FQS FORUM: QUALITATIVE SOCIAL RESEARCH SOZIALFORSCHUNG

Volume 9, No. 1, Art. 34
January 2008

Cultivating the Under-Mined: Cross-Case Analysis as Knowledge Mobilization

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Key words: case study, cross-case analysis, computer-assisted analysis, knowledge mobilization, researcher, database

Abstract: Despite a plethora of case studies in the social sciences, it is the authors' opinion that case studies remain relatively under-mined sources of expertise. Cross-case analysis is a research method that can mobilize knowledge from individual case studies. The authors propose that mobilization of case knowledge occurs when researchers accumulate case knowledge, compare and contrast cases, and in doing so, produce new knowledge. In this article, the authors present theories of how people can learn from sets of cases. Second, existing techniques for cross-case analysis are discussed. Third, considerations that enable researchers to engage in cross-case analysis are suggested. Finally, the authors introduce a novel online database: the Foresee (4C) database. The purpose of the database is to mobilize case knowledge by helping researchers perform cross-case analysis and by creating an online research community that facilitates dialogue and the mobilization of case knowledge. The design of the 4C database is informed by theories of how people learn from case studies and cross-case analysis techniques. We present evidence from case study research that use of the 4C database helps to mobilize previously dormant case study knowledge to foster greater expertise.

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Forum Qualitative Sozialforschung / Forum: Qualitative Social Research (ISSN 1438-5627)

1. Cross-Case Analysis: Introducing the Foresee Database

Cross-case analysis is a research method that facilitates the comparison of commonalities and difference in the events, activities, and processes that are the units of analyses in case studies.[1] Despite a plethora of case studies in the social science literature and archived on web sites, few are adequately mined again by researchers or are known to inform practitioners or policy at a broader level. The expertise embedded within the vast number of case studies in the fields of education and sociology remains relatively dormant. In this paper, we propose cross-case analysis as a mechanism for mining existing case studies so that knowledge from cases can be put into service for broader purposes. To mobilize case knowledge across subject domains and across communities, we introduce the creation of a novel database. The database represents a workspace to perform cross-case analysis and a workspace where expertise can flow in systematic and unexpected ways through the representation, transfer and mobilization of case studies. [1]

Engaging in cross-case analysis extends the investigator's expertise beyond the single case. It provokes the researcher's imagination, prompts new questions, reveals new dimensions, produces alternatives, generates models, and constructs ideals and utopias (STRETTON, 1969). Cross-case analysis enables case study researchers to delineate the combination of factors that may have contributed to the outcomes of the case, seek or construct an explanation as to why one case is different or the same as others, make sense of puzzling or unique findings, or further articulate the concepts, hypotheses, or theories discovered or constructed from the original case. Cross-case analysis enhances researchers' capacities to understand how relationships may exist among discrete cases, accumulate knowledge from the original case, refine and develop concepts (RAGIN, 1997), and build or test theory (ECKSTEIN, 2002). Furthermore, cross-case analysis allows the researcher to compare cases from one or more settings, communities, or groups. This provides opportunities to learn from different cases and gather critical evidence to modify policy. [2]

2. Literature Review

2.1 Learning from and with cases

Assuming that the researcher's learning process parallels the ways in which individuals develop expertise, the authors will, in this section, examine four learning theories that support the notion that cross-case analysis is a method for mobilizing case study knowledge: AUSUBEL, NOVAK, and HANESIAN's (1978) cognitive theory of meaningful learning, KOLODNER's (1993) case-based reasoning, FLYVBJERG's (2001) notions of developing expertise from cases, and DONMOYER's (1990) theory of vicarious learning from case knowledge. These learning theories support the notion that researchers develop expertise from

1 There are a number of definitions of case study; the authors generally view case study as a heuristic that enables the circumscription of the unit of analysis (VANWYNSBERGHE & KHAN, 2007).

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cases, and they conceptualize the processes through which this expertise is cultivated. [3]

KOLODNER and AUSUBEL et al.'s theories primarily emphasize human learning as a cognitive and experiential undertaking and do so while pointing to cognitive processes that are similar to those required for engagement in cross-case analysis. FLYVBJERG and DONMOYER stress the importance of learning from one case to another, arguably emphasizing a form of case-based reasoning, that is, the process of reasoning about the similarities and differences across diverse cases, as key to the development of expertise. Cumulatively, these theories appear to hypothesize that cognition involves cases of experiences and that learning from cases is accomplished by cross-case analysis. The authors extend these hypotheses on learning and suggest that case study researchers can develop expertise through learning from and comparing cases. When the case study researcher makes this comparison public, case knowledge becomes mobilized. [4]

AUSUBEL et al.'s *cognitive theory of meaningful learning.* AUSUBEL et al.'s cognitive theory of learning (1978) emphasizes that people learn meaningfully by developing cross-connections between related concepts. This allows them to engage in inferential and analogical reasoning. These cross-connections can take the forms of either cognitive assimilation or accommodation of concepts. Assimilation of concepts increases knowledge while preserving the cognitive structure, whereas accommodation modifies existing knowledge to account for the new experience. AUSUBEL et al.'s conception of cross-connections can be applied to cross-case analysis: relating one case to another, building cross-connections between cases, preserving the essence of the original case knowledge while changing the character of the current case, can accumulate and produce new knowledge. [5]

Case-based reasoning. KOLODNER (1993) extends AUSUBEL et al.'s theory of cross-connections to memory. KOLODNER's case-based reasoning (CBR) explains learning as a cognitive process in which the individual interprets a new situation in terms of its relevance to a previous case. KOLODNER further theorizes that the lessons learned from the combination of previous and new cases are encoded and indexed in memory as abstract generalizations. This process of memory storage and retrieval implies that a person will be able to evaluate possible solutions through an indexing process that discriminates among cases. At memory retrieval time, when the person is engaged in a new situation, a memory probe searches through the index for cases that are similar to the new one. KOLODNER describes this probing as a creative process and suggests that the more astute the person is at conceptualizing a situation, the more likely he or she is to find relevant knowledge about previously learned, memorable cases (KOLODNER et al., 2003; SCHANK & BERMAN, 2002). This ability to enlighten oneself develops over time through case-based reasoning. It appears that analyses of a variety of cases are necessary to learn well. [6]

