

Discipline-Independent-Transdisciplinarity: The Essentials

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Abstract: *This paper presents a practical methodology for discipline-independent-transdisciplinary knowledge and understanding. This methodology provides both breadth and depth of understanding throughout the disciplines of the sciences and humanities. It is universal in that it integrates the knowledge of all the disciplines into a single coherent body of knowledge. It is based on isomorphies, specific patterns-of-organization of structure and process that occur in diverse situations, wherein they determine the origins of those situations, their structure and processes, and the interrelations of those situations with other situations. These isomorphies are used as conceptual-tools—what is known about the intrinsic nature and the roles of an isomorphy in one situation can be used to enhance understanding in other situations where that isomorphy occurs. The methodology is based on scientific knowledge, and results in the emergence of a universal language of transdisciplinarity. The methodology is not simple, but it is real, and exceptionally rigorous.*

Keywords: Transdisciplinarity; transdisciplinary methodology; isomorphy; Bertalanffy; qualitative methods; qualitative analysis; universal language; general system theory; knowledge integration; consilience; structural logic; rigor; deep structure; development; system

Discipline-independent-transdisciplinarity recognizes that all that exists has intrinsic pattern-of-organization of structure and process, and that these patterns-of-organization can be used as conceptual-tools for the qualitative analysis of all that exists.

Discipline-Independent-transdisciplinarity is to qualitative analysis what math is quantitative analysis.

The conceptual-toolkit described here enables the holistic mapping of the ways in which the higher level disciplines emerge from the subject matters of the lower level disciplines. The result of this mapping is a conceptual model of unified understanding free of the artificial boundaries between the disciplines that inhibit transdisciplinary efforts.

Key elements:

Patterns-of-organization as conceptual-tools.

A universal-conceptual-model.

Rigor.

A universal language of transdisciplinarity.

Science, the knowledge base of the methodology.

Prerequisite knowledge and understanding.

The methodology in practice.

PATTERNS-OF-ORGANIZATION AS CONCEPTUAL-TOOLS

The methodology uses patterns-of-organization as conceptual-tools of exploration, analysis, understanding, description, and communication.

- ❖ A great many different kinds of pattern-of-organization exist, with many isomorphic instances of each kind.
- ❖ These patterns determine the existence and intrinsic nature of the situations in which they occur.
- ❖ What is known about a pattern-of-organization and the roles it plays in one instance is used to enhance understanding of various other situations where isomorphic instances of that pattern occur.

A UNIVERSAL-CONCEPTUAL-MODEL

A single unified worldview.

- ❖ The methodology is universal in both breadth and depth of scope because pattern-of-organization is universally omnipresent.
 - The universality of the methodology results in a single unified worldview—a discipline-independent-transdisciplinary-universal-conceptual-model.
 - This universal-model serves as a conceptual-tool for an integration and unification of knowledge that enables universal breadth and depth of understanding (Vesterby, 2007).
- ❖ The pattern-of-organization of the universal-conceptual-model matches the intrinsic pattern-of-organization of the universe, the reality-referent of the model.
 - Because the universe itself has no disciplines or disciplinary boundaries, matching the pattern of this model to the pattern of its reality-referent eliminates the artificial boundaries between the disciplines.
 - The model displays the various ways in which the subject matters of the higher level disciplines developmentally emerge from the subject matters of the lower level disciplines—resulting in discipline-independent-transdisciplinary understanding.

RIGOR

Using the intrinsic qualities of the universe that determine the nature of the universe as conceptual-tools to analyze the intrinsic nature of the universe makes the methodology accurate and rigorous.

- ❖ Using these intrinsic qualities as tools of analysis focuses the attention directly on what is being investigated, thus enhancing accuracy and careful objectivity, while avoiding artificial and anthropomorphic aspects of analysis.

A UNIVERSAL LANGUAGE OF TRANSDISCIPLINARITY

In practice, this discipline-independent methodology results in the emergence of a universal language of transdisciplinarity.

