finished puzzle is supposed to look like, but the person actually assembling the puzzle finds that the pieces don't fit together perfectly. Or possibly there are not enough or too many pieces. In any case, the end product is not perfect…	***Jigsaw Puzzle Analogy:*** In an interdisciplinary effort, team members would all know exactly what the finished product is supposed to look. Team members still bring along their own puzzle pieces - that relate to the part of the puzzle that they are personally responsible for. But the entire team would work together to find all the right pieces required to complete the puzzle. Team members may even work together to modify some pieces to ensure that all of the pieces fit together perfectly, thus ensuring that the end product looks good.	***Jigsaw Puzzle Analogy:*** In a transdisciplinary effort, first you decide what the picture that you want to create will look like, then you carve out the individual the pieces (the size, shape, and nature of your resources) yourself!