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Ontological Geometries: The Phenomenological Shape of Experiences

תקציר

כאשר אנו מתייחסים לעולם הסובב אותנו אנו נוטים לעשות זאת באמצעות חלוקתו לתת-היבטים, למרכיבים יסודיים יותר או לאונטולוגיות. בחינוך, הדבר בא לידי ביטוי כאשר אנו מחלקים את הידע לדיסציפלינות אקדמאיות, לרמות מותאמות גיל וכיו״ב. מאמר זה בוחן את האופן שבו ניתן להתייחס ביעילות ללמידה ולחינוך באמצעות מונחים של תת-ההיבטים של אותן תופעות שקיימות בהקשר זה, תוך הצגת הסבר תיאורטי על מהותן של תופעות אלו. בנוסף, מציע המאמר התבוננות ותובנה לאופן שבו ניתן להבין תת-היבטים של תחום עניין, המוסברים הן כיחידות איכותניות הן כיחידות כמותיות, וכיצד ניתן לשלב אותן כדי לשקף את התרחשותן של התופעות וההתנסויות בהקשר של עולם אמיתי. המאמר טוען ומדגים כיצד ניתן להציג ולתאר תופעות והתנסויות שונות כבעלות תצורה גיאומטרית, וכן שתצורה גיאומטרית זו כוללת בתוכה את התפקידים ותת-היחידות של התופעות וההתנסויות הפועלות, לתובנות כמו: אירוע, התנהגות, תופעה פסיכולוגית וכו׳.

המאמר מבוסס על התיאוריה של תורת השטחות, וסוקר את הקריטריונים הנחוצים של התיאוריה: האופי של השטחות, מרכיביהן ושילובן.

כמקובל בתורת השטחות, המאמר מראה כיצד ניתן, בעזרת משפט המיפוי, לספק מידע רב על רכיבי המחקר ועל תוכנו.

מילות מפתח: אונטולוגיות, התנסות אישית, תורת השטחות, משפט מיפוי.

Introduction

When we think about the world around us it is easy to identify many problems and tragedies. Examples of these include, the war in Ukrainian, the issues and effects associated with climate change, poverty and inequality, the erosion of democracy, and the list goes on. It is of course also possible to identify many positive issues, such as developments in technology, increasing gender and racial equality (although these are happening far too slowly and in a fragmented manner), etc. What I am going to argue in this essay is that each of these concepts and events is best understood in terms of their ontology and mereology. I make this claim because it seems to me that cardinal to these events are how we conceive of the world, our worldview and how we believe the world is at a fundamental level. Moreover, we conceive of the world around us as existing as interacting parts or sub-components and we understand these sub-units within the framework of how we divide up the world to make our understanding of our lives easier to manage and communicate: How we understand and label the world in highly influential in how we communicate our understandings of the world, how we teach and how we learn. Our ontologies are also how we construct edifices of exclusions, discriminations and advantage. Racism, gender based discrimination, ageism, etc., are mereological and ontological concepts. The ontologies we construct, where ontologies are the basic building blocks of our existence, may allow us to escape notions of truth and fact and to replace these with our own ontologies of difference and unity. These mental phenomena are socially constructed realities or socially constructed ontologies with their associated socially extant mereological interconnections. These are the meanings that we create, the realities we construct in order to make sense of the lives we live.

As well as constructing ontologies and living our lives through ontologies, we try to understand our ontologies and share these with other people. We use words to describe our ontological constructs, words that describe our worldview and its components, what is important and why and also our understanding of how the conceptual parts of our worlds come together. Our thoughts and feelings exist within ontologies as well as describing them. Ontologies, such as those by Aristotle and Ackrill (1975), Hackett (2018) and Lowe (2007), are categorial systems with components that are linguistically arranged within texts. We describe ontologies in terms of their linguistic components (words and phrases) and we arrange these components to suggest the experientially meaningful total of ontologically defined existence. These language-based arrangements, I argue, can be understood as having an implicit geometry that organises aspects of the mereology of an ontology in space and that these geometries are central to the meanings that are embodied within the in the ontological categories. For example, Aristotle locates his ontological categories within a list, whilst Lowe locates his categories in a two by two tabular configuration. These spatial arrangements are important aspects of the mereological constitution of their respective ontology as they suggest how Aristotle and Lowe understood the category components to exist in relation to each other: The units within Aristotle's list interact differently to the units in Lowe's two-by-two table. Thus, at the fundamental level of the basic categories of existence there is a geometry of meaning.