- ❖ The names of the various patterns-of-organization are the words of the language.
- ❖ The interrelations of the patterns-of-organization, as those patterns occur together in the universe, constitute the syntax.
- ❖ The relation between the patterns as concepts within the mind and their reality-referents provides the semantics.
 - The reality-referents are the meanings of the concepts.

THE SCIENCES PROVIDE THE KNOWLEDGE BASE OF THE METHODOLOGY.

The scientific body of knowledge is the primary source of isomorphic-patterns-of-organization identified and used by this transdisciplinary methodology.

- ❖ Scientific disciplines identify patterns-of-organization as factors playing roles in specific situations, within the subject area of a discipline.
- ❖ Discipline-independent-transdisciplinarity identifies patterns-of-organization as general-factors playing their roles in various situations throughout the subject areas of all the disciplines.
- ❖ Because this transdisciplinarity involves only what is real, the careful accuracy of the scientific method is critical to the correctness of transdisciplinary understanding.

Science is a procedure, based on observation, that is designed to provide accurate knowledge and understanding about the intrinsic nature of reality, the intrinsic nature of that which exists.

- ❖ The procedure is designed to enable careful objective observation resulting in objective knowledge and understanding.
 - The scientific procedure.
 - Observe first.
 - Second, speculate about what knowledge is still missing after observation (make hypothesis).

- Check speculation (make further observations, such as experiments, to check validity of hypothesis).
- Double check.
- Repeat until a body of facts has been accumulated (scientific knowledge).
- Summarize the body of facts into a coherent, integrated body of knowledge (scientific knowledge).
- Speculate about what knowledge and understandings are still missing from the summarized body of knowledge (summarized body of knowledge plus the associated speculation constitutes scientific theory) .
- Check and double check theory based speculation.
- Repeat to continue accumulating the body of scientific knowledge and to develop the theory as a tool to indicate what to investigate next.

A secondary source of isomorphic-patterns-of-organization are the many isomorphic patterns that become evident as a result of using known patterns as conceptual tools.

PREREQUISITE KNOWLEDGE AND UNDERSTANDING.

Key elements:

Conceptual-tools.

Factors, situations, and general-factors.

Isomorphism.

Structural-logic.

Development.

Emergence.

Deep-structure.

Universal-factors.

Larger-scale-patterns-of-organization.

Thinking developmentally.

Conceptual-tools.

- ❖ A conceptual-tool is a mental-pattern that is used to analyze other mental-patterns.
- ❖ For mental-patterns that are accurate representations of the patterns-of-organization of their reality-referents, the conceptual-tools can be used for the analysis of the reality-referents.

Factors, situations, and general-factors.

- ❖ A **factor** is something that exists, and plays a role in the origin, existence, structure, or processes of the situation or system in which it exists.
- ❖ A **situation** is a combination of interrelated factors.

- A pattern-of-organization that exists in a situation, and plays a role there, is a factor of that situation.
- ❖ A **general-factor** is something that exists and plays a role in the intrinsic nature of two to many different situations.

Isomorphism.

- ❖ The term, *isomorphy*, refers to essentially identical or significantly similar patterns-of-organization occurring in different situations.
- ❖ The term, *general-factor*, incorporates the meaning of the term, *isomorphy*, and additionally emphasizes the roles of isomorphic patterns-of-organization as factors in the origins, existence, structures, and processes of the various situations in which they occur.

Structural-logic.

- ❖ Structural-logic is the intrinsic logic of reality, the manner in which the intrinsic qualities of something that exists determine the types of relations that something can have with other things that exist (Vesterby, 2008b).
 - Structural-logic determines the roles patterns-of-organization play as general-factors.

Development—Universally omnipresent transition.

Key elements:

Transition with sequential-difference and enhancement.

Two foundational forms of development.

Universal forms of development.

Other forms of development.