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FLYVBJERG's notion of expertise. Drawing heavily upon DREYFUS and DREYFUS' (1988) work on skill acquisition in experts, FLYVBJERG (2001) extends the notion of case-based cognition to experts' ways of reasoning. Experts think quickly, intuitively, holistically, interpretive, and visually. As DREYFUS and DREYFUS explain, "bodily involvement, speed, and an intimate knowledge of concrete cases in the form of good examples are a prerequisite for true expertise" (1988, p.15). According to FLYVBJERG (2001), expertise or virtuosity is intimate knowledge of concrete cases. This intimate knowledge is gained through reflection upon thousands of cases directly, holistically, and intuitively. Case studies are the domain of expertise, which is neither guesswork nor a conscious analytical division of situations into parts and rules but rather, the recognition, interpretation and discrimination of cases and new situations. [7]

DONMOYER's theory of learning from cases. DONMOYER's (1990) conception of generalization reveals how an expert might simultaneously access numerous cases to make a comparison among these cases. DONMOYER suggests that new understanding takes root when an individual begins to generalize across cases that were derived or constructed from different contexts. According to DONMOYER, generalization across cases is not a formal act of generating working hypotheses that are to be tested in new cases. Instead, he views learning from cases as a meaning-making endeavor in which cross-case analysis is essential. DONMOYER suggests that learning from case knowledge can be better characterized as assimilating, accommodating, and integrating case knowledge from previously learned cases. His own example of becoming a better teacher over the years exemplifies this kind of learning. DONMOYER suggests that his development as a teacher was not an effort to consciously test hypotheses in the different schools he taught at but rather, an attempt to learn from individual cases of teaching that he and others experienced over the years. [8]

In sum, learning through cross-case analysis empowers the learner to access the experience of others and thus, to extend their personal experience. These new connections made across cases produce new knowledge and augment existing knowledge and experience. While learning theorists invoke different cognitive structures and processes to explain cross-case analysis, there are the following commonalities:

1. cases represent rich holistic examples of experiences;
2. cases are comparable in relation to patterns of similarities and differences;
3. memorable cases are accessed through memory;
4. comparisons among cases can construct and yield meaningful linkages, and
5. cognitive cross-case analyses are a useful way to produce analogies, make inferences, and develop conditional generalizations for the individual. [9]

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Similarly, for researchers who develop expertise through cross-case analysis:

1. cases represent rich examples of cases they have learned or know about;
2. the cases are deemed comparable in relation to patterns of similarities and differences;
3. the cases are accessible;
4. meaningful connections between cases can be made explicit by the researcher, and
5. the researcher can produce and share new knowledge through cross-case analysis. [10]

3. Review of Several Cross-Case Analysis Approaches and Techniques

There are several well-known cross-case analysis approaches and techniques available to the case study researcher. RAGIN (1997) for example delineates between variable and case-oriented research as two approaches to cross-case comparisons. In variable-oriented research, variables take center stage; that is, the outcome observed in the cases varies across observations and causes appear to compete with one another. The cases are selected in advance with an eye toward randomness or the degree to which they represent the general population. The goal is to explain why the cases vary. Variable-oriented approaches to cross-case analysis are a challenge to conduct because fair comparisons are difficult to achieve and the multitude of factors that are associated with social phenomena are often too numerous to disentangle. In case-oriented research, commonalities across multiple instances of a phenomenon may contribute to conditional generalizations (MILES & HUBERMAN, 1994). The researcher can thus demonstrate that the outcomes in the cases selected are in fact enough alike to be treated as instances of the same thing. The central question of interest to the case-oriented researcher is in what ways the cases are alike. Therefore, special emphasis is given to the case itself instead of on variables across cases. Examples that illustrate the complexity of this approach are case studies that focus on the role of violence in schoolyard bullying and national warfare. Both case studies are about violence, but the scale and scope of the violence in the respective contexts are likely incommensurable and difficult to compare or contrast. Still one is immediately attracted to the prospect of crossover and mutual illumination. Thus, in a variable-oriented approach, factors known to be involved in violence, such as resources and perceptions of vulnerabilities, could be used to evaluate both cases independently before comparing factors between a case of schoolyard bullying and a case of war-mongering states to explain and predict violent behavior. On the other hand, in a case-oriented approach, one could conceivably compare two cases of "swarming" in schools with two cases of "swarming"-like behavior in war-mongering nation states to search for or construct similar processes that appear to lead to violent behaviors. [11]

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In this section, several variable-oriented and case-oriented approaches that are applicable to cross-case analysis are discussed by drawing upon the more extensive reviews of these approaches by GEORGE and BENNETT (2005) and MILES and HUBERMAN (1994). For variable-oriented cross-case analyses, several well-known research techniques include: MILLS' Methods, Case Survey, and Before-After research design. For case-oriented cross-case analyses, several well-known techniques include: Most different design, Typologies, Multicase Methods, and Process-tracing. [12]

3.1 Variable-oriented approaches to cross-case analysis

MILLS' methods. MILLS' (1843) famous comparative system of logic involves a method of agreement and a method of difference as two potential analytic techniques for comparing cases. The method of agreement identifies a similarity in the independent variable associated with a common outcome in two or more cases. The method of difference identifies independent variables associated with different outcomes. MILLS' methods require eliminating candidate causes for the outcome. In the method of difference for example, the condition that is not present in both cases where the outcomes were different, could be considered a possible causal factor in the variance between outcomes. The factor(s) that survive this systematic process of elimination are inferentially connected to the outcomes. MILLS himself noted some serious obstacles to his comparative system of logic, especially when applied to studies in social science. Social phenomena are often rooted in a complex web of causes, which are difficult if not impossible to isolate as deterministic. That leaves the researcher open to the danger of false positives. GEORGE and BENNETT (2005), who conducted an extensive review of comparative techniques, suggest that MILLS' methods can work if the causal relationship involves only one factor that is either necessary or sufficient for a specified outcome, if all causally relevant variables are identified prior to the analysis, and if cases that represent the full range of possible causal paths are available for study. GEORGE and BENNETT contend that there are few theories in the social sphere that are strong enough to support general claims of necessity or sufficiency for single variables (2005, p.157). [13]

Case survey method. The case survey method (YIN, 1994, 2003) involves gathering evidence from a large set of cases (e.g., 250) so that statistical analyses can be performed on the variables pertinent to all the cases. Case surveys are challenging to carry out because researchers seldom study so many cases and they rarely find perfectly comparable cases. Furthermore, increasing the number of cases often means making assumptions of homogeneity that are simply unjustifiable. An example of a case survey method is a study of the cultural antecedents of procrastination wherein large numbers of individuals from all over the world would be analyzed as separate case studies within a case survey method. [14]

Before-after design. Another method for cross-case analysis is the before-after design. The before-after design offers some level of control by dividing one case into two sub-cases. Some event or critical juncture in a natural setting creates the

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conditions for a before and after investigation. One of the assumptions on which the before-after design is based, is that only one variable changes, dividing the longitudinal case neatly in two. Determining the change in a variable is difficult unless a careful analysis of all factors involved in the case is conducted over the same period of time. An example of this type of cross-case analysis is the study of online communication in a science course where patterns of communication are analyzed before and after a major course assignment. [15]

3.2 Case-oriented approaches to cross-case analysis

Most different design. Some social scientists have abandoned the quest for controlled comparison in favor of PRZEWORKSI and TEUNE's (1982) most different design. A most-different research design deliberately seeks to compare cases that differ as much as possible in order to find similar processes or outcomes in diverse sets of cases. This case-oriented approach emphasizes diversity in the selection of cases (GEORGE & BENNETT, 2005, p.165). The power of the most different design lies in its ability to extend the lessons learned in single cases to inform another case and to uncover similar processes in unexpected contexts. Cross-case comparisons of school principals and CEO's of large auto companies would be one example of a most different design. While schools and auto companies do not, on the surface, appear to be meaningfully comparable, it may be fruitful to compare the work habits of CEOs who produce cars and their organization techniques with those of school principals who view schools as organizations with students as products. [16]

Typologies. Cross-case comparison can support the creation of clusters or families of phenomena. Sets of cases are categorized into clusters of groups that share certain patterns or configurations. Sometimes the clusters can be ordered or sorted along several dimensions. For example, DENZIN (1989) suggests deconstructing prior conceptions of a particular phenomenon and then collecting multiple cases and bracketing them for essential elements and components across cases. The essential elements are then rebuilt into an ordered whole (e.g., construction of the alcoholic self) and put back into the social context. In another typologizing effort, the pathway to the outcome is inspected and compared among a set of cases. Like process tracing below, the same outcome is theorized according to different pathways. For example, science education reforms that better integrate technology would be considered a sub-class of the general category of educational reforms. Typologies share a specified combination of factors, but these are not necessarily causal, mutually exclusive or exhaustive. GEORGE and BENNETT (2005) argue that a typological regularity can be sought through previously unexamined causal paths or a building block approach. Typologizing supports the construction of theories by identifying the sub-classes of a major phenomenon. [17]

Multicase methods. This method has recently been introduced by STAKE (2006) and focuses on the quintain, which is a common focus (organization, campaign, problem) for a set of case studies. The quintain, for example, might be mega-events, like the Olympic Games or a school district that wishes to incorporate

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technology at all of its sites. The quintain is comprised of case studies that have both common and unique issues. The common issues address important and complex problems about which disagreement exists. The impacts of mega-events on host regions might be elicited from case studies done at different Olympic sites. Common research questions (e.g., what is the economic impact of enhanced international image of the host region?) tie together all of the case studies. A cross-case analysis of these cases facilitates a greater understanding of the quintain (again mega-events). According to STAKE, after cross-case analysis, researchers can make assertions about the quintain. These assertions are then applied to the individual case studies to determine the extent to which the case studies reflect the quintain. The degree of congruity or disparity speaks to the uniformity of the quintain and the power of cross-case analysis (STAKE, 2006). [18]

Process-tracing. In this method, the progression of events that may have led to an outcome in a single case is traced (GEORGE & BENNETT, 2005). Process-tracing forces the researcher to consider alternative paths through which the outcome could have occurred, and it offers the possibility of mapping out one or more potential causal paths that are consistent with the outcome. Cross-case analysis allows the researcher to develop a typological theory by charting the repertoire of causal paths that reveal given outcomes as well as the conditions under which they occur. In process-tracing, all the intervening steps within a case must be predicted by a hypothesis or else the hypothesis is amended. Process-tracing generally takes the form of a detailed narrative in which the unfolding of a story is theoretically oriented. [19]

In addition to variable and case-oriented approaches, some analytic techniques are worth mentioning, such as stacking, building truth tables, and constructing narrative models. MILES and HUBERMAN (1994) suggest that these techniques are a mixture of variable and case-oriented approaches. These mixed techniques are mentioned here because any of the approaches discussed above can also utilize these techniques. The authors refer to these three techniques as data display and analysis techniques because they help to visualize sets of cases, and they bring case relationships to the surface in ways that invites and facilitates comparison. In the stacking comparable cases technique, a series of cases are displayed in a meta-matrix by fields of interest (MILES & HUBERMAN, 1994). Each case is condensed in a form that permits a systematic visualization and comparison of all the cases at once. [20]

The "qualitative comparative analysis" or QCA technique, developed by RAGIN (1993), allows for the analysis of certain aspects of the case without obscuring it. QCA is based on Boolean analysis where relationships among the cases are built by the use of conjunctions (and, or, not). This approach to synthesizing cases involves a technique that arranges cases in a "truth table" by variable in order to study common causes or outcomes. Conjunctions are utilized to locate relationships within the truth tables. [21]

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The third technique discussed here was developed by GOLDSTONE (1997). He suggests that narratives are the keys to cross-case analysis. Narratives can preserve the essence of the case during cross-case analysis. It could also be argued that constructing narrative models helps to facilitate comparison by encapsulating the case as a storyline. [22]

In summary, there are multiple research techniques to conduct cross-case analyses. Variable-oriented approaches to cross-case comparison tend to pay greater attention to the variables across cases rather than the case itself. Variables are compared across cases in order to delineate pathways that may have led to particular outcomes. These pathways are often represented as probabilistic relationships among variables. The complexity and context of individual cases is not at the center of variable-oriented approaches. Case-oriented approaches, on the other hand, such as creating typologies, are more particularistic. This approach can show how a story unfolded in different cases, how researchers can make sense of the original case, or suggest new typologies, classes or families of a social phenomenon. Visualization techniques, such as stacking cases, can be utilized by either approach to invite and show comparison. Advantages of cross-case analysis that emerge from these techniques are:

1. the case content is made available to the researcher in an easily accessible form;
2. cases are clustered and represented in a visual display to facilitate comparison by the researcher and by others;
3. cases are compared in a method that either centers on the case or on the variables, depending on the goal of the researcher, and
4. findings of the case and the cross-case comparison are shared with others. [23]

4. Several Issues for the Case Study Researcher Engaged in Cross-Case Analysis

While there are a number of scholars who suggest that cross-case analysis can enhance a researcher's contribution to theory and method (cf. ECKSTEIN, 2002; RUESCHEMEYER, 2003), there are others who are less optimistic about comparing cases. Counter- arguments stem from an epistemological conviction that case knowledge emerges from a dense descriptive study of the particularities of a case. Comparison, the counter-argument goes, obscures case knowledge including knowledge not germane to the comparison (PEATTIE, 2001). Indeed, there are long-standing tensions between deeply contextualized and particularistic case knowledge and multiple case study research (FOREMAN, 1948; ALLPORT, 1962; MOLENAAR, 2004). To begin to reduce the tensions among idiographic and nomothetic research traditions, case study researchers must recall their original goals for the cross-case analysis. As mentioned previously, goals for engaging in a cross-case analysis can include, for example: further illustration, concept and hypothesis development, prediction, and empathic portrayals. [24]

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Researchers' goals notwithstanding, the cross-case analyst will also be confronted with questions about the generalizability of the conclusions emerging from the analysis and the ability of the researcher to justify any comparison beyond the set of cases studied. As suggested by KHAN (2007), positivist notions of generalizability have been largely abandoned or modified in social science and case study scholarship (SCHOFIELD, 1990; DONMOYER, 1990; GUBA & LINCOLN; 1981). Generalizations have been recognized as contextual, having half-lives (CRONBACH, 1975) that require updating (even in experimental research). It is far easier, and more epistemologically sound, simply to give up on the idea of generalization; if generalizations are accepted, they should be as indeterminate, relative, and time and context-bound (LINCOLN & GUBA, 2000, p. 32). [25]

Instead of positivist notions of generalizability, new concepts have emerged to extend and amplify the impact of a single case beyond the case itself (YIN, 2003; BECKER, 1990; SMALING, 2003). For example, GOETZ and LECOMPTE (1984) recognized that the findings from case studies cannot be generalized in a probabilistic sense, but that findings from case studies may still be relevant to other contexts. "Comparability" is a concept they proposed to address the issue of generalizability from a single case or cross-case analysis. Comparability is the degree to which the parts of a study are sufficiently well described and defined that other researchers can use the results of the study as a basis for comparison. "Translatability" is a similar concept but refers to a clear description of one's theoretical stance and research techniques. [26]

While it is not the purpose of this paper to elaborate on idiographic and nomothetic debates or delineate all classes of generalization for the cross-case analyst, we recommend that interested case study researchers explore idiographic generalization (ALLPORT, 1962), analogical generalization (SMALING, 2003), analytic generalization (YIN, 2003), and naturalistic generalization (STAKE, 2005) as alternative forms of generalization that can be invoked to rationalize cross-case analyses. In addition to developing a stance on generalizability, there will be at least three accompanying, practical concerns for case study researchers to attend to before embarking upon their cross-case analysis:

1. preserving the essence of the cases,
2. reducing or stripping the case of context, and
3. selecting appropriate cases to compare [27]

Preserving the uniqueness of cases. SILVERSTEIN (1988) states that cross-case analysis must reconcile the preservation of the uniqueness of the case while attempting to analyze the case across other cases. The concern is that the complexity of meaning (from each case) might get lost when the content is simplified in order to make comparison possible (TESCH, 1990). While comparing multiple case studies holds great potential to inform theory, RUESCHEMEYER cautions that the researcher must "increase the number of

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cross-case comparisons without losing the advantage of close familiarity with the complexity of cases" (2003, p.323). The authors' stance, and the stance of others (STAKE, 2006), is that it is possible to learn from both the uniqueness and commonality of a case. By providing ample contextualized details of the cases and findings of cross-case analysis, a researcher can conceivably preserve the uniqueness of a case and convey the value of their engagement with a cross-case analysis. [28]

Contextual stripping. In cross-case analysis, the contextualized origins of each case are in danger of being lost as cases are compared, especially if a variable-oriented approach is adopted. However, according to AYRES, KAVANAUGH, and KNAFL (2003), losing some contextual detail may be consistent with the goals of cross-case comparison, which is to identify themes across cases. TESCH (1990) described cross-case comparison as essentially a "decontextualization and recontextualization" of cases. The process is as follows: case study data are separated into units of meaning (decontextualized because they are separated from the individual cases) and then recontextualized as they are later integrated and clustered into themes. The themes, which are a reduced data set, can help to explore relationships. The origin of each unit of meaning is less important than its membership in a group of like units. AYRES et al. (2003) referred to this approach as "moving between across- and within-case comparisons" (2003, p.875). Such a cross-case synthesis, according to these authors, achieves its authenticity in the immersion within individual cases. [29]

In a similar approach to cross-case comparison, KNAFL (as cited in AYRES et al., 2003) reduced the contextual stripping in a cross-case analysis of family management styles during illness. KNAFL first identified general themes that shaped the experience of families dealing with illness (searched for commonalities across accounts). Secondly, she delineated variation within the themes (across individual family members), and thirdly, created a "thematic profile" for each family member and family unit (within case analysis). Finally, she offered a differentiation of family management styles (across families case analysis). Themes such as being a burden ended up playing a role in illness management style. Sub-themes emerged when the accounts of individual family members were compared with that of the family as a unit. Within-case comparisons were represented as narrative case summaries and cross-case comparisons were displayed as a grid using a database manager to identify clusters of families with similar configurations. In both AYRE’s and KNAFL's approaches to cross-case analysis, attempts to preserve the uniqueness and authenticity of the case were successful. [30]

Selection of cases. Generally, in variable-oriented approaches, the number of cases to compare should be high, whereas in the case-oriented approach, the number of cases to compare is generally low (but not less than two). In both instances, the researcher is advised to search for comparable cases until they are satisfied that the search is no longer yielding new insights or until theoretical saturation has been achieved. Variable-oriented researchers support comparison of cases that are fairly similar in order to achieve a level of control that can foster

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predictability and idiographic or nomothetic generalizations. Case-oriented research can support the comparison of cases that are ostensibly very different. Earlier, the example of a cross-case comparison study of school principals and CEO's was introduced. At face value, such a comparison might be challenging since the contexts and roles are so different. However, a principal focused on cultivating citizenship and academic achievement may have something in common with a CEO who runs a car manufacturing plant and is focused on production of vehicles and car performance. Both are attempting to motivate individuals to produce a set of outcomes in a certain time span. It is possible to imagine both case studies featuring interviews of a sampling of students and workers discussing their perceptions of accomplishment and alienation in regards to their duties and responsibilities. The selections of cases, and their corresponding units of analyses, are an important methodological consideration in case study comparisons and should be related to the overall goals of the case study researcher. [31]

5. The Foresee Database Project

With the above techniques and considerations regarding cross-case analysis in mind, an online database, known as the Foresee or 4C (Cross-Case Comparisons and Contrasts) was developed. The Foresee database utilizes Web 2.0 capacities to bring together case study researchers to perform cross-case analysis, and thus, to mobilize new knowledge. The long-term objectives of the database are, first, to promote cross-case analysis as a research method that facilitates the comparison of commonalities and difference in cases and second, to establish an online research community that facilitates dialogue and the mobilization of case study knowledge. In this section, the design principles and features of the 4C database are described. [32]

5.1 Design principles of the 4C database

The aforementioned assumptions regarding how researchers develop expertise informed the creation of four design principles to guide the development of the database. The four design principles are:

1. analyzing cases from different contexts can build common ground between case study researchers from multiple disciplines and diverse backgrounds;
2. cross-case analysis involves a set of cases that are indexed, accessible, and can be probed visually and conceptually by the researcher;
3. cross-case analysis can be facilitated by constructing meaningful linkages and relationships, and
4. in a cross-case analysis, researchers should attempt to preserve the richness and uniqueness of the case. [33]

These four principles were incorporated in the design of the database. The first and second principles were incorporated by applying the technique of stacking comparable cases. This means that one case is condensed and placed above

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and below another case or cases in a "meta-matrix" view, where cases are visualized in a table according to set fields. The matrix view offers a first pass visual comparison of cases. The meta-matrix also supports hyperlinking to uncondensed versions of the case to preserve the case in its original form. [34]

The third design principle incorporates RAGIN's qualitative comparative analysis. This method offers an attractive strategy for using conjunctions, and, or, but, which makes it possible to include some case studies and exclude others. For example, case studies that address both "Education" and "Chemistry" can be selected from the database. The third principle also dictates the use of "tags". Tags are personal, adaptable, and descriptive terms that can be applied to a body of information as metadata (CAMERON, 2004; HAMMOND et al., 2005; MATHES, 2004; SACCO, 2004). The ability to tag means a case study researcher could conceivably create a tag (e.g., "media") and apply it to his or her case study data on, for example, public anti-smoking advertisements. Another researcher could tag the same case with the tag "social marketing." In this way, one researcher could gain access to all the researchers who employed the same tag "media." Another researcher could determine that their case study data contains similar parameters and tag this information as "media." Thus, tagging can facilitate cross-case comparisons of media campaigns aimed at reducing smoking or media-based health promotion campaigns. [35]

The fourth design principle draws on PRZEWORKSI and TEUNE's (1982) most different research design, which argues for comparing diverse sets of cases because these could generate unforeseen discoveries. To promote this discovery, the authors opened the database to the possibility of researcher's building personal libraries of cases. In addition, researchers are also required to submit cases. The possibility of building a collective as well as personal library builds capacity by offering cases from many fields of endeavor. There are pragmatic and theoretical reasons for being able to do both, which will be discussed in the next section on the affordances of the 4C database. [36]

5.2 Affordances of the 4C database

Case study researchers can access the 4C database upon registration at http://www.foresee-database.com/. The database is currently housed on a university server. Figure 1 shows the splash page each case study researcher encounters once logging in and becoming members of the system.

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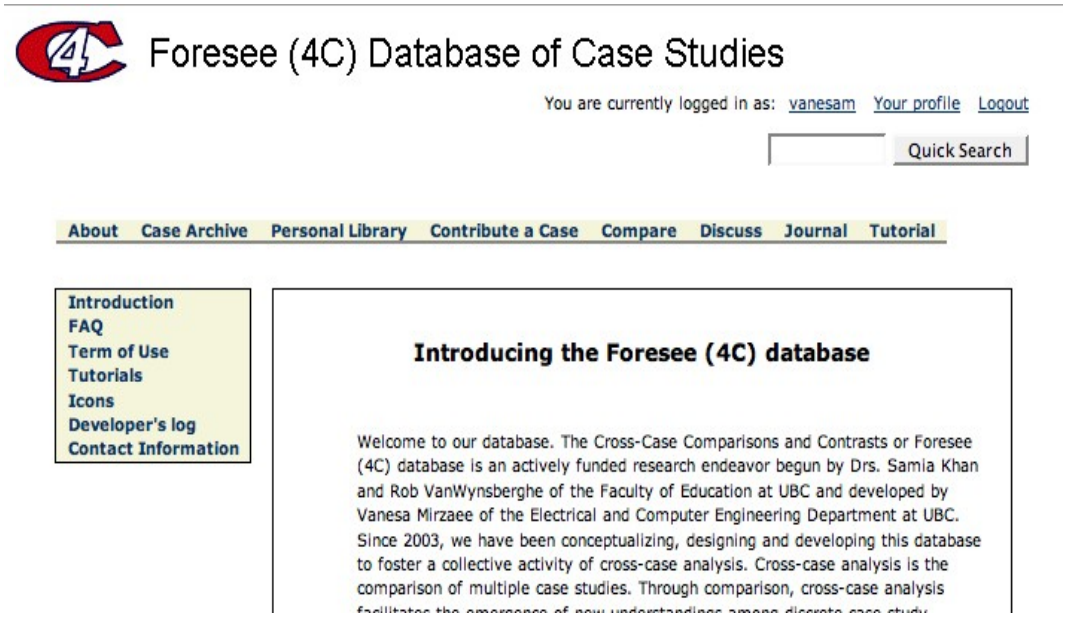

Figure 1: 4C splash page [37]

Firstly, the 4C database records seven aspects of case studies that are submitted: title, focus of study, purpose, research tools, what was learned, related studies, and tags. These seven aspects, or categories, are based on the outcomes of a user study with case study researchers in 2004, and establish common ground among the 4C collective. The case categories are also congruent with most primary journal publishing requirements. Using our example, the "media" tag fits under the tag case category where it can be accessed and analyzed by other researchers much like a keyword. [38]

4C members can view the collection of submitted and archived case studies as a "list" or as a "meta- matrix" view. Clustering the cases in a central visual display affords what MILES and HUBERMAN (1994) call the "first deep dive" into cross-case analysis; that is, researchers can scroll through the meta-matrix, look across rows or down columns and perform a squint analysis. This gives 4C members the opportunity to scan potential cases for comparison. [39]

Secondly, 4C members can search the database and select candidate cases for comparison by using the search functions and conducting their search by title, author, content, authors' name, or researcher recommendation. Thirdly, once cases have been selected for comparison, 4C members have access to two methods for cross-case analysis that build relationships among cases. A set of comparison tools allows members to use Boolean terms and code multiple cases with tags. [40]

Finally, the 4C database helps to enable the publication of cross-case research by offering a multi-way dialogue forum among prospective researchers as well as the public annotations of case studies. A set of screenshots are included to illustrate these affordances. [41]

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Collective Capacity. As Figure 2 depicts, 4C members contribute cases to a collective case study archive. The cases are indexed chronologically as well as by tags. Researchers can gain access to submitted cases and works in progress from a wide range of disciplines, and the public archiving of researchers' cases, tags and researchers' notes facilitates greater learning from cases. The contact information of the researchers who have submitted their case studies to the 4C database is available for other researchers, which enables researchers to further discuss cases and explore research connections.

Figure 2: Case archive in list view [42]

Personalization of database. Researchers can build their own personal library of cases suitable for work on contained research projects (see Figure 3). Researchers can also construct personal notes on each case submitted that are not viewable to the community. Researchers are able to create their own tags for cases that are different or the same as the submitter's tags.

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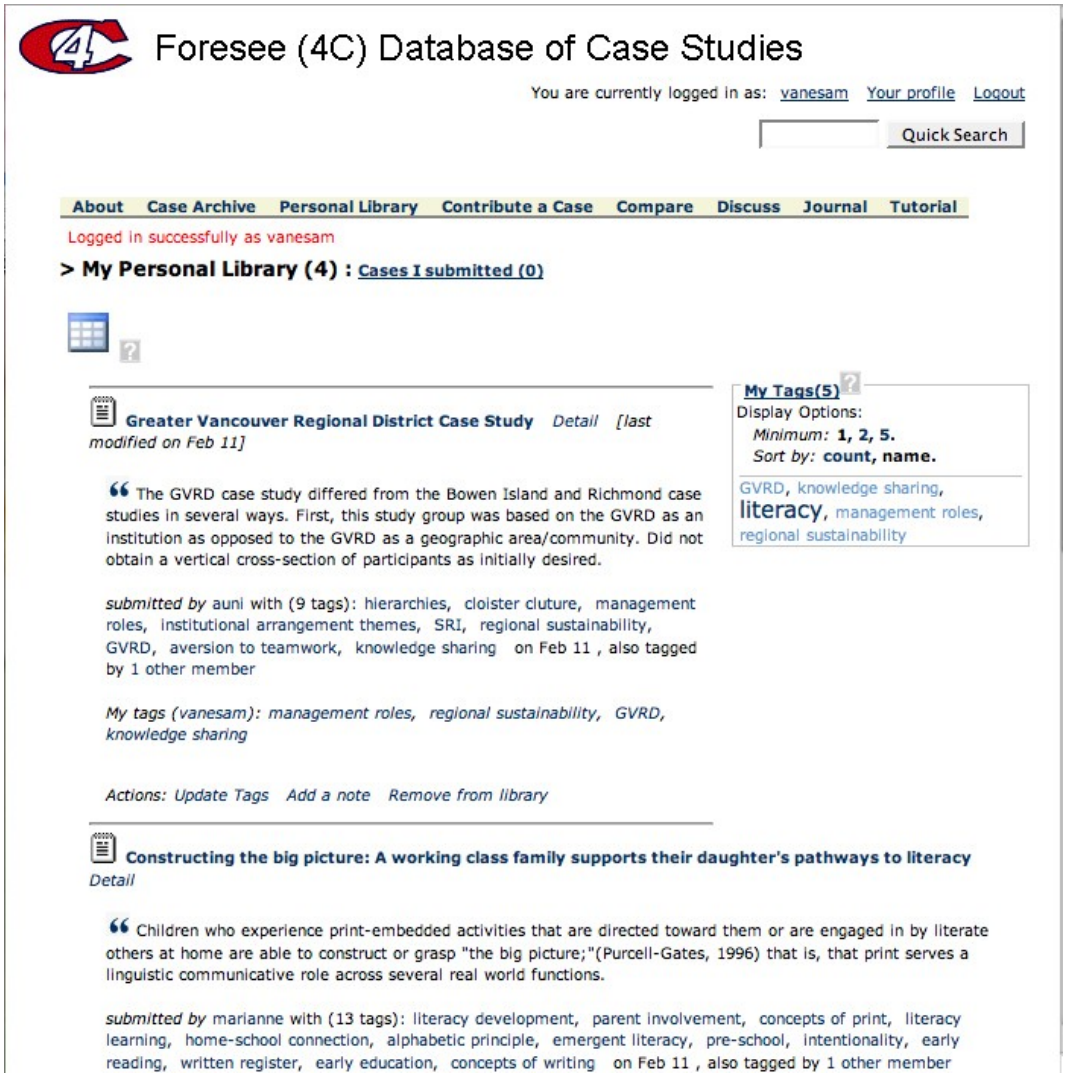

Figure 3: A 4C member's personal library of cases [43]

Visual display. 4C database offers a visual display to view the studies as a "meta-matrix" where each study's text is structured and indexed into separate field or case categories. Figure 4 shows how a visual comparison is supported within a meta-matrix view of 4C case studies.

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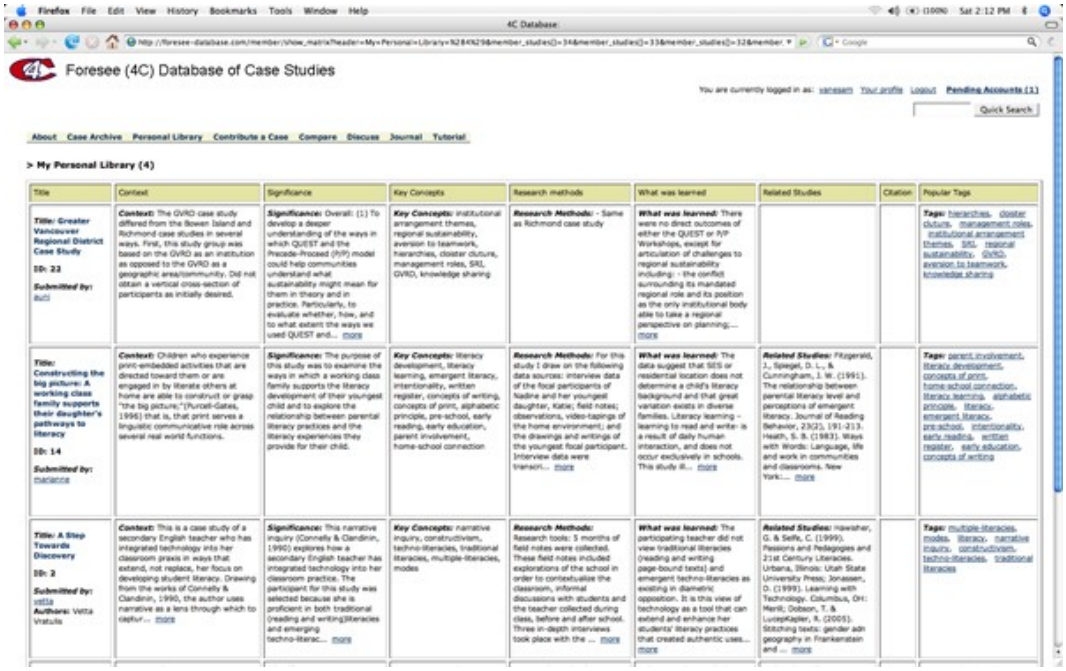

Figure 4: A meta-matrix view, see the PDF file for an improved version [44]

Advanced search and select tools. 4C's option to compare and contrast the same case categories between different studies with the use of Boolean search terms allows a researcher to find patterns across the database. Figure 5 outlines all the selection choices, and Figure 6 shows how Boolean search terms can be applied to compare cases.

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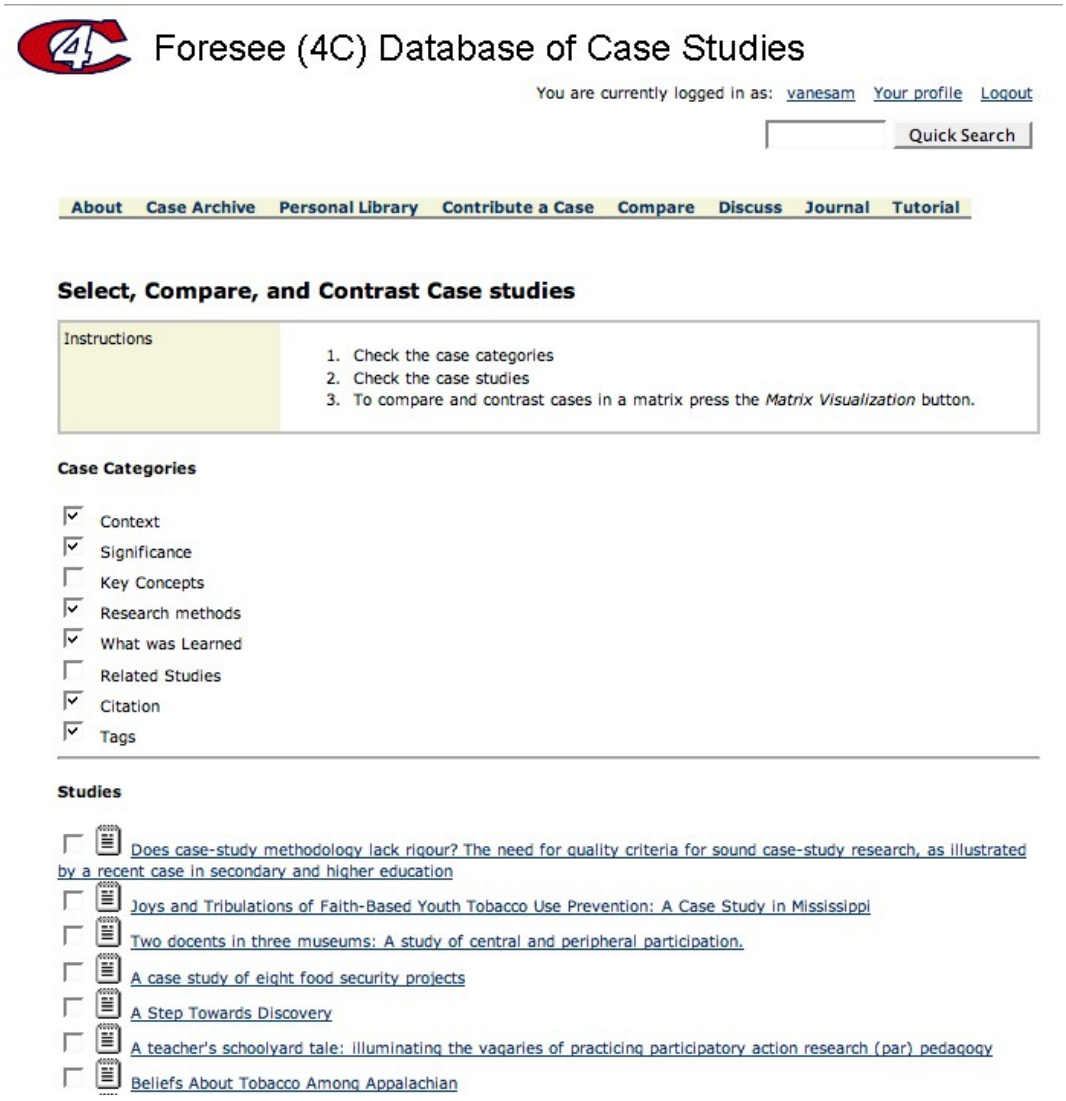

Figure 5: Selection choices

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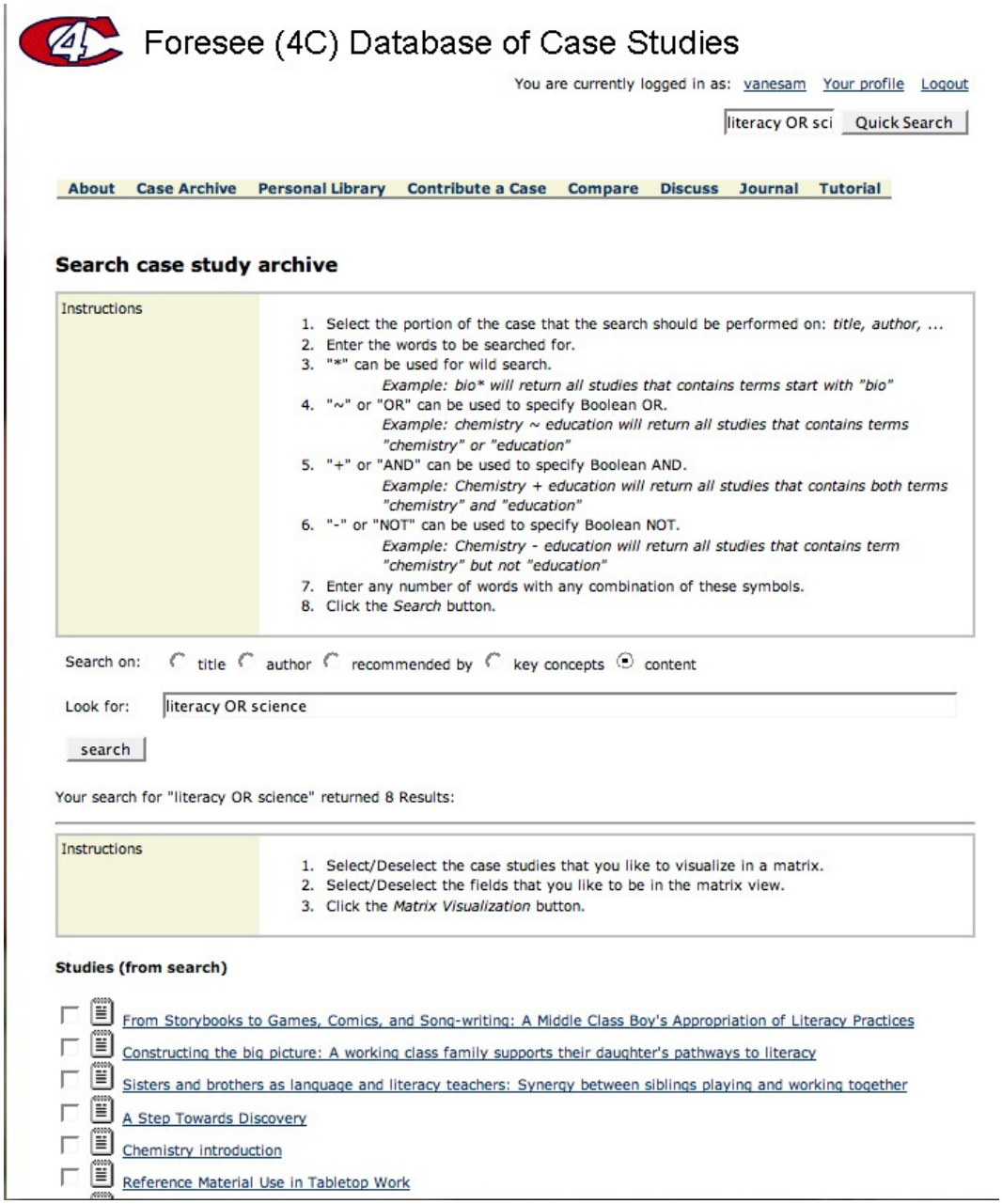

Figure 6: Boolean search [45]

Conceptual and Conjunctive Relationships. 4C's use of tags helps researchers make comparisons. Tags provide not only a way of locating and comparing cases, but user-driven naming of relationships via tags also increases the flexibility of typical databases. The researcher can use terms to link various cases and search case studies by these terms (GRUDIN, 1994; GUERRERO & FULLER, 2001, PAHLEVI & KITAGAWA, 2003; SCHACHTER, N.D.; STAR, 1998; YEE, SWEARINGEN, