

THE STRUCTURE OF INTERDISCIPLINARY KNOWLEDGE: A POLANYIAN VIEW

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ABSTRACT

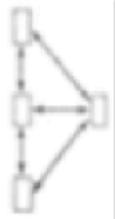
The five-part theoretical scheme that Erich Jantsch devised to describe interrelations among disciplines provides interdisciplinarians with a sound framework for interdisciplinary knowledge. However, when Jantsch introduces the concept of human purpose into the category of "interdisciplinarity," he departs from the foundational ground of structuralist epistemology and builds his scheme for both "interdisciplinarity" and "transdisciplinarity" without a foundational theory of epistemology. Support for Jantsch's scheme can be found in Michael Polanyi's theory of knowledge, since the two-level structure of Jantsch's "interdisciplinarity" is analogous to the structure of Polanyi's theory of tacit knowing. Comparison of these two theories of knowledge also demonstrates how interdisciplinary knowledge is the knowledge of new meaning created by the integration of concepts and ideas from different disciplines.

I

Over the past twenty years, many concerned scholars in interdisciplinary studies have made serious efforts to establish classifications for the complex relations among disciplines. As a result of their efforts, books and articles presenting comprehensive views on these issues are now available.¹ Anyone who reads these works, however, will immediately come to realize that there are various definitions of interdisciplinarity. Among these various definitions, the definition given by Erich Jantsch² invites serious attention from interdisciplinarians, because it provides them with a sound framework for the justification of interdisciplinary knowledge.

According to Jantsch, interdisciplinarity is one of five categories classified for the organization of interrelations among various disciplines. As one finds in Table I, Jantsch makes the definitions of all five categories very clear in logical terms. Not all scholars, however, agree with his definitions. For example, although Joseph Kockelmans basically follows Jantsch's five

Table 1: Steps for Increasing Cooperation and Coordination Between Disciplines

	General Concept	Type of System	System Configuration
Multidisciplinarity	A variety of disciplines are offered simultaneously, but without making explicit possible relationships between them.	One-level, multi-goal; no cooperation.	
Paradisdisciplinarity	Various disciplines are juxtaposed, usually at the same hierarchical level, in such a way as to enhance the relationships between them.	One-level, multi-goal; cooperation (but no coordination)	
Cross-disciplinarity	The axiomatics of one discipline is imposed upon other disciplines at the same hierarchical level.	One-level, one goal; rigid control from one disciplinary goal	
Interdisciplinarity	A common axiomatics for a group of related disciplines is defined at the next higher hierarchical level or sublevel, thereby introducing a sense of purpose. <i>teleological</i> interdisciplinarity acts between the empirical and pragmatic levels, <i>normative</i> interdisciplinarity between the pragmatic and normative levels, <i>purposive</i> interdisciplinarity between the normative and purposive levels.	Two-level, multi-goal; coordination from higher level	
Transdisciplinarity	All disciplines and interdisciplines in the education/innovation system are coordinated on the basis of a generalized axiomatics (introduced from the purposive level down) and an emerging epistemological ("Synapstemic") pattern.	Multi-level, multi-goal; coordination toward a common system purpose	

Source: E. Jantsch, 1972b, pp. 106-107

categories, he does not use Jantsch's terminology and definitions.³ Kockelmans explains that Jantsch, like Jean Piaget, presupposes "a certain concept of structuralism and genetic epistemology" which has "a limited applicability"; moreover, the philosophical assumption underlying the positions Piaget and Jantsch take "are not universally accepted."⁴ This explanation indicates the importance of the role of the philosophical position that one takes in defining interdisciplinary studies. In this article, I shall explore a theory of knowledge that makes a meaningful contribution to interdisciplinary studies, while also providing support for Jantsch's own theory. It is Michael Polanyi's theory of tacit knowing. First, however, Jantsch's own theory needs to be examined in greater detail.

II

Erich Jantsch originally presented his definitions of interdisciplinary studies in a seminar on interdisciplinarity in universities which was held in 1970 at the University of Nice, France. Jean Piaget also participated in this seminar.⁵ As mentioned earlier, Kockelmans identifies Jantsch's approach with that of Jean Piaget and other structuralists. But Jantsch claims at the outset that although he feels very much in resonance with Piaget's thoughts, he is "encouraged to venture out farther" and "leaves the platform set up by Professor Piaget's thoughts."⁶ This "venture out farther" is what leads Jantsch to distinguish his concepts of interdisciplinarity and transdisciplinarity from Piaget's. Jantsch introduces the concept of human purpose into his definition of interdisciplinarity. This is how Jantsch explains his point of departure from Piaget:

Professor Piaget speaks of causal relationships and he even calls them necessary, which seems to imply that these relationships are understood as being dynamic and that there is a telos, or even a purpose. But what is this telos or purpose of science? Is it inherent in an "internal evolution" of the science, as Professor Piaget seems to imply? Does this mean that the purpose is placed in God, or simply in Nature itself? Or -- and here is my point of departure from Professor Piaget's arguments -- is it not becoming increasingly clear that man, through science and technology, has become the principal cybernetic "actor" on our planet, that this attempt rationally to construct new and dynamically evolving ecological configuration also burdens him with the main responsibility for this purpose?⁷

Jantsch's five categories of interrelations among disciplines -- multidisciplinary, pluridisciplinary, crossdisciplinarity, interdisciplinarity, and transdisciplinarity -- are arranged in an ascending order, with transdisciplinarity placed at the top. The ascending concept implies an increasing degree of cooperation and coordination among disciplines as the categories move from multidisciplinary to transdisciplinarity. At the lowest category, which is multidisciplinary, there is zero degree of cooperation. Cooperation begins from the second category, pluridisciplinary, and continues to the highest degree in transdisciplinarity. If we read the definitions of the categories carefully, we notice that the concept of human purpose and coordination is introduced at the fourth category, interdisciplinarity; the highest degrees of human purpose and coordination are found in transdisciplinarity.

The concept of human purpose that Jantsch introduces at the category of interdisciplinarity is what is not found in the structuralist epistemology. In structuralism, relations among the parts of a whole are not understood to result from the activities of the conscious mind. Structural relations are the works of unconscious laws which cause the relationships to exist internally among the parts. This is what Piaget means by causal relationships. Causal relationships work inherently as organizational principles without human participation. Jantsch, unlike Piaget, recognizes human purpose, an activity of the conscious mind, at work in establishing relationships among the parts of a whole.

Setting up a framework for purposive knowing requires interdisciplinarity. Jantsch clearly states that "interdisciplinarity has to be understood as a teleological and normative concept"⁸ Interdisciplinarity is directed toward an end. Thus, disciplines involved in interdisciplinarity act as means toward an end; moreover, they are coordinated by this end. Jantsch calls the end a norm which is placed at the next higher level. Jantsch's definition of interdisciplinarity is given below:

A common axiomatics for a group of related disciplines is defined at the next higher hierarchical level or sublevel thereby introducing a sense of purpose; teleological interdisciplinarity acts between the empirical and pragmatic levels, normative interdisciplinarity between the pragmatic and normative levels, purposing interdisciplinarity between the normative and purposive levels.⁹

An interesting aspect in Jantsch's definition of interdisciplinarity is that interdisciplinarity, when taken as a whole, is structurally made up of two levels with the involved disciplines serving as the parts of a whole and a common

axiomatics at the next higher level serving to coordinate the involved disciplines. In crossdisciplinarity, the coordinating norm is determined by the norm of one discipline dominating another discipline. In actuality, this is not coordination; it is domination. Genuine coordination begins in the category of interdisciplinarity. In interdisciplinarity, the coordinating norm is placed at a higher level, higher than any involved discipline; so, it coordinates all the involved disciplines. In other words, there is an organic relationship among the disciplines involved in interdisciplinarity.

As mentioned earlier, in the ascending order of interrelations among disciplines, transdisciplinarity is placed at the highest level. The basic unit of transdisciplinarity is interdisciplinarity. In other words, the former is an expansion of the latter. As the diagram in Table I illustrates, within one overarching norm that coordinates all sub-norms of lower levels, there are multiple sub-norms, each of which coordinates the norms of the next lower levels. Strictly speaking, in Jantsch's scheme, since interdisciplinarity is the basic unit of transdisciplinarity, there is not transdisciplinarity without interdisciplinarity. The difference between them is the increased number of norms and levels. The structure of transdisciplinarity is the most complex of all categories. Since, however, all involved disciplines are organically related by an overarching norm, there is a sense of unity. Without doubt, transdisciplinarity is an ideal form.

Jantsch's scheme of five categories is logically well constructed. The category of interdisciplinarity, however, has a weak foundation, although its superstructure appears to be strong. How does this happen? It happens when Jantsch introduces the concept of human purpose into the category of interdisciplinarity, because he departs from the ground of structuralist epistemology and builds his scheme for both interdisciplinarity and transdisciplinarity without support from any foundational theory of epistemology. His categories need an epistemological foundation. I believe this foundation can be supplied by Polanyi's theory of knowledge.

III

The basic principle of Polanyi's tacit knowing begins from the fact that "we can know more than we can tell."¹⁰ What this means is that in knowing anything there is a tacit element which is not specifiable and explainable. In explaining the basic structure of tacit knowing, Polanyi recognizes two types of awareness: subsidiary awareness and focal awareness. This means that in the knowing process one attends from what is known to what can be known. In this case, what is known is a means which points to what can be known, which is an end. In the knowing process, then, one's attention is shifted from the means to the end. The end is the object of focal awareness, and the means,

which is now known only subsidiarily, is the object of subsidiary awareness. Polanyi regards subsidiary awareness as the root of focal awareness, and since the object of subsidiary awareness is known only subsidiarily, one's knowledge of it is not explicit. Taking non-explicit knowledge as the basis for explicit knowledge is bound to include a tacit element. That is why Polanyi says that all knowing is tacit knowing.

From the functional aspect of tacit knowing, subsidiary awareness moves in the direction of focal awareness. This aspect of tacit movement can be characterized by "purpose." When subsidiary awareness is directed to focal awareness, the purpose of the former is integrated into the latter. This is an ascending process which takes the two-level structure of tacit knowing as the basic unit with the object of subsidiary awareness at a lower level and the object of focal awareness at a higher level. The integration of both subsidiary and focal awareness is obviously done by the human mind. Thus, subsidiary awareness, focal awareness, and the human mind are the three co-efficients of tacit knowing.

Jantsch's recognition of purpose in his definition of interdisciplinarity is very significant when it is interpreted in terms of Polanyi's epistemology. The two-level structure of Jantsch's interdisciplinarity, with the teleological norm at the higher level, is analogous to the structure of Polanyi's tacit knowing. Although Jantsch does not recognize the role of human purpose in the categories below interdisciplinarity, Polanyi includes it in all forms of knowing. According to Polanyi, there is no knowing without the participation of human consciousness in the knowing process.

The fact that knowing is purposeful now brings us again to the parts and whole concept of human knowledge. Epistemologically, from the Polanyian perspective, a whole is new knowledge created by the integration of concepts and ideas which were not formerly connected at all. These concepts and ideas may come from different disciplines. When concepts and ideas from different disciplines are integrated, they create new meaning and the knowledge of this new meaning is interdisciplinary knowledge, which one gains, according to Jantsch's scheme, in the category on interdisciplinarity. To be more specific, interdisciplinary knowledge is formed when concepts and ideas well established within their respective disciplines are integrated for the creation of new meaning. For example, in dealing with an environmental problem, if one brings ideas respectively from ecology, public health, and sociology, then integrates them to find a solution, the solution is new meaning. The knowledge of this solution, which is also the knowledge of new meaning, is interdisciplinary knowledge.

The solution, or the new meaning resulting from the integration of ideas from different disciplines, is equated, in Polanyiian terms, to a whole. In this case, ideas from different disciplines are subsidiary parts, and the solution is a focal whole toward which the former is integrated. The integration is achieved, in Jantsch's terms, by human purpose with a teleological norm which coordinates ideas from different disciplines.

In the structure of Polanyi's theory of knowledge, a solution, a new meaning, and a whole are all found objects of focal awareness which exist at a level above the objects of subsidiary awareness in the knowing process. In Jantsch's category of interdisciplinarity, they are found as teleological norms. With the ascending direction that Polanyi's concept of tacit knowing takes, meaning (a solution or a whole) itself can also become a subsidiary part when it is used to search for another meaning at a higher level. For example, if a monetary theory, which acted once as a solution to an economic problem, is now used to search for a comprehensive national policy, along with other political and sociological theories, the monetary and the other theories take the role of subsidiary parts as the comprehensive national policy becomes the object of focal awareness. In such a case, these theories which were once wholes in their respective disciplines now become sub-wholes for a new focal whole which is found at a higher level. Basically, this is the phenomenon that takes place in the formation process of a whole in Jantsch's theory of interdisciplinarity. If this process continues to a higher whole using the wholes of interdisciplinarity as subsidiary parts, the development of transdisciplinarity will take place. The transition from lower wholes to a higher whole, from lower meanings to a higher meaning, which is found in Polanyi's theory of knowledge, is analogous to Jantsch's movement from interdisciplinarity to transdisciplinarity.

Since interdisciplinary knowledge is formed on the basis of wholes which are already well established in disciplines, it takes place at a higher level than disciplinary knowledge in the ascending process of knowing. In order to comprehend this phenomenon, one has to understand the fundamental level where knowing is first formed. According to Polanyi, knowing begins with a single whole which is primarily made up of the clues gained from sensory experiences. Therefore, tacit knowing begins with our body, because senses are part of our body and because in knowing anything around us we use our body as our instrument. We use senses to know things outside our body. That means we use many functions of our body as subsidiary particulars to know the things outside our body. This principle applies to the next step of tacit knowing; that is, the things that are known by the senses of our body are now used as our body. They are used as extensions of our body. The use of probes is a good example. Practically all tools, when in use, function like our body: a hammer like our hand, glasses like our eyes. If we move from these tangible "probes"

to intangible ones, such as ideas, concepts, theories, and views, we find that they function by the same principle of subsidiary particulars as our body functions. They are mental tools as our body is a physical tool. If we accept the principle that knowing begins with the use of our body as subsidiary particulars, we can now say that interdisciplinary knowledge formed by the use of established disciplinary ideas and concepts takes place at a higher level in the ascending process of knowing.

IV

From the Polanyian perspective, the knowledge of a new meaning as interdisciplinary knowledge is also considered to be the knowledge of a new reality. How can this be so? How is new meaning related to a new reality? As explained in the preceding section, in the Polanyian theory of knowledge, a new meaning is equated to a new solution and a whole. A solution is, strictly speaking, the discovery of a new reality, and since a solution is equated to a new meaning and a whole, it is not difficult to understand how a new meaning can be related to a new reality. Although the concept of new reality is not epistemologically related to the structure of interdisciplinary knowledge itself, it is an important concept that gives interdisciplinarians direction for examining and making decisions on human issues in general and academic problems in particular. In this sense, interdisciplinary knowledge is inseparably related to the knowledge of a new reality.

In this concluding section, attention will be focused on Polanyi's concept of reality and then on Polanyi's rejection of the positivist approach to the search for truth that is found in academic communities today. From the Polanyian perspective, a whole represents a new reality. One of the basic beliefs that Polanyi holds is the following: a whole is more than the sum of its parts. If a whole is the exact sum of its parts, it cannot be a new reality. If it is a new reality, the parts must have inherent qualities that change the parts internally. In general, this is what positivists believe. Polanyi does not accept this theory because of his belief that without personal participation in knowing no meaning can be established. According to the positivist theory, all manner of things can be determined by the same laws controlling the ultimate elements of the parts. In other words, since inanimate things mostly constitute the world, the laws governing inanimate things should also govern all animate beings, including human beings. This is what scientists have believed traditionally and many of them still believe so. According to this theory, basically there is no hierarchy of beings in the world. Ultimately, animal and human beings are the same. Polanyi believes human beings and animals are different in terms of the creative power inherent in human beings for the creation of new meaning for their lives. Human beings aim beyond themselves to their ideals, which animals do not. Because of this very aim, a whole is a

new reality.

This aim is the human purpose that Jantsch recognizes in his definition of interdisciplinarity and that Polanyi recognizes in the direction of moving from subsidiary particulars to a whole in tacit knowing. The aim is for achievement. Without an aim there is no achievement. Polanyi explains the difference between the inanimate and the animate in terms of the aim and its achievement. Inanimate things have no aim and achieve nothing. Thus do we discover the laws of chemistry and physics that govern them. But all living beings achieve something. The aim and purpose of living beings in lower levels is basically to survive. Survival is their achievement. They use their bodies as tools for this achievement. There is a tacit system working in them and thus the achievement is a whole and a new meaning which cannot be found in inanimate things. The laws of chemistry and physics cannot explain this phenomenon. This is what Polanyi says: "The task of physiology is to explain the achievements of living beings. Physiological mechanisms are based, like machines, on the laws of physics and chemistry, but they are not accounted for by these laws."¹¹ This is due to the fact that mechanical principles are basically different from the laws that govern the inanimate materials made for the machines. But, as long as chemical materials constitute living bodies and serve themselves toward the achievement of the life of living beings, the laws of chemistry and physics are, we can say, made to serve the physiological mechanisms of living beings. These laws serve by explaining the constituting inanimate parts but not the achievement. In order to explain the achievement, which is a whole and a new meaning, another principle needs to be brought in, the principle of a higher level. What I am trying to say is that interdisciplinary meaning cannot be explained entirely by the principles that govern disciplinary parts. In interdisciplinarity, as already explained, disciplines themselves serve as subsidiary parts for the creation of interdisciplinary meaning.

Polanyi recognizes the gradual progression from lower to higher levels of living beings, which means that the levels of their achievement change. Therefore, the way for us to understand and acquire knowledge of these living beings of different levels also changes as we move from lower to higher levels. Polanyi explains this phenomenon as follows:

The progression from lower to higher levels of individuality involves a fundamental change in the relation between the observed individual and ourselves as observers. When comprehending the lower levels of life in an individual, we ascribe success or failure to it by standards which we deem appropriate to its kind. Throughout the usual compass of biology, we find this relation between the observer and his

subject: he is always critical of it. But as our study, ascending to higher levels, reaches that of man, criticism becomes mutual; the subject of our study now criticizes us, just as we criticize it. Nor is this the end of the progression: our subject may ascend still further and become our master. We then become apprenticed to our subject and learn to accept its criticism of ourselves.¹²

What this passage says is that searching for the meaning of human life moves from the lowest level of inanimate things to the highest level of human ideals. Academic institutions divide our study of inanimate things and human ideals into disciplines, on a narrow scale, and into divisions, on a larger scale, like natural sciences, social sciences, and humanities. In reality, however, these disciplines or divisions are all related by the fact that they serve for the creation of newer wholes, newer meanings, and newer realities. There are hierarchies in the progression system to the highest aim of human life. The highest aim will be the universal ideal that is the universal whole constructed upon the coordination and cooperation of the multiple levels of interdisciplinary units. This is the aim that we find in Jantsch's definition of transdisciplinarity, but it has to start from the lowest level of the knowing process. In the past several decades, discipline-oriented studies have accomplished a marvelous achievement. They cannot, however, stop at that level. Their achievement has to be recognized and used in interdisciplinarity for realizing the higher aims of human life.

I have said many times in this article that interdisciplinary knowledge is the knowledge of a new meaning created by the integration of concepts and ideas from different disciplines. As long as the concepts and ideas are understood in the context of their respective disciplines and integrated as subsidiary particulars for the creation of new meaning, there is interdisciplinary meaning and the knowledge of that meaning is interdisciplinary knowledge.

Human beings cannot stop searching for the creation of new meaning which, according to Polanyi, is also the creation of new solutions to problems, new realities, and new wholes without which we cannot survive as human beings. Interdisciplinarity is simply a necessary means for achieving this aim of human life. It will take a long time to achieve the transdisciplinary ideal. We may not achieve it, but we cannot divert our attention from making an attempt toward the achievement of that aim. At that moment we stop, we lose sight of the meaning that makes human life truly worth living.

NOTES

1. For a comprehensive bibliography on interdisciplinary studies, consult Julie Thompson Klein, "Interdisciplinary Literature," Perspectives, The Journal of the Association for General and Liberal Studies, Vol. 19: No. 3 (Fall 1984), 36-47.
2. Erich Jantsch, "Toward Interdisciplinary and Transdisciplinarity in Education and Innovation," Interdisciplinarity: Problems of Teaching and Research in Universities, eds. L. Apostel and others (Paris: Center for Educational Research and Innovation, OECD, 1972), pp. 97-121.
3. Joseph J. Kockelmans, "Why Interdisciplinarity?" Interdisciplinarity and Higher Education, ed. J.J. Kockelmans (University Park, Pa.: The Pennsylvania State University, 1979), pp. 122-159.
4. Kockelmans, p. 126.
5. Professor Piaget's article is also found under the title "The Epistemology of Interdisciplinary Relationships" in Interdisciplinarity: Problems of Teaching and Research in Universities, pp. 127-139.
6. Erich Jantsch, "Toward Interdisciplinarity and Transdisciplinarity in Education and Innovation," p. 97.
7. Jantsch, p. 98.
8. Jantsch, p. 103.
9. Jantsch, p. 106.
10. Michael Polanyi, The Tacit Dimension (Garden City, N.Y.: Doubleday, 1967), p. 4.
11. Michael Polanyi, "Science and Man in the Universe," Science as a Cultural Force, ed. Harry Woolf (Baltimore: the John Hopkins University Press, 1964), p. 67.
12. Michael Polanyi, Knowing and Being, ed. Marjorie Grene (Chicago: The University of Chicago Press, 1969), p. 136.

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