The Shape of Individual Experience

So far I have been talking about the basic aspects of our worldview or the fundamental components of existence (ontologies) and I have claimed that our worldviews are componential and maybe be more clearly understood through geometric arrangements of their parts in order to convey and embody meaning. Graphical, geometric, visual forms may also convey meaning in regard to other, perhaps less-fundamental and more mundane, prosaic or banausic aspects of our lives (less fundamental than Aristotle's and Lowe's expatiations upon the rudimentary stuff of existence), which may also be understood categorially. It is of course foolish to think that thought, experience, emotions or other psychological and behavioural events and phenomena have a physical geometric shape. These phenomena are amorphous and often highly temporal, fleeting happenings. This point is made clear if you think about how you experience the laptop you may be using at the moment to read this article and then ask yourself questions such what shape is your reaction to laptop? What is the geometry of the relationship between the apps you use and the weight and texture of the laptop’s casing? Of course, we can label a reaction using what are perhaps hackneyed cliched phrases, such as saying "my laptop is square" meaning you consider your machine to be outdated. However this is not what I am talking about when I ruminate on the shape of experiential phenomena. Instead, I am asking if there is a manner in which geometric shapes and configurations may be employed in order to explicate the meaning of such an event for the person who is experiencing this and to communicate, teach or to facilitate learning about this phenomena to someone else?

My answer to this question is in the affirmative and in the writing that follows I will be expanding upon my answer and providing examples to support my assertion in the form of geometric declarations. However, before I go on to talk about such declarative statements I want to lend further support to my claims of the utility and pervasive everyday nature of geometries in the communication of experience by asking you to consider the fact that we very frequently use geometric and spatial metaphors or analogies. We use expressions such a "I have been going round and round the problem in my mind" (a circular metaphor) or "I have started thinking about the problem from the start and continued until the end" (a linear metaphor) and "I have come at the problem from all sides" (a polygonal metaphor) and "I have boxed myself in" (a cubic metaphor). We also use spatial metaphors in a more generic sense rather than implying a specific shape, for instance when we say, "I am going to map out my diet for the week" or "we use a process of gene mapping". In all of these examples, and in countless others, we used a geometric or spatial analogy to help us understand for ourselves, and to communicate learning to others, a mental process that is essentially shapeless.

I hope that I have demonstrated that spatial and geometric metaphors and analogies do indeed have the ability to convey a sense of what we feel or think is happening in regard of psychological and experiential processes. Having briefly commented upon the above points I will now introduce a methodology and philosophical orientation from within the social sciences that has employed spatial representations, namely facet theory.

Facet Theory and Facet Structures: the Basis of Metaphor

Facet theory is a research approach from within the social sciences. It originated as a solely quantitative methodology (Guttman, 1968, Canter, 1985) but has been refined to facilitate use as a qualitative and philosophical device (Cowle and Hackett, 2021; Hackett, 2021 a,b&c, 2020, 2019, 2018, 2016a, 2014; Hackett and Fisher, 2019; Hackett and Gordley-Smith, 2022a&b; Hackett and Li, 2022; Hackett and Lustig, 2021). When addressing research questions and research domains that embody complexity, the facet theory approach hypothesises and clearly identifies multiple aspects (facets) of such a domain as being pertinent to the phenomenological experience of that domain. The domain of teaching, education and learning are obviously complex and require a philosophical and methodological orientation that is able to capture such intricate multi-component reality.

The researcher using facet theory employs a stringent procedure to explore the content (elememnts) of the sub-aspects (facets) of the domain of interest and the relationships between facets/elements and the domain as a whole. The hypotheses regarding relationships between facets and elements is stated in the form of a sentence written in ordinary language in which the facets are incorporated in a manner that suggests their expected or hypothesised interrelationships. These sentences are called mapping sentences and will be discussed after a brief consideration of facets and elements.

Ontological Roles of Facets and Elements

Facets are the major sub aspects of a domain of interest. A very simple example of this is demonstrated if we consider a lecture series. This may be divided up into sub-components, each of which is of a certain degree of specificity or generality. The notion that underlies facet theory is that complex domains that are of interest to scholars may be made more readily understandable through reduction of the domain into meaningful parts. If we return to the lecture series, it is possible to reduce the course of lectures to all of its individual components including, for example, each individual lecture, the slides used by the lecturer, printed materials, audio-visual aids, students' and lecturers laptops, background reading, homework, class activities, etc. However, this does not provide complete understanding of the lecture series as a whole and as experienced by either teachers or students. It must also be remembered that if we are interested in a lecture series we probably are interested in this as functional entities, as things that provide education for people within a classroom or remotely. That is to say, our interest is broader than the assembly of a list of components that make up a lecture series. Therefore, in order to better understand a lecture series we may attempt to identify the major sub-aspects of the series and then to divide these into further sub-aspects to allow us to more clearly comprehend the this.

In the above example of a lecture series, as in all research that is attempting to understand a complex domain of interest, the first major question that the researcher must address is: what are the appropriate major sub-aspects of a phenomena of interest?[1] In our example, we may decide, after reviewing the literature on research into lecture series and their implimentation, and subsequent to discussing series of lectures of

1 This is one of the perennial questions of classical ontology.

several kinds with different people or gathering information about lectures in some other ways, that the major aspects (these aspects are called facets) of cars are the: the syllabus; the lecture slides; textbooks; the skills of the lecturer; student/lecturer interactions. This is list is meant for illustrative purposes and you will almost certainly be able to divide a lecture series into other more appropriate facets. However, in order to be useful sub-aspects of a lecture series, (useful in the sense that analysing a series in these terms will produce information about a lecture series that is able to resolve our questions about lectures and their ability to facilitate learning in students), rather than information about some other entity, these facets should approximately fulfil the following criteria:

- a facet is a necessary part of the whole
- a facet is not part of another facet
- all facets are required within the whole
- a particular facet is understood as a particular facet within a particular whole

Whilst I am addressing the specific facet structure of a lecture series it is important to note that the above criteria are exist for all facets in all situations or domains. In addition to identifying these major sub-aspects of a domain, the facets are also broken down into their meaningful sub-aspects (known as elements) and as well as facets needing to approximately fulfil a series of requirements the elements within each facet have to approximately meet these criteria:

- each element is a necessary component of its facet
- each element can only be an element of a single facet
- if a similarly named element exists in other facets this is a separate element in each of its occurrences
- a facet element is understood as a specific element within a specific facet
- elements are relatively independent within a facet
- all elements are required within a facet

It is also important to note that facets and elements have some fundamental relational properties. These are that:

- if an element is part of a facet then the facet cannot be part of an element
- if an element is part of a facet then there is part of that facet that contains no part of that element
- an element is an ingredient or component of a facet if the element is part of the facet or if it is the facet

It should be noted that the instantiation of the of final part this third relationship (if the element is the facet), is rarely the case of facets that contain the content of a research domain as this would have the effect of holding the facet as a constant aspect of that domain and as such would yield little information about the domain. Consequently, it would be advantageous to think of this form of content facet as a background facet, that is one that sub-divides membership to content facets.

Furthermore, there are similar relational properties between facets and domains:

- if a facet is part of a domain then the domain cannot be part of the facet
- if a facet is part of a domain then there is part of that domain that contains no part of that facet
- a facet is an ingredient or component of a domain if the facet is part of the domain or if it is the domain

Again, with the final part of the third relationship, this time between facets and domains, the relationship is problematic as it implies domain non-divisibility which is theoretically non-problematic but the instantiation of which is unlikely.

I have presented the notion that our experiences within our daily lives are complex and that this intricacy may be conceived more clearly by dividing this into its major parts and then further dividing this into more differentiated parts. However, the different aspects of our experiences are not all the same. For example, the way we conceive of an activity in a classroom that is designed to encourage students to develop original and personal ideas will be of a different kind of conception to that involved in attempting to transmit historical dates. In the next section I will address the nature that the sub units of our experiences may take.

Main Forms and Roles of Individual Facets and their Elements

In the preceding sections I have provided very basic details in regard of facets and elements. In the next section I will turn to talk about the roles that facets and elements may play and the forms they can take and how it may be useful to geometrically portray these experiential units. The first point that I have made is that facet roles constitute a rudimentary ontology of the domain of interest and that there are a limited number of roles that a facet can play. These are: axial (Hackett, 1995), modular (Meyer Schweizer, 1993), and polar (Levy, 1981). Of these three roles the first two incorporate a sense of order and embody an ordering of the phenomena and which may be represented in a way that demonstrates an order of their content. Whether a facet possesses either one or the other of these two configurations will be determined by the manner in which the facet interacts in the domain of interest with other facets, or indeed if the facet does interact with other facets. Let us first consider the axial geometry.

A single straight line is the simplest way to understand the nature of a phenomena and how aspects of a phenomena are related to each other. A simple linear geometry is called a simplex and results when phenomena are understood as being of more or less of something. An example of this is present in the colour spectrum in which colours are linearly positioned according to their wave lengths from violet at the one end to red at the other.

However, a circular configuration can also be conceived of and this is called a circumplex. An example of this configuration is provided if we think about the same colours as we did immediately above. The colours can be arrange in the colour circle in which the indigo and red colours meet and the linear arrangement becomes a circle. The example of the linear simplex arrangement represents the physical properties of the light in the spectrum whilst the circular arrangement shows an abstract illustration of the organisation of colour hues demonstrating the relationships between primary, secondary and tertiary colours.

In considering facet structures I have commenced with a geometry that is of single facet of which there are the two possible structures noted in the above example of colour, a linear and a circular geometry know respectively as a simplex and a circumplex (Guttman & Guttman, 1965). The fact that there are only two possible two-dimensional structures makes sense as it is hard to conceive of other arrangements. It should be noted that the linear arrangement of a phenomena (I am speaking here in a general sense and not about colours) may not be perfectly straight and may be wavy or distorted. Indeed, instead of thinking about the linear arrangement of a single line the simple linear configuration may be envisioned as a series of planes or layers stacked upon each other as in a layer cake. However, if we conceive of linearity in terms of layers then this asks the question as to what causes a phenomena to be experienced in terms of the breadth of each layer and this then becomes a two-dimensional (or two-faceted) depiction of semantic space rather than a simple linearity. Nonetheless, the important feature here is the arrangement is in terms of the extent or richness of a quality or quantity.

If we think about a specific aspects of life, and especially those in education, behavioural events, states of affairs, phenomenon, psychological circumstances and so on, it is immediately apparent that these may be understood and evaluated in a variety of ways and that different people will employ different constructs in their understanding and evaluations. However, as illustrated in the preceding example, there are two main forms of understanding and consequently two main types of facets: ordered (linear)and non-ordered (non-linear). To elaborate on this, a given construct may contain a degree of evaluation that implies that events are understood as being more or less something. In this case phenomena are ordered by this something. A simple example of this form of understanding is temperature. In this situation a person will understand an event as possessing more or less warmth and they will understand places, for example, as being more or less warm and will be subconsciously or consciously arrange these places along a simple linear continuum. Another form of understanding employs a non-ordered differentiation. An example of this would be types of fruit where different types of apples are seen as similar to each other but distinct from oranges or pears: fruits would be arranged into unordered regions. Below I expand my illustrations of the spatial geometries of experiential phenomena by considering the phenomenological roles that facets may embody.

Axial Role – Simplex

The first facet role I consider is one that is present when the understanding that surrounds the phenomena that the facet is representing exists separately to other facets within the specified domain. Axial representations form a geometry that divide space into distinct parallel strips or regions that run from more of something to less of that something. The simplex, as its name suggests, is the simplest form of arrangement or shape that information can possess. This shape is a simple linearity along which phenomena, situations, events, etc., are positioned such that the degree of similarity between these is reflected in their linear proximity (Gabriel, 1954; Runkle and McGrath, 1972). Items or events progress from one extreme position to an opposite extreme. In a simplex, adjacent phenomena are more alike than more distant phenomena.

An example of a simple simplex configuration is provided in a description of ordered facets in the context of educational testing. Here, intelligence tests were developed to test intelligence and other abilities that were of increasing complexity and where each the underlying rational for the tests was that successive test required of an examinee to complete all that the previous test required, plus something more.

Guttman demonstrated that if the content of tests was kept constant and addressed, for instance, arithmetic test items that varied only in terms of how complex the content was, such teats tests could be simply ordered along a simplex from least to most complex.