- ❖ Transition with sequential-difference and enhancement.
 - Everything that exists takes part in one way or another in a universally omnipresent transition, a sequential-difference from one time, place, part, pattern, level, condition, stage, or situation to another involving some form of enhancement.
 - Structural-logic determines the sequential-difference and enhancement of all forms of development.
 - **Sequential-difference** occurs as the difference from part to adjacent part—from place to adjacent place, from time to adjacent time, from component, situation, condition, state, or stage to adjacent component, situation, condition, state, or stage.
 - ◆ The difference is intrinsic-identity—that the adjacent parts or stages are ontologically distinct.
 - ◆ Individual ontological distinction can be recognized by coexistent adjacent-location of parts (as with space and coherent-structure—

coexistent-sequential-difference), or by noncoexistent occurrence of sequentially adjacent parts or stages (as with time and motion—noncoexistent-sequential-difference).

- ◆ All forms of change occur as noncoexistent-sequential-difference.
- **Enhancement** occurs as more of something.
 - ◆ The enhancement can be starkly simple (increasing distance through space or more time that has occurred), or exceedingly complex (as in a newly evolved species of plant or a city that has developed from a village).
 - ◆ Enhancement, as a general-factor, develops overall from simple forms to increasingly complex forms.
- ❖ There are two foundational forms of development.
 - Extensional-development—occurs with the coexistent-sequential-difference of space and the coexistent-sequential-difference that occurs in patterns-of-organization of matter in space.
 - Change-development—occurs with the noncoexistent-sequential-difference of time, motion, emergence, cause, throughflow, and all more developed forms of change.
 - All forms of newness are consequences of change-development.
- ❖ Universal forms of development—some examples (listed developmentally):
 - The sequential-difference from place to place through space.
 - Factor-development.
 - The sequential-change that occurs with ongoing time.
 - The sequential-change that occurs with ongoing motion.
 - Existential-pathway-development.
 - Situation-development.
 - The process of emergence.
 - The general-development-of-reality.
- ❖ Other forms of development—some examples (listed developmentally):
 - The creation of atoms from helium to the heavy elements.
 - Plate tectonics, and the associated volcanism and orogeny.
 - The sequential-difference that occurs with coherent structure, as occurs with the layers of sedimentary rock exposed in the Grand Canyon in Arizona.
 - The sequential-difference of the topology from one side of a continent to the other side.

- Biological evolution.
- Ontogeny.
- Cultural change.
- The general development of technology from sharpened sticks and stone hand axes to computers and space shuttles.
- The development of a star from a protostar to a white dwarf.
- Galaxy rotation.

Emergence—The origin of matter based pattern-of-organization.

- ❖ Emergence (a form of change-development) is the universal process-pattern-of-organization that brings into existence new pattern-of-material-organization as a consequence of motion (Vesterby, 2011).
 - In the simplest form of emergence, motion initiates changes in the distance and direction relations between two units of matter, with consequent changes in the pattern-of-organization of the units—and the emergence of new pattern-of-organization.
 - At this foundational stage of the development of emergence, it is a creative process based on the sequential-difference of motion—on sequential-enhancement.
 - In material situations, all change involving reorganization of components is based on this form of emergence.
 - A developed form of emergence occurs when motion brings units of matter together, combining them loosely or coherently into groups, with the emergence of the group pattern-of-organization and hierarchic organization as the enhancements.
 - At this stage of the development of emergence, it is a creative process based on the sequential-difference that occurs with the emergence of new pattern-of-organization due to combining components into newly occurring wholes—emergence based on combinatorial-enhancement.
 - Emergence based on combinatorial-enhancement, on combining, and combining again and again, results in the development of the hierarchic organization of material-reality from atoms and molecules to solar systems and galactic clusters.

Deep-structure.

- ❖ Emergence creates deep-structure by way of combining components into larger more complex structures.
 - All material reality that humans experience is foundationally composed of elementary particles.
 - Elementary particles combine to form atoms.

- Atoms combine to form molecules.
 - Molecules combine into larger molecules, crystals, and multimolecular materials and objects.
 - Molecules, crystals, multimolecular materials, and objects combine into larger more complex objects, groups of objects, and systems, all the way up to galactic clusters.
- Each level of this hierarchic pattern-of-material-organization is composed of the levels below it, all the way down to the elementary particles that constitute its material basis.
- Deep-structure—occurs as the underlying patterns-of-organization of structure and process of lower levels of the hierarchic-organization of material-reality that result in the existence and organization of structure and process of upper levels.
 - Patterns-of-organization constitute the situations in which they occur.
 - With material reality, deep-structure extends from the level of elementary particles to the level developmentally just below the top level of an object, system, or situation.

Universal-factors.

- ❖ Some factors, such as space, time, structural-logic, development, emergence, and several others, are themselves omnipresent throughout the universe.
- These universal-general-factors constitute the unifying framework of discipline-independent understanding.
 - Development is the primary unifying factor because it is both universally omnipresent and plays a role in the order of relations of all other factors.
 - Everything is not connected to everything—However, everything is developmentally connected to something.
 - Organizing the universal-conceptual-model developmentally makes it possible to universally organize knowledge and understanding in a way that matches the organization of the reality-referents of that knowledge and understanding.

Larger-scale-patterns-of-organization.

- ❖ These are patterns-of-organization that extend through several to many stages of development or levels of organization, either horizontally throughout a level or vertically up the hierarchy of material-reality.
 1. Factor Form—Simple to Complex.
 2. Identity of developed general-factors.
 3. Identity of levels of organization.
 4. Qualities of components determine qualities of the whole.
 5. Energy/matter changes due to throughflow.
 6. What goes before determines what follows.

7. Oriented developmental connection.
 1. Factor Form—Simple to Complex.
 - Patterns-of-organization, as general-factors, tend to occur in simpler forms in simpler situations, where few other factors are playing roles, and to occur in more complex forms in more complex situations, where more additional factors are playing roles.
 - The roles or consequences of a general-factor can be different at different stages of the development of the general-factor due to the roles of the additional factors.
 2. Identity of developed general-factors.
 - The basic pattern-of-organization of any general-factor is present within all developed forms of that general-factor, giving the developed forms their identity as that general-factor.
 3. Identity of levels of organization.
 - The basic form of a level of the material-hierarchy, (the basic pattern-of-organization that constitutes a particular level), is present within any instance of that level, giving every instance of the level its identity as that particular level.
 4. Qualities of components determine qualities of the whole.
 - The qualities of the components of a situation determine by way of structural-logic the kinds of relations that can occur between those components.
 - The qualities of those relations determine by way of structural-logic the patterns-of-organization that can occur in that situation.
 - The qualities of the pattern-of-organization of a situation determine by way of structural-logic the qualities of the situation as a whole.
 - When used as a conceptual tool, this larger-scale-pattern serves as a deep-structure template upon which to arrange the details in any situation involving the combinatorial based emergence of a whole due to the combining of its components.
 5. Energy/matter changes due to throughflow.
 - In throughflow situations matter alters the flow of energy, and the flow of energy alters the organization of matter.
 - When used as a conceptual tool, this larger-scale-pattern serves as a deep-structure template upon which to arrange the details in any energy-flow/matter-change situation.
 6. What goes before determines what follows.

- In all forms of change, the existence and intrinsic qualities of what goes before determine by way of structural-logic the existence and intrinsic qualities of what follows.
 - When used as a conceptual tool, this omnipresent larger-scale-pattern serves as a deep-structure template upon which to arrange the details in any situation involving change—be it time, motion, emergence, cause, or any developed form of change (for example growth—of a crystal, of a volcano, of an organism).
7. Oriented developmental connection.
- Everything that exists is developmentally connected to something else that has existed just prior, exists now, or will exist immediately following.
 - Through these developmental connections, the universe has an omnipresent deep-structure aspect of orientation, a directionality of structure and process.
 - When used as conceptual-tools, these connected oriented pathways of development provide highways of exploration, analysis, understanding, and description.

