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Multi-perspective Exploration as a Tool for Mixed Methods Research

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Introduction

During past decades mixed methods research tradition has undergone a rapid evolution and there is a body of excellent research which demonstrates various possibilities to combine qualitative and quantitative aspects into coherent research designs. However, several meta-analyses undertaken by different inquirers indicate that more extensive integration of qualitative and quantitative sub-designs as well as various types of data have been and continue to be a challenge for mixed methods studies (e.g. Bryman, 2007; Caracelli and Greene, 1993; Niglas, 2004). Thus, the question of how to combine statistical tools with more interpretive approaches to get the best understanding of the phenomena under study is still in focus today and waits for further innovative solutions.

As one way to meet this challenge it is possible to utilize new tools for multi-perspective exploration and knowledge construction, which are based on interactive media made possible by contemporary digital technology, in the framework of mixed methods research. In this chapter we will concentrate on the *exploratory soft ontology* (ESO) *approach* which has been used creatively to form 'ontologies' enabling, for example, the exploration of a single corpus of textual material or to achieve flexibility in interpretation of a class of phenomena by simulating different perspectives (Aviles Collao et al., 2003). As such, soft ontologies appear to encourage emergence of mixed research styles similar, for example, to Bourdieu's (1984) combination of ethnography with statistical correspondence theory.

In the following we first introduce the concept of ESO and related software as introduced by Kaipainen et al. (2008) for the context of knowledge environments. Thereafter, drawing on the argument that the research process can be seen as a specific form of knowledge building and the conceptualization of metadata in the context of knowledge environments resembles in many ways the more traditional ways of data handling in the framework of empirical studies, we demonstrate that the concept of soft ontology and related software can be fruitfully utilized within the context of academic research. As in the case of ESO the conceptualization of (meta)data brings together a structured way of thinking and a non-deterministic flexible approach to data, and the resulting research designs will combine features of quantitative and qualitative traditions. To illustrate this we propose several examples about the possibilities to use ESO in the framework of research studies.

Origins of an explorative soft ontology approach

The ESO approach is based on domain conceptualizations, such that allow themselves to be continuously and iteratively redefined through the process of defining multiple equally legitimate perspectives to a domain. The approach was originally created for experts, such as cultural heritage curators and analysts (Aviles et al., 2003) to describe, study and negotiate the nature of cultural artifacts with no or poor a priori definition.

The ESO approach has recently been elaborated and generalized for all knowledge environments, i.e. socio-technological applications of interactive media that are designed to facilitate individual and joint knowledge and meaning building (Kaipainen et al., 2008). The latter include learning environments, in which knowledge construction is facilitated for the purposes of education, knowledge management systems designed to support joint innovation and productivity of members of an organization, and communities that share and jointly produce knowledge, such as open source communities. In that context ESO has been shown to be particularly promising for structuring different people-driven media, such as the content-sharing virtual communities or the blogosphere that are constantly being redefined by their members by means of tags of folksonomies.

Exploration as knowledge building

A spectrum of recent thinking can be summarized to the idea that through the human life, environment is made sense of in terms of *exploration*, which is the foundation for increasingly more abstract levels of thought. The widely recognized principle of *constructivism* generally refers to the active process of constructing knowledge, instead of assuming a priori knowledge that is directly transferable in terms of instruction. Furthermore, construction of knowledge is seen as a self-directed exploration of the phenomenon 'beyond the information given' (Bruner, 1973) and the learner should be free to select and transform information autonomously in ways that are not dominantly pre-structured by some authority (Bruner, 1966).

Although useful starting points, these views remain too constrained to account for a full explanation of the ways in which the knowledge is constructed. Individualistic nature of experiences, interpretations and ways of sense-making do not imply the impossibility of shared understanding, which is regularly created through the process of social negotiation of meaning (Vygotsky, 1978). Jonassen et al. (1993) lay the ground for constructivist approach to design of learning environments that support personal knowledge construction without imposing a prescribed knowledge structure to a learner. Quite in line with Jonassen's thinking, Collins (1991) suggests the cognitive apprenticeship model for situated learning, where the learners are engaged in sense-making of the world or domain through modeling the processes they observe or experience (e.g. expert performance). The most important characteristics of cognitive apprenticeship are articulation (making tacit knowledge explicit) and exploration (forming and testing hypotheses). The ESO approach aims to concretize these views by means of a dynamic model of structuring domain conceptualizations.

Soft ontologies and multi-perspective explorability

Soft ontologies

Soft ontologies, first coined by Aviles et al. (2003), can be defined as explicit specific tions of conceptualizations of information domains in a way that allows the weigh given to its individual elements as well as its overall dimensionality to be flexible a negotiable.

Technically, soft ontology $\mathbf{O} = [o_1, o_2, \ldots, o_m]$ is a coordinate system that defines m-dimensional ontological space **A**. Each item i can be represented as an element **A**, say, $\mathbf{A}_i = [a_{i1}, a_{i2}, \ldots, a_{im}]$, where a_{ix} expresses the value of the item i for the pro erty x, which depending on the given context may indicate, for example the pre ence of that property, its probability, strength of relation or agreement. Here a_{ix} interpreted as the position of item i with respect to *ontological dimension* x. An ideal distinctive property or ontological dimension contributes to distinguishing items the domain between a minimum and a maximum, which, for convenience, can set to $p_{xmin} = 0$ and $p_{xmax} = 1$.