Modular Role – Circumplex

The second of the ordered facets is the modular facet. The role played by a modular facet is very similar to that of an axial role in that it arranges phenomena along a simple ordering. However, modulation involves an interaction with another facet where this interaction, if it is with a non-ordered facet, can be geometrically represented as concentric circles. If the interaction is however with another ordered facet the combination forms a square grid. In the former of these facet combinations the arrangement of the modular facet stretches from the centre of the circles to the rim. In the latter the two facets intersect orthogonally. The non-ordered configuration arises due to events that are understood as being more similar or general in terms of the facet's content are clustered together at the centre of the geometry, whilst dissimilar or individualistic events are located at or towards the periphery. That is to say, events or phenomena located spatially in outer regions are comprised of a similar content to the events in more central regions but they also comprise of an added complexity that differentiates them from other items. In the latter case of two ordered facets interacting the facets meet orthogonally and create a two-dimensional space.

A facet with a circular configuration may be oval, triangular, polygonal, irregular… but the important point is that there is a single line that has ends that meet and opposing and adjacent locations possess relationships of difference and similarity respectively. As I have already described, in facet theory the circular arrangement is called a circumplex (Martinez-Arias, et al, 1999).

In a circumplex arrangement there is no start or end to the arrangement as is present in the simplex. Instead, categorial of event, or events themselves, are distinguished as similar to each other (in some cases) and different from each other (in other cases). Imagine for example if we asked school pupils to rate animals of different species on a series of attributes and if these attributes were not linear measurements, such as size or weight, but categorial characteristics such as colour and other sensory or experiential information, then animals would be expected to be arranges using some non-linear construct: That is to say, the arrangement may approximate a circle. A way of thinking about the circumplex is as a circular shape that results when the linear extremes of a simplex are themselves highly similar and are those closely positioned. In quantitative research the circularity arises because the correlations in a correlation matrix are at their highest along the diagonals and at the corners and at their lowest in the centre of the matrix (Brown, 1985).

An example of a circumplex is provided in Guttman's task facet (Guttman, 1980; Guttman, et al, 1990; Levy, 1985). He discovered a modular role facet to exist in his analyses of the content domain of intelligence. In his geometric analyses he discovered that test items that needed the person taking the test to perform an inference task were usually positioned within the innermost circular region of the plot. He also found there to be an intermediate circular region within which tasks that needed respondents to execute a rule based procedure were located. An outer circular region was also usually present made up of tasks that required, in their performance, for rules to be learnt. Dancer (1990) noted how the innermost central region possessed tasks that were more highly intercorrelated than were items in the outermost region. She further noted that all pairs of adjacent items that are positioned at about the same distance from the centre of the plat will have approximately similar degree of association. It may be noted from that Guttman's analyses have the important implication that when a pupil is inferring a rule that this task is more general in its nature than when the pupil applying a rule which is more general than learning a rule. Furthermore, these three types of tasks are distinct.

It is possible to interpret the simplex and circumplex geometric shapes as a graphical or pictorial illustration of the domain that is being investigated where this configuration is understood to demonstrate linearly ordered or circularly arranged relationships between the sub-aspects of the domain of interest. Having commented upon the two ordered forms of understanding a person may employ when they are considering a domain of interest, I now turn to the non-ordered polar role.

Polar Role

In the axial and modular facet there are inherent understandings of there being more or less of a particular phenomena present within how a person understands and differentiates their world. However, another type of assessment may be undertaken which allocates phenomena differentially dependent upon them being distinct from each other but not ordered in terms of an amount of something. For example, as I am typing this page I can see birds in my garden and I understand these to be of distinct species: a mourning dove, northern cardinal, black-capped chickadee, American crow, common grackle, etc. I understand these events to be species that are different from each other but not in terms of any measurable quantity. In this case the facet of species of bird is performing in a polar role which allocates aspects of my world qualitatively to non-ordered geometric regions.

The regions of a polar facet are wedges in space, rather like a pie-chart, and events are arranged due to a non-measurement based criteria, but rather because of an unordered semantic property of the event and there is likely no a priori hypothesis or reason for the allocation of events within space. In my example of bird species, I do not know how different bird species would be arranged and which species would be adjacent and which further apart. It is important here to stress that I am not here speaking about arranging birds by some specified criteria such as their size, as this would be an arrangement and understanding of the size of birds and not of birds per se. Bird size, on the other hand, would be a simply ordered facet arranged from small to large (black-capped chickadee, northern cardinal, mourning dove, common grackle, American crow). However, close examination of the arrangement of events with the configuration of a polar facet may reveal criteria for the allocation of events to geometric spatial regions. This is because events that are understood as similar are positioned adjacent to one another but not in terms of a previously specified construct.