Thinking developmentally.

- ❖ To be constantly aware of the various forms of development that are playing roles in whatever is the current focus of attention, and to allow those forms of development to determine the forms of thinking within the mind (Vesterby, 2008a).
- With practice, a discipline-independent-transdisciplinarian develops the habit of mind to think developmentally.
 - Exploration and analysis seek out the structural-logic of developmental relations and developmental sequentiality.
 - Understanding, description, and communication are developmentally organized.

THE METHODOLOGY IN PRACTICE

In general the methodology involves (a) pattern recognition and (b) understanding the roles patterns play in determining the nature of the situations in which they occur, both the manner in which universal omnipresent patterns-of-organization determine the order of the universe, and the manner in which less universal general-factors determine the nature of all the lesser situations and systems throughout the universe.

Key elements:

The prime-imperative-of-analysis.
 Approaching an unknown situation.
 Spreading out the development.

List-mapping.
Defining.
Naming.
Hyphenating.
The modern-generalist-universal-conceptual-model.

The prime-imperative-of-analysis.

- ❖ Look to the situation under analysis itself, allowing the intrinsic qualities of that situation to dictate to the mind the qualities of the mind's understanding of the situation.

Approaching an unknown situation.

- ❖ The transdisciplinarian brings to bear on the new situation an intellectual-toolkit consisting of the prerequisite knowledge.
 - This includes the universal-conceptual-model that contains many already known, understood, and integrated general-factors.
- ❖ Applying the prime-imperative-of-analysis will reveal that there are known general-factors present in the new situation.
 - Their presence there provides an entry way into the analysis and preliminary understanding of the situation.
- ❖ Through further application of the prime-imperative-of analysis, new, previously unknown, general-factors will be observed.
 - These new general-factors are analyzed, added to the universal-conceptual-model, and then used in the further analysis of the situation of which they are constitutive components, providing more detailed and deeper understanding.

Spreading out the development.

- ❖ The purpose here is to obtain a view of the stages of development of a situation that is sufficiently detailed to reveal the roles of structural-logic in determining that development.

List-mapping.

- ❖ Creating a list of the qualities of a general-factor in which the order of the list provides some indication of the intrinsic organization of the qualities of the general-factor such that the list-map can be used to aid the process of mapping out the pattern-of-organization of the general-factor.
- ❖ Creating a list of the stages of a development in which the order of the list provides the sequence of the stages of the development such that the list-map can be used in the process of mapping out the development.

Defining.

- ❖ A descriptive-definition is created for each general-factor based entirely on the intrinsic qualities of the general-factor.

Naming.

- ❖ The foundational form of each general-factor is given a name that is derived from the content of the descriptive-definition.
 - Names are provided for each stage in the development of a general-factor based on the descriptive-definition of the stage.

Hyphenating.

- ❖ Hyphens are used whenever a term has specific meaning in the methodology.
- ❖ Often general-factors do not have names, in which case terms are hyphenated together as semidescriptive labels.

The modern-generalist-universal-conceptual-model.

1. How to see it in the mind's eye—as a dynamic picture.
2. How to understand what it is—as pictorially displayed knowledge.
 1. How to see it in the mind's eye—as a dynamic picture.
 - The relations between components in this mental model are based on structural-logic.
 - Structural-logic, as it occurs throughout the universe, is a factor of the interrelations between existential, organizational, and causal factors, and is thus intrinsically nonsymbolic, nonmathematical, and nonlinguistic in nature.
 - The universal-conceptual-model is therefore pictorial, displaying the factors, the patterns-of-organization, that play roles in the structural-logic relations between the components of the model.
 - This enables an integration of the components of the mental model that matches the integration of their reality-referents as those referents exist in and constitute the organization of the universe.
 2. How to understand what it is—as pictorially displayed knowledge.
 - All components of the universal-conceptual-model have reality-referents.
 - All terms in the description of the universal-conceptual-model have reality-referents.
 - Terms refer to the reality-referents of concepts—not to the concepts themselves.
 - All terms refer to something that has existed, exists now, or will exist.
 - Terms can refer to a single instance of a general-factor, or to several or all instances of that general-factor.
 - The methodology of this form of transdisciplinarity does not use abstraction.
 - This is not an abstract model.
 - ◆ It is a model of reality—a model of what exists.

- The reasoning involved is structural-logic—not abstract reasoning.
- The universal-conceptual-model does not contain speculation such as assumptions, suppositions, hypotheses, and the speculative aspect of scientific theory.
- This model is an integrated unified summary of knowledge and understanding.
 - ◆ The model is not a theory.

A GENERALIST MODE OF KNOWLEDGE AND UNDERSTANDING

This form of transdisciplinarity constitutes a modern-generalist mode based on breadth and depth of understanding in contrast to the traditional generalist mode based on quantity of knowledge.

- ❖ The methodology of transdisciplinarity provides integrated unification of knowledge from all the disciplines.
 - Discipline-independent-transdisciplinarity is a form of universal-generalist knowledge and understanding.
 - The generalist mode based on quantity of knowledge cannot achieve a universal form due to the vast quantity of knowledge currently available.

A DISCIPLINE-INDEPENDENT MODE OF KNOWLEDGE AND UNDERSTANDING

Within the integrated universal knowledge base of transdisciplinarity there are no disciplines.

- ❖ Knowledge and understanding based on isomorphic patterns-of-organization, on general-factors, is discipline independent.
- ❖ Transdisciplinarity requires a transformation in mode of thinking.
 - To thinking in in the mode of patterns-of-organization as conceptual-tools for qualitative analysis.
 - To thinking in in the mode of patterns-of-organization as conceptual-tools of exploration, analysis, understanding, description, and communication.
 - To thinking in the mode of isomorphic general-factors.
 - To thinking in the mode of the roles of general-factors in determining the origins, existence, structure, and processes of the situations and systems in which they occur.
 - To thinking in the mode of the universal interconnecting role of development throughout the universe.
 - To thinking in the mode of the role of development as a conceptual-tool that integrates and unifies the universal knowledge base of transdisciplinarity.

- To thinking in the mode of how structural-logic determines development.
- And in the mode of the various ways in which the process of emergence creates organization and complexity.

The reason this methodology is effective for discipline-independent-transdisciplinarity is that it is equally effective when used within any discipline.

- ❖ The isomorphic basis of this transdisciplinarity is omnipresent throughout the patterns-of-organization of structure and processes of the subject matters of all the disciplines.
 - And that explains why it results in communication across the disciplines—because it provides a common way of thinking and a common vocabulary.

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About the Author

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At the beginning of my Junior year I asked my mentors at the University of California, Berkeley, “What is required to train a modern generalist?” They said they did not know, and suggested I spend my Junior and Senior years in supervised independent study to answer that question. No one had a clue, so I had to go it alone. Two years were not enough, but no graduate school anywhere could train a modern generalist. After graduation, I began independent research on that question outside academia, although often employed by universities, which provided access to world-class libraries. Decades later I realized that the process of researching how to train a generalist had turned me into a modern generalist. What I had to do was identify the generalist modes of thinking I was using. A modern generalist is characterized by both breadth and depth of understanding, rather than quantity of knowledge that characterized the now impossible traditional form of generalist. As Bertalanffy realized, breadth and depth of understanding and the unification of knowledge can be achieved by way of isomorphies. Discipline-independent-transdisciplinarity is the inevitable consequence of asking the question, “What is required to train a modern generalist?” in the context of deep and broad understanding of isomorphies.