The soft ontology approach inherently suggests regarding ontological properti or dimensions as coordinates that altogether define the ontological space which an information domain 'exists' or can be interpreted. Thus, ontological spa **A** can be conceived as a framework of metadata that is associated with and giv structure to some primary data, perhaps along with other types of ontologic elements.

Even though the idea behind the 'softness' is to allow the dimensionality of t ontological space to be continuously increased or decreased in the process of expl ration at any given moment, the space **A** consists of a finite set of properties a items, and can thereby be represented by a matrix where ontological dimensio define columns and ith row represents positions of the item i in regard to every ont logical dimension. As such the ontological space **A** does not differ technically fro the data table we used to construct for ordinary statistical analysis of data. The ont logical dimensions can be seen as analogues to variables and items as analogues cases commonly referred to in connection with statistical data. This intrinsic simila ity gives us the possibility to apply the concept of soft ontologies and relat software tools in the context of research settings.

However, the fact that ontologies here are conceived as being 'soft' or malleab rather than absolute allows us to go beyond simple statistical analyses and ma ontologies i.e. data explorable in terms of perspectives as will be described in the fo lowing section. In the research context it means that the implementation of the s ontology concept assumes the framework were structured and open approaches a to be intertwined calling thereby for mixed methods research designs.

Perspectives to a domain of information

Let vector $\mathbf{P} = [p_1, p_2, \ldots, p_m]$ denote a *perspective*, that is, a set of weights of taking in account corresponding ontological dimensions of **A**. Each perspective defines linear transformation $\boldsymbol{P} : \mathbf{A} \rightarrow \mathbf{B}$ of **A** given by $\mathbf{P}([a_{i1}, a_{i2}, \ldots, a_{im}]) = [p_1 a_{i1}, p_2 a_{i2}, \ldots, p_m a_{i}$

In our context, one may pay attention to the fact that there is actually no onto ogy-free domain, but **A** is always a result from some a priori decisions that in pra tice take the form of some statistical preprocessing, such as scaling or weightir

Therefore **P** should not be considered as an additional factor, but rather as an intrinsic term that is in a particular context made explicit, accessible and negotiable.

In our approach, **P** can be considered as a similarity-preserving projection from an m-dimensional domain **A** to some lower q-dimensional[1] *projection domain* **B** (that is in most cases a subspace of **A**) regarded as a momentary model of making sense of multi-dimensionally complex information in the environment. A projection with $m > q$ cannot preserve the distributions of all dimensions equally, but distorts some more than others. Assumed that $0 < \text{px} < 1$, its extreme values can be interpreted as follows:

$p_x = 1$ reflects the desire of maximizing the preservation of variance along dimension x, and

$p_x = 0$, is equal to ignoring the variance along dimension x.

In interactive applications designed for exploring multiple perspectives, it is **P** that can be used as the means of determining the desired degree to which each ontological dimension should be taken into account in projection $\mathbf{P}: \mathbf{A} \rightarrow \mathbf{B}$. However, translating the operation of projection to knowledge building, we do not assume that a single projection can make sense of the information domain but reflects a static, momentary meaning. While building a more encompassing understanding of it, that is, knowledge, many subsequent projections are required.

Iterative exploration

In terms of the soft ontology approach, a single projection $\mathbf{P}: \mathbf{A} \rightarrow \mathbf{B}$ is only a step in the process of building a rich multi-perspective understanding of the domain. Such is constructed by means of a series of projections moving from one perspective to another, resulting in a series of $\mathbf{P}_1: \mathbf{A} \rightarrow \mathbf{B}_1$, $\mathbf{P}_2: \mathbf{A} \rightarrow \mathbf{B}_2$, ..., $\mathbf{P}_w: \mathbf{A} \rightarrow \mathbf{B}_w$, with w growing until a satisfactory understanding has been achieved or the need for incorporating new dimensions perceived.

In order to clarify the idea of iterative exploration, it may be instrumental to compare a single perspective with a single saccadic fixation in vision. One fixation alone does not yet amount to a complete perception, but such emerges only as the result of iterative saccadic movements. As another analogy, it does not suffice for a complete idea of a physical object to emerge by seeing it as a two-dimensional picture taken from one side only. For any better understanding it is necessary to see the object from different perspectives. Consider for example a design for a piece of furniture or a building. Many CAD, VR and 3D visualization software tools facilitate this with respect to three-dimensional, real-world objects. Our approach aims at equal ease in exploring multi-dimensional information domains.

Exploratory soft ontology and ontological realism

In the research methods literature the term 'ontology' is often used in the meaning common to philosophical discourse reflecting beliefs about what exists and definition of the ways or senses of being. From that point of view the question might be raised about the suitability of the concept of soft ontology approach, which is based on the constructivist principles, to the frameworks assuming realism or critical realism as an underlying ontological position. We will argue in the following that ESO approach as defined above can be used both within relativist as well as within realist ontological frameworks.

First, we can see that the term 'ontology' is used in the context of ESO approac not in its philosophical meaning, but in line with the technical meaning of the wo referring to 'specification of a conceptualization', as concisely defined by Grub (1993) and used in the field of information technology. Thus, ontology is taken he as a framework which defines and describes the basic characteristics of a particul domain. In the case of the domain being some kind of system, an ontology may al define the relationships between its elements which enable the system to opera Ontology in this context reflects an underlying assumption concerning the bei or existence of the domain but does not refer to any particular notion of truth reality.

While in the case of relativist ontology this kind of soft conceptualization of t phenomenon can be seen as an act of creating 'reality' or more precisely 'realities', can also be applied in the framework where the 'real' reality is believed to exist 'o there' while not being directly accessible to the human mind or the 'knower'. In t latter case what is constructed in the course of ESO approach is the knowled about the reality which is not believed to be a direct reflection of that reality, b understanding mediated by our (post hoc) conceptualization of the phenomeno In that context ESO technically frames the possibilities of organizing the inform tion about the phenomenon, and more importantly, determines the possible perspe tives that can be taken on it. Taken this way, soft ontology can be seen as adjustab lenses to look at the reality and make sense of it, which leave the conceptualizati of the phenomenon unfixed and allow for multiple interpretations. The latter clea implies an assumption of relativist position on the epistemological level no matter the ontological position is realist or relativist.

However, from here further skepticism towards our approach could be raised the basis of paradigmatic view on research methods advocated mainly by Americ methodologists like Guba, Lincoln and Smith during the last decades of the past ce tury, but widely adapted by other authors as well, which proposes that there is a lir ited number of competing paradigms – sets of basic beliefs (or metaphysics) – social research which the researcher follows (or should follow) (Guba and Linco 1989; 2005; Lincoln and Guba, 1985).[2]

The aspect of paradigmatic view which has had the most extensive implications the context of 'mixed methods' approach is that very often these paradigms are tak as tightly bound to specific (that means quantitative versus qualitative) ways of doi research. Today the incommensurability of quantitative and qualitative methods as su seems to be off the agenda in the mainstream methodological literature. However, t question of paradigms and (in)commensurability between them is the issue whi needs to be further tackled and clarified in the context of present discussion.

Having seemingly moved from the concept of two paradigms to the flexible a evolving five-paradigm picture (see Table 11.1) Guba and Lincoln in 2005 still arg for two broad but incommensurable 'philosophies' from which one relies on rea and the other on relativist ontology:

> So, ..., *positivism* and *postpositivism* are clearly commensurable. In the same vein, elements of *in pretivist/postmodern* critical theory, constructivist and participative inquiry, fit comforta together. Commensurability is an issue only when researchers want to "pick and choose" amc the axioms of positivist and interpretivist models, because the axioms are contradictory a mutually exclusive (op. cit.: 201; italics in original; see also Table 8.5: 198)

TABLE 11.1 *The evolution of the 'paradigm system' in the texts by Guba and Lincoln*

1989	1994	2000/2005
Conventional (positivist)	Positivism	Positivism
Constructivist	Post-positivism	Post-positivism
	Critical Theory	Critical Theory
	Constructivism	Constructivism
		Participatory

The paradigms, according to Guba and Lincoln, are then defined first and foremost by beliefs on the level of axiology, ontology, epistemology and methodology. According to their depiction of paradigms and incommensurability thesis between positivist-realist and nonpositivist-relativist paradigms there is no room for a worldview which would accommodate realist ontology with relativist epistemology nor for the possibility of valuing 'propositional knowing about the world' as such in parallel with seeing 'transactional' and 'practical' knowing as valuable means for social emancipation or improved wellbeing. (The latter is the predicable essence of the contradicting *axioms*.)

We do not agree with the basic ideas of paradigmatic view nor can we see any convincing argument on why one could not value the instrumental and practical role of knowing and believing at the same time that in some cases or situations also more descriptive or propositional knowledge about the world (if assumed to exist) is intrinsically valuable. We have argued elsewhere that the realm of different methodological approaches and underlying worldview positions is better depicted by the idea of continuum than by incommensurable paradigms (see Heikkinen et al., 2005; Niglas, 2001; 2004; 2007).

The roots of the problem seem to be embedded in the interpretation and usage of the terms ontology and epistemology in the context of research methodology by which the boundary between the two has blurred. Talking about the realist ontology assuming that there is a 'real' world 'out there' it is the physical or empirical world which is mostly referred to. As it comes to the relativist ontology and the claim that there are multiple locally constructed realities people tend to talk about the social world or social reality, but leave the question of existence of a material world open as not important or relevant for their focus of interest. As such we do not see here an either-or question: if one believes the 'real' world to be out there (that means being an ontological realist) it does not impose intrinsically that she has to deny that different people or groups of people can interpret the existing world or reality in various ways and construct multiple and/or ambient social realities for themselves.

We argue, therefore, that soft ontology approach which enables one to explore the reality, both 'real' and constructed, from multiple perspectives can be seen as playing the mediating role between ontological and epistemological level and does not have to be seen as a manifestation of relativist ontology in the philosophical sense. This view on ESO approach enables us to accommodate soft or relativist epistemology and realist ontology within a single framework and ease the alleged ontological conflict between different research approaches and/or methods combined within mixed methods designs.

The use of exploratory soft ontology approach in the context of mixed methods research

We learned from previous sections that the ESO approach relies on the premis according to which knowledge is constructed in terms of active exploration, rath than being direct reflection of reality or something directly transferable or comm nicable from one person to another. This view implies that throughout the hum life, including research settings, environment is made sense of in terms of expl ration, which is the foundation of increasingly more abstract levels of thoug Drawing on this we argue that the concept of *multi-perspective exploration* is partic larly applicable to complex information domains, often characteristic to mix methods research projects to which there is no single 'right' perspective and whi thereby call for multiple perspectives of interpretation.

In the context of knowledge environments, for which the ESO was original developed, the notion of *environment* points to the idea of being immersed in info mation, and a sense-making community, which is essentially an interpretive endeav characteristic of qualitative approaches like ethnography and narrative research, b also participatory approaches like action research and many others. On the oth hand the ESO assumes the information about the domain to be systematized a scaled or categorized before the multi-perspective exploration can start and utili statistical techniques to visualize various mappings of the structure emerging fro the data. As such the approach supports and facilitates various types of mixed desig

Thus, building on the ideas of ESO approach the ultimate aim would be to pr vide the user with the tools which would help to organize objects under explorati according to their mutual similarity or dissimilarity relations to spatially laid-out cl ters. The software prototype we have developed on the basis of Kaipainen et al. (200 is built to demonstrate this using the classical multi-dimensional scaling (MDS) alg rithm, but in principle any MDS algorithm could be utilized and applied. The d suitable for this kind of exploration can be subjective similarity judgments giv by people, 'objective' similarity measures like distance in kilometers or an ind calculated by the program from multivariate data by using some measure of distanc

Figure 11.1 depicts the simple interface of the soft ontology tool. All the existi ontological dimensions (or variables) are listed on the left hand side of the main windo and followed by the sliders and input fields by which it is possible to change weights single dimensions. On the right hand side there is a space for 2-dimensional projecti of the original multidimensional ontological space where the items or cases organized according to their similarity patterns. The rules for calculations and visualization of the results can be set by clicking the Options button in the ma window which opens the smaller window where one can change the settings (s Figure 11.1). It is possible to ask for immediate renewal of the projection as soon the weight for any single dimension is changed or to set the weights for a group dimensions and only then calculate the projection. The essential feature for t exploration and sense making is the possibility to rotate the projection so that n dimensions would allow clearer interpretations. On the projection space it is pos ble to point to any item with the mouse, and the bars in the middle of the windo indicate the original values for this particular case. This feature allows very quick a easy interpretation of new dimensions.

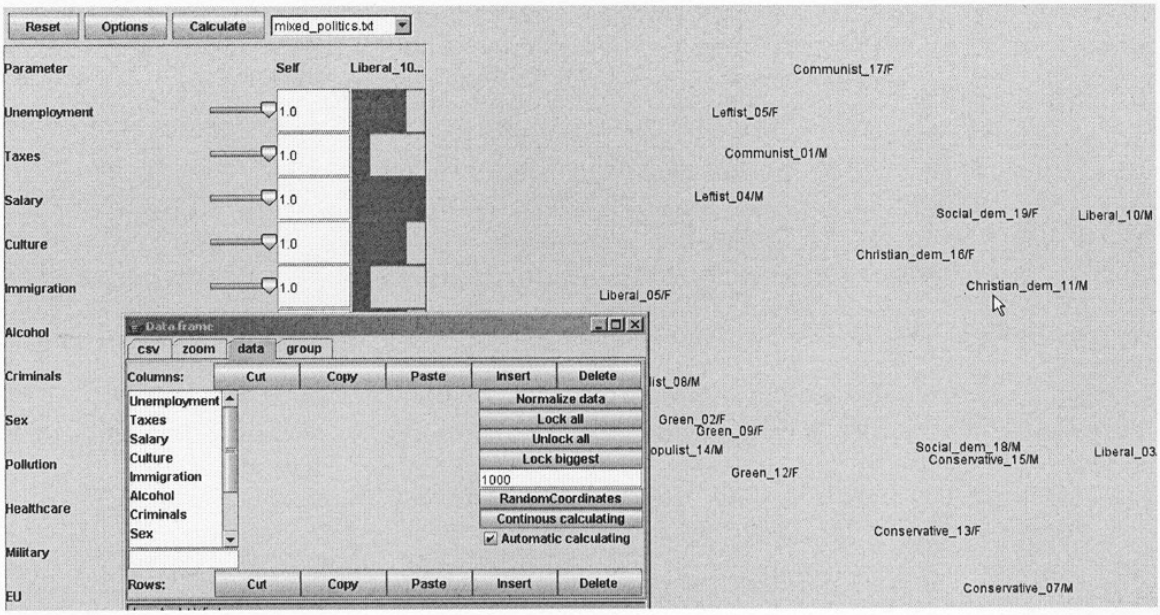


FIGURE 11.1 *Exploratory soft ontology tool – interface of the prototype*

In the following sections we will discuss several examples of the use of soft ontology concept and aim to demonstrate its applicability in the context of mixed methods studies.

Multi-perspective exploration – example 'Politics'

The simplest example to start with would be the case where the information domain is complex but data are collected by using a structured instrument as is the case for most surveys using questionnaires for data collection. As an example, let us introduce one case from the original knowledge environment context where the data are accessible and explorable not only for initiators of data collection (i.e. researchers) but also for the public via the web. Let us consider an information domain consisting of political agendas of candidates for a parliament.[3] The agenda of the candidate c is expressed in terms of degrees of her agreement on the 5-point scale with political propositions, denotable as $\mathbf{A}_c = [a_{c1}, a_{c2},..., a_{c12}]$. The list of propositions given below corresponds to soft ontology $\mathbf{O}_{Polititics\ s_t}$, in this case a specification of a political 'climate' by what appear as its defining issues for initiator(s) of data collection s at time t.

1. The government has taken sufficient measures to fight unemployment.
2. Taxes should be lowered even if this would mean compromising the welfare society.
3. The increase of salary differences is acceptable.
4. The state should decrease its support to culture.
5. Tough immigration policies are justified.
6. Wine and strong beer should be sold in supermarkets.
7. Criminals are not punished with hard enough sanctions.
8. Buying sex should be criminalized.
9. Pollution of the environment should be controlled with an environmental harm tax.
10. Healthcare fees can be increased significantly if the savings can be used to increase the resources of the healthcare system.

11. The compulsory military service should be abandoned.
12. The country should leave the European Union.

After data collection the data table with 13 variables (including identifier) a 19 cases, called in this context ontological space $\mathbf{A}_{Politics}$ with $n = 19$, correspondi to the descriptions of candidates' political profiles, is composed and made explorab to both citizens and the candidates by means of an interface illustrated in Figu 11.1. With such an interface the explorers of information can visualize in real tir various classifications and a multi-perspective structure of data computed using real-time, MDS algorithm. Using sliders in the left block of the window and/or va ious options for calculation available through the dialog box it is also possible to g immediate visual feedback about the effects of the weights given by the user to t ontological perspectives/variables. Depending on the selected perspective, such those relating for example to *social*, *criminal*, or *immigration* issues, the resulti projections reveal different groupings of the candidates (Figure 11.2).

As a result, the user, in this case a citizen, may reveal similarity mappings that m or may not be consistent with a priori expectations, such as party lines or pub image, or alternatively divide the domain into groups that are more relevant to t explorer's priorities. A candidate, in turn, may seek for a perspective from which h approach appears similar to or different from someone else's, to emphasize in h campaign. One purpose of exploration may be to try different what-if alternativ say, those of a political opponent. This may facilitate finding compromises, or alt natively, work as a means formulating counterarguments.

Thus, there are several possible exploration strategies the user can practi depending on her aims and the relationship to the data. The first is the analy approach in which the exploration begins with the simplest possible view that with one ontological dimension only, thereafter adding more ontological dimensic in order to make more refined distinctions. The opposite exploration strategy wou be to start with a perspective in which all dimensions available are taken into accou

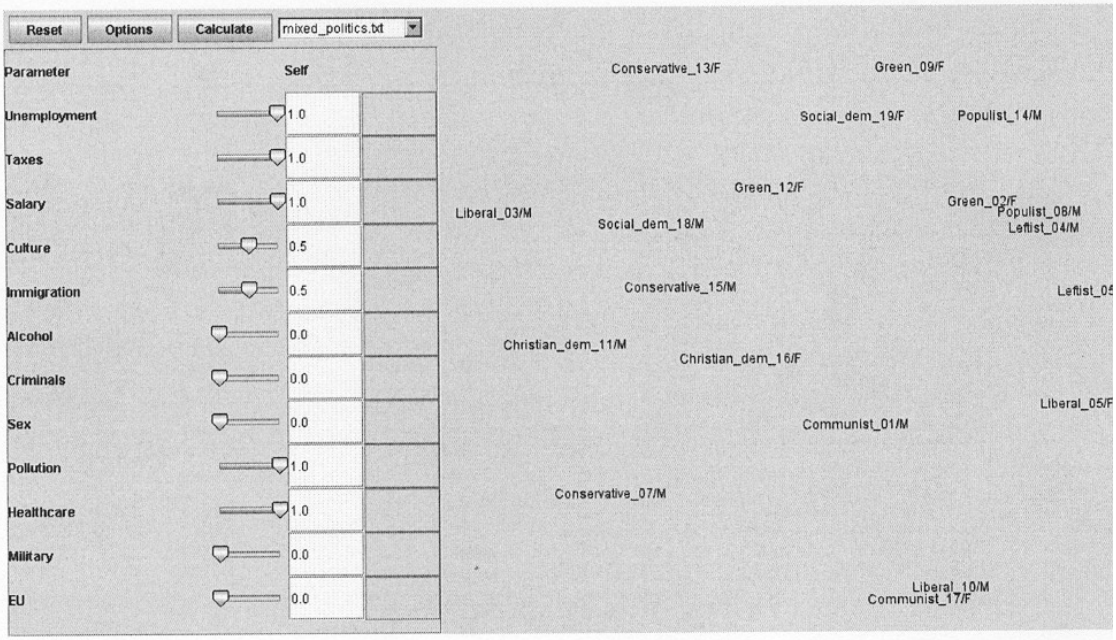


FIGURE 11.2 *Selected ontological perspective to the domain 'Politics'*

with maximum weights, and then continue by turning down dimensions which seem not to be relevant in order to find one or several classifications which could be well interpreted and give some new insights into the phenomenon under study.

Another method for an individual to explore the domain is *immersion*. In this case, the individual localizes herself with regard to each ontological dimension by adding an extra case to the dataset, and thereby determines her position in the projection domain. Within our example this kind of method can be used to find the closest matching candidate to your own views.

The demonstrated possibility to project the same dataset from multiple perspectives by changing weights to the variables (or ontological dimensions) in an interactive manner, is the feature which allows us to call the approach 'soft' and distinguish it from the mainstream exploratory quantitative analysis. Another example of how the ontologies (i.e. systems which define the phenomenon) can be unfixed would be the use of an environment where new possible dimensions could be invited from and negotiated within a community. Data to be added on the ontological dimension could be collected using a distributed community application that automatically forwards the proposition to all the candidates for opinion rating, perhaps via email or an SMS service. The updated ontological space with the expanded dataset will then be immediately at the disposal for further exploration.

It is also important to note that the individual explorer may also choose to ignore an ontological dimension totally by giving it the weight 0, or do so partially by choosing the weight between 1 and 0, as with all the other dimensions in the given ontological space.

Classification and interpretation – example 'Methodological Paradigms'

In our second example we use data from a small-scale study where 46 articles from the academic journal on educational research were analyzed with the aim to classify the studies according to the used methodological approach and to see if the emerged classification fits with the paradigmatic view which argues for two clearly divergent and incommensurable methodological paradigms advocated for example in early texts by Guba and Lincoln (1989; 1994) in several influential books on research methodology (see Niglas, 1999). In this study the initial data was unstructured, but categorized by the researcher using content analysis. The whole article was used as a unit of coding and the following methodological aspects, categorized to the scale: 1=quantitative, 2=mixed/both_used and 3=qualitative, were chosen to be the variables used for classification of studies:

1. Aims of the research (AIMS_R)
2. Strategy of the research (STRAT_R)
3. Type of the sample[4] (SAMPLE_R)
4. Data gathering methods (D_GATH_R)
5. Data recording and representation methods (DATA_REC_R)
6. Data analysis methods (D_ANAL_R)

In the original study the cluster analysis was used to clarify whether particular studies follow clearly only one of two broad methodological approaches or combine

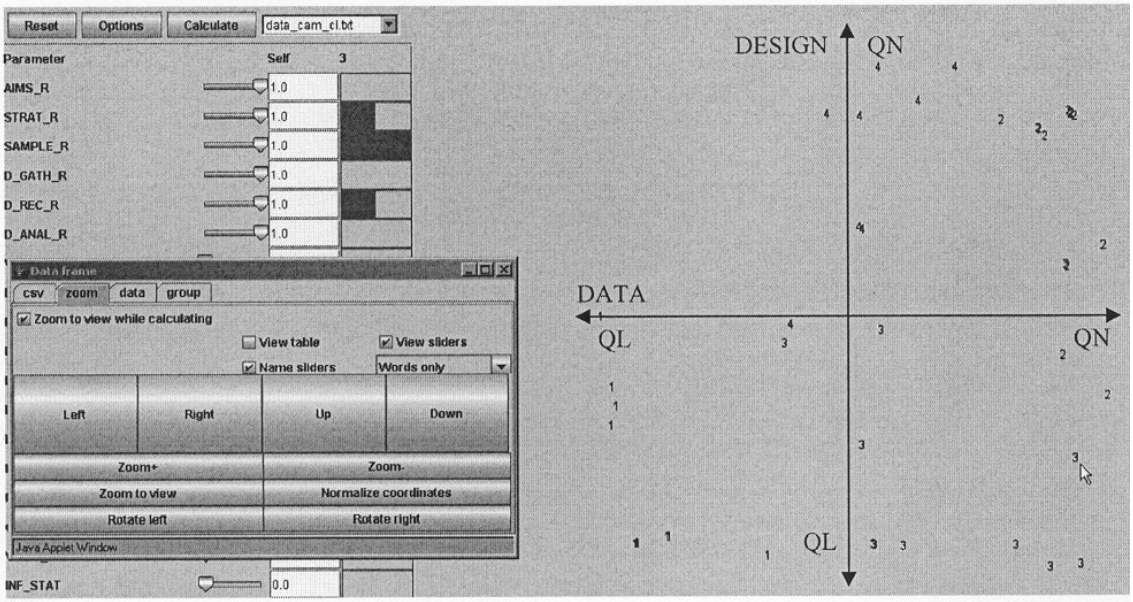


FIGURE 11.3 *Classification of 46 studies on the basis of 6 methodological features using exploratory soft ontology software*

these approaches, mixing aspects from both of them in the framework of one stuc Preliminary hierarchical cluster analysis on the basis of six methodological aspe suggested that there was one group of studies clearly different from others – the were studies using qualitative features consistently on all levels of inquiry. T k-means cluster analysis was also used and compared to the other possible solutio the solution with 4 groups resulted in cluster patterns which were better int pretable and helped to define clusters as follows: 1. Qualitative studies, 2. Quantitati studies, 3. Mixed/quantitative case studies, 4. Mixed surveys and experiments.

To further explore the data and to see what kind of classification would be reach by other classification techniques we analyzed described data using explorative s ontology software. The codes for cluster membership were used as labels for cases see if there is a fit with previous analysis. From Figure 11.3 it can be seen that havi used all the six dimensions with weight 1 and rotated the coordinates after the c culation of distances, we got the classification which broadly overlaps with the o gained in the original analysis. However, further exploration would be necessary, the variable describing aims of the study is known not to be strongly correlated w other variables and could therefore cause some fuzziness in classification resu Thus, in the current example the further step to take would be to lessen the weig for the dimension/variable AIMS_R.

In this case the two-dimensional projection is easy to interpret as there are t broad perspectives: overall design of the study and data-related aspects, to which t six original dimensions converge. The coordinate axes can be set and interpreted shown on Figure 11.3. However, to be able to find a reasonable position and int pretation for the coordinate axes of the projection it is necessary to access under ing data. In the ESO tool it is possible to move the mouse to any data point on t projection and see the bars indicating values of all original variables contained in t database for that case on the left side of the window right next to the projection. the figure one can see that for the chosen case, which belongs to the third cluster original classification, the data-related variables show values on the lower end of t

scale (quantitative in this case) and design-related variables show values from the higher end of the scale (qualitative, respectively).

In combination with the possibility to give different weights to the variables, or to totally eliminate them, this feature which enables to see the original values of the cases in real time next to the visualized distances between cases makes further exploration of data and interpretation of the classification results interactive, as well as very quick and comfortable compared to traditional approaches.

Going beyond easier exploration and enhanced interpretation – facilitating integration of different types of data

Our current prototype of ESO tool uses the metric algorithm of MDS which sets several limitations to the type of data which can be used for exploration and classification. However, it is possible to build into the software other algorithms from the family of MDS and to allow the user to choose the best suitable one for the type of data they have. Some of these algorithms assume data to be quantitative (measured on the ratio or interval scale), while others can handle also categorical, that means, structured qualitative data (see, for example, Young and Hamer, 1987).

The latter is an important feature which allows seeing the use of soft ontology software as a second step in the process of integrating structured and initially unstructured data giving the ESO a great potential within the context of mixed methods studies. Before being able to explore data with the ESO tool, the data have to be converted to a simple table form, using for example some of the well-known spreadsheet software packages. In the case of ESO with a metric MDS algorithm, preparation of data means basically eliminating any possible string-type data from a database and handling missing data.

However, as in non-metric MDS algorithms it is possible to integrate categorical data into the process of exploration; the spreadsheet software can be used on the first step to record both pre-structured (i.e. quantitative) data from survey or structured coding sheets and unstructured textual notes (i.e. qualitative data) from open questions, memos or interview transcripts at the same time in the same database. Spreadsheet packages have lots of features and tools which support this kind of open recording process and handling of resulting semi-structured data as well as making the initial integration of different types of data very flexible. These tools make it easy to learn from qualitative data in order to inform your decisions while analyzing and interpreting your quantitative data and vice versa. Furthermore, as it is rather easy to transport data from one program to another, it is entirely feasible to take (part of) your data from the spreadsheet to some software package like ESO which enables more complicated or flexible quantitative analysis (Niglas, 2007).

For the further exploration of data by ESO it is essential that the unstructured data is categorized. This process is well supported by sorting and filtering tools of spreadsheet packages. It is possible to use pre-structured categorical data or keyword variables to sort the data so that comments for various subgroups are brought together in the display, enabling one to see if there are common features in the comments or a trend for each subgroup. Thereafter one can add in a new column in order to post-categorize a variable that was initially recorded as text. For even better informed categorization, data transport between spreadsheet and software for qualitative analysis

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	kood	qcl_8	explore	examine/ inve	test(hypothes	evaluate/valid	understand	determine/ dis	answer questi	develop/ impr	show/ provide	compare	aims	aimslong	who1	action1	
2	7		0	1	0	0	0	0	0	0	0	0	examine				
3	8	6	0	0	0	1	0	0	0	0	0	0	evaluate effectiveness	of intervention, reason for failure	progr		effect
4	9	2	0	0	0	1	0	0	0	0	0	0	evaluate	effectiveness of new approach, change in conceptions	approach		effect
5	10	2	1	0	1	1	0	0	1	0	0	1	explore,evaluate, answer,test hyp	compare classroom practices, efficacy of ...	classroo m pr		effect
6	11	3	1	0	0	0	0	0	0	0	0	0	explore	impact of methodology to councelling educ, q method and following feelings	progr	infl	educ
7	12	5	0	1	0	1	0	0	0	0	0	0	examine the value of methodology		method		value
													monitor how, what	effect of re-examining knowledge			

FIGURE 11.4 *An example of a database where the unstructured data are post-categorize and can be used together with quantitative data*

can be practiced, to benefit from possibilities for more substantial thematic analys built into these programs.

We will take an example of this kind of post-categorization and integration qualitative and quantitative data from another study focusing on the methodologic aspects of mixed methods studies (see Niglas, 2004). In this study we used mainly structured coding scheme for identifying various methodological aspects of th sample of 145 studies with combined research design printed in a number academic journals on educational research. However, we also collected unstructure notes, memos and keywords about certain aspects of used methodology.

Figure 11.4 shows an excerpt from the database, where the notes about the air as stated in the articles are first collected and entered in an unstructured format ar thereafter categorized as binary variables (on the left) and as keywords (on the righ In the original database there are also a lot of pre-structured variables on the basis which the cluster analysis was performed to filter out different types of combine designs used in the analyzed studies. Thus, we have in the same database origin interval and ordinal variables and categorical variables calculated on the basis of th quantitative data as well as unstructured data which have been categorized to th form of binary variables in this case. To explore the similarity patterns of a sample studies on the basis of the aims set by the authors the data can be taken to the ES tool. Setting the cluster membership variable as the identifier, it is now also possib to explore the relationships between the aims of studies as set by the autho (initially qualitative data) and the type of methodological design (categorical variab emerged in the course of quantitative analysis) (see Figure 11.5).

After categorization it is possible then to use initially unstructured data indepen ently or together with quantitative information as a basis for exploration by usi the ESO tool. Indeed, there are several well-known MDS programs like ALCSCA or PROXSCAL available which could also be used for the further analysis of cat gorized data, but as we have learned, the essential advantage the ESO has over trad tional statistical tools is that it enables the user, e.g. a researcher, to set the weights f the dimensions/variables right in the user dialogue box and thus reveal and explo multiple similarity mappings or perspectives of the domain that may or may not consistent with a priori expectations. The real-time exploration of the domain fro

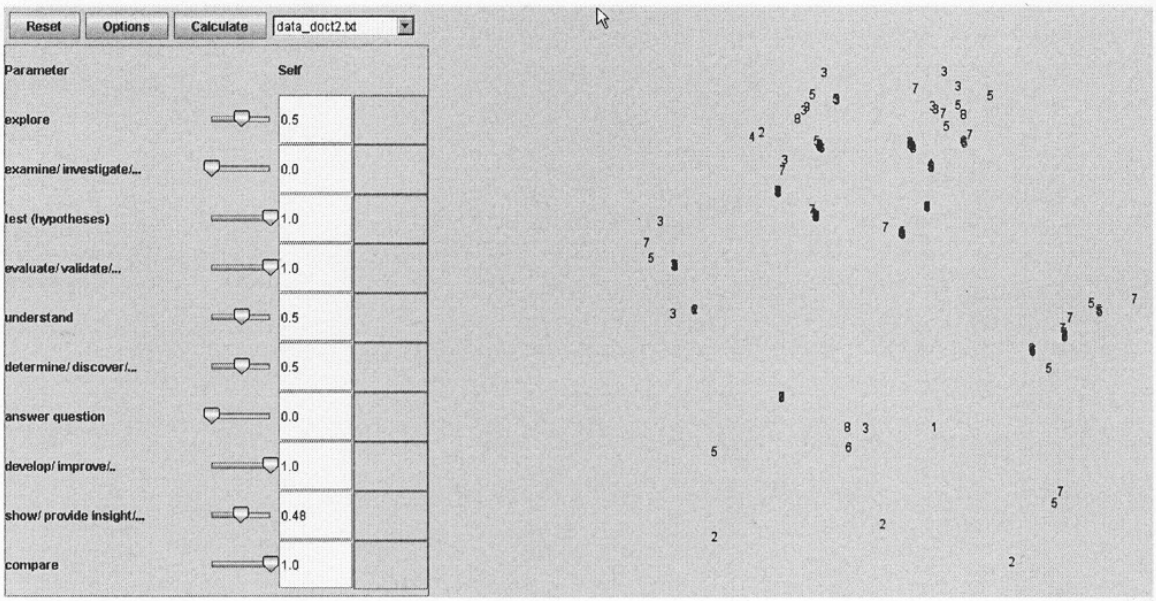


FIGURE 11.5 *One possible projection to explore the similarity patterns of a sample of studies on the basis of the aims set by the authors*

multiple perspectives facilitates more informed interpretation and flexible knowledge construction.

Conclusions

In this chapter we aimed to introduce the concept of ESO and to demonstrate how it could be beneficially implemented within mixed methods research designs. Furthermore, we have argued that the concept intrinsically calls for the consolidation of structured and open ways of thinking in the course of organizing, exploring and interpreting data. Following our discussion above it can be concluded that the ESO approach potentially facilitates integration of different methods, methodologies and ways of thinking about the phenomena under study. As we have shown, this can take place on three levels: paradigm or worldview level, research design level and data processing level.

Having its roots in constructivist thinking, ESO denies the idea of knowledge as something which is ready-made and directly transferable and emphasizes the role of open and self-directed exploration as the means of personal and social knowledge building assuming thereby a relativist stance to epistemology. However, we have argued that the soft ontology approach does not have to be seen as a manifestation of relativist ontology in the philosophical sense: it enables one to explore both 'real' and constructed reality. In contrast to the paradigmatic view on research endeavor then we propose that ESO can be seen as playing the mediating role between ontological and epistemological level which enables us to accommodate soft or relativist epistemology and realist ontology within a single research framework and thereby ease the alleged paradigmatic conflict in mixed methods designs.

On the level of research design ESO brings together quantitative approach to initial data processing (i.e. structured data plus statistical techniques) and qualitative (i.e. open and flexible) ways of exploration, sense making and interpretation to get the best understanding of the phenomena under study. Thus it focuses on exploration

of an ever-changeable framework for defining the phenomenon, which is essentiall an interpretive endeavor characteristic of qualitative approaches like ethnograph and narrative research, but also of participatory approaches like action research. O the other hand ESO assumes the information about the domain to be systematize and scaled or categorized at first, and utilizes statistical techniques to visualize vari ous mappings of the structure emerging from the data. As such the approach sup ports and facilitates various types of mixed model designs where quantitative an qualitative aspects are integrated into the design on different methodological stage of the study (see Niglas, 2004; Tashakkori and Teddlie, 1998). While designs wher unstructured (qualitative) data are categorized and analyzed in a quantitative manne are rather common, the strategies supported by ESO, such as where initially struc tured (quantitative) data are processed and interpreted according to principle common to qualitative approaches, have been quite rare so far.

Finally, it was demonstrated that ESO can support and facilitate the integration o different types of data in the framework of a single study, or help to bring togethe information (secondary data) from different studies. In this case ordinary spreadshee software can be first used to bring the pre-structured (i.e. quantitative) data from survey, structured coding sheets, unstructured textual notes (i.e. qualitative data) fron open questions, memos or interview transcripts together into the same database After the categorization it is possible to use initially unstructured data independentl or together with quantitative information as a basis for exploration by using ESC tools. The latter allows seeing the use of soft ontology software as a second step i the process of integrating structured and initially unstructured data, giving the ESC a great potential within the context of mixed methods studies.

Drawing on the above we come to the conclusion that the ESO approach, whicl accrues from the concept of multi-perspective exploration of the environment with th aim of knowledge building, is particularly applicable to complex information domains often characteristic to mixed methods research projects, to which there is no singl 'right' perspective. Such domains thereby call for multiple perspectives of interpretatio and the combination of structured ways of thinking with a non-deterministic flexibl approach to data and data analysis.

Notes

1 Due to limitations of the perceptual-cognitive apparatus, it is not usually reasonable to us projection spaces in which $q > 3$.
2 See, for example, Smith, 1983 and 1989; Smith and Heshusius, 1986; Lincoln and Guba, 1985 Guba and Lincoln 1989 and 1994.
3 See Kaipainen et al., 2008 for further details of this example. The data in this example ar imaginary.
4 Here the term *sample* is used in its wider sense that means not only as a part of a population but whatever set of objects/subjects are under study.

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