If we consider the polar role facet within the educational context, an example of such a facet is given by Guttman (1980). He has a polar facet within his analyses which demonstrates that in a testing situation the language of the communication of the test divides into the elements of verbal, numerical, and geometrical language and that these are arranged as a circular configuration playing a polar role. That is to say, the analyses demonstrate that the language aspects of a test differ in terms of the kind of language employed rather than some form of degree of language competence. Furthermore, Dancer (1990) notes that given this arrangement of task items it can be stated that geometrical language requires of the test-taker something in addition to what is required in verbal language tasks and that the three types of language used in the test are rudimentary unordered categorial differences.

I hope that by now the reader understands my assertion that facets are the ontological building materials of our understanding of the world, where the structural arrangement of a facet and elements has a limited number of possible geometric arrangements. I have briefly touched upon how a plurality of facets may interact and that these combinations become two-dimensional or three-dimensional representations of two- to n-dimensional arrangements that incorporate multiple facets. In the section that follows I will consider these structure in more detail.

Multiple-facet configurations: two facets

Above I have provided examples of how events or phenomena can be understood in terms of a single aspect of, or variable associated with, the event (an example of this is the linear physical properties of colour). However, it is immediately obvious that whilst a domain that is being scrutinised may be usefully understood by considering the individual aspects or variables associated with this domain much more information and understanding may result from considering multiple parts of the event together. I therefore return to the mereological nature of interacting aspects of experiential events. Consideration of how it is possible to conceive and visualise a structural mereology is of great importance to the researcher as the interaction between different variables associated with the domain provides richer forms of information than is provided by considering isolated individual aspects or variables. This statement is supported by the fact that when multiple aspects of a phenomena are considered together these units will typically interact and produce combined effects. For instance, if I look at a painting there are many aspects associated with how I experience the painting. If I simply concentrate upon aspects of the work of art itself, rather than the place it is on display, characteristics of the viewer, etc., there are many discrete experiential components of the work such as: colour, perspective, figurative/abstract, tone, texture… and many more. A very interesting study may be conducted that looks at how colour impacts upon and influences the viewer. However, as colour is not experienced in isolation in the real world setting of a gallery, a book, print, etc., this study provide us with very limited understanding regarding the experience of the painting and it is obvious that colour, tone, hue… all interact to constitute the experienced painting (see Hackett 2013, 2016b, 2017a&b; Schwarzenbach and Hackett, 2015, for details regarding how I have used facet theory and the declarative mapping sentence to elucidate the experience of two and three dimensional works of art and art education).

If we return to the main topic of this essay, the shapes of mereological experiences, geometrically such interacting aspects of any phenomena may be illustrated through more complex structures or shapes than the simplex or circumplex. In the facet theory literature, more complex geometries are known as higher-order structures. These shapes or arrangements may be composed of two or more facets in combination and I will start my consideration of these with the relatively rudimentary structure known as a duplex. The duplex is the configuration that arises when a pair of simply ordered aspects of a phenomena (when two simplex arrangements) interact such that this may be represented by their meeting orthogonally (Elizur and Shye, 1976). In a duplex, the aspects of the phenomena that are interacting are relatively distinct from each other. Another multi-aspect structure is the radex. The radex structure (Guttman, 1954, Shye, 2009) arises from the intersection of two rudimentary arrangements of facet elements, which in this case are a simplex and a circumplex (Lingoes and Borg, 1977).

In this section I have spoken about the shapes that may be taken by two interacting aspects of a phenomena. However, it is possible to determine the shape that arises when three aspects of an event are simultaneously or conjointly considered.

Multiple-facet Configurations: Three Facets

There are multi-facet structures that are made up of three facets, for example, the cylindrex and triplex. The cylindrex is composed of two or more radex structures that are stacked one above the other (Brown, 1985). This structure comes about when an understanding that embodies the extent or amount of a phenomena (a simplex) combines with an understanding that encompasses unordered differentiation (a circumplex) forming a radex and the radex is independently associated with, or present at, a series of different levels of another ordered facet (see, for example, Hackett, 1995). The triplex is also a three-facet structure. However, in this situation the phenomena that is under scrutiny is understood through the combination of three aspects or facets that are all ordered by the amount of relatively independents facets or aspects of (simplexes) of the event (for example, see: Borg and Mohler, 2011).

The above higher order structures (and other facet combinations that have not been presented in this very brief review) constitute complex spatial understandings that are the combinations to the more rudimentary forms of understanding that are present in the two-dimensional structures and are related to Guttman's work (Hildebrandt, 1986). One strength of employing visual structures in research is that elegant models of quite complex relationships can be developed. As well as developing geometries that demonstrate how facets interact in the situation of their occurrence, it is possible to linguistically represent these arrangements in the form of a mapping sentence.

Mereological Roles of Facets and Elements in Mapping Sentences

Facets, with their associated elements, are stated as they combine together within the situation of their existence as a mapping sentence that provides an account of their specific domain. Mapping sentences may be of two forms: the traditional mapping sentence (which has been used in quantitative research) and the declarative mapping sentence (which has been used in qualitative, non-numerical and philosophical research). Mapping sentences are sentences that are written in ordinary prose and which include all of the facets that a researcher believes are associated with the phenomena they are studying. All of the elements for all facets are also included. Mapping sentences account for the interactive whole of a domain of interest by using connective phraseologies that join together the facets and their elements in such a manner as to suggest how the facets are interrelated in the real-world and thus the mapping sentence facilitates an understanding of that whole domain. In many ways, the connective phrases that are used in a mapping sentence are the central component of a mapping sentence as even subtle changes in these connectives may radically alter the understanding of the domain and its facetted composition. In this way, mapping sentences constitute mereological structures that portray the part to part and part to whole relationships present between facets and elements within a domain.

Non-numerical and Numerical forms of Understanding

At this point, I will not go into the complexities of data gathering or analysis as this is beyond the scope of this short article. However, when using the approach to understanding research within education and learning that I have described in this essay either qualitative, quantitative or both qualitative and quantitative information may be incorporated in order to understand the domain of interest. In qualitative studies of participant narratives, behavioural observations, etc., the mapping sentence is used as a coding frame for thematic content analysis. In quantitative studies questions are developed that incorporate the facets and their elements where each question comprises a different permutation of elements from all facets from the mapping sentence in combination and these are analysed using multidimensional scaling (MDS) (see, Levy, 1994) where MDS analysis produces geometric (spatial) displays.

Conclusions

At the start of this brief essay I noted that our understanding of the world around us is composed of experiential sub-divisions. Throughout my writing I have claimed that such fundamental units of our reality are our ontological understandings which interact mereologically. Moreover, I have claimed that these units of reality combine and form our worldview, which permeates all of our world-based experiences. The exposition I have offered is theoretical in its nature but has consequences upon the understandings we have within education and teaching where dividing knowledge, understanding, abilities, practices, etc., is undertaken to assist in the educational process. Possessing and using componential ontologies of various forms of sub-constructs which possess different forms that interact differentially seems to be a fundamental characteristic of the way human animals (and indeed non-human animals) orient themselves within their worlds. This also seems to underlie teaching and learning and we should therefore, I believe, we should keep an ontological and mereological way of thinking in mind during our professional practices and when we conduct research into teaching, learning and education.

Moreover, the conceiving of the sub-units of our experiences in geometric visual terms also helps us to be aware of and communicate the nature of the phenomena of interest and its components. When employing a research approach that attempts to develop understanding of an experiential phenomena within an educational context, both qualitative and quantitative approaches reveal the experiential structure of the teaching, learning or other type of phenomenon being analysed in a way that coveys meaning in an easily understandable (often image-based) format. Geometric configurations embody the roles that sub-units of a phenomena play in understanding an event, behaviour, psychological phenomena. Moreover, the spatial arrangements of both individual or combined aspects of a research domain act as metaphors or analogies for the underlying processes of interest: the shape of this arrangement suggests the nature of the processes within its content in their arrangements or ‘facet geometries’. I concluded by suggesting that a domain of interest may be holistically and mereologically described using a mapping sentence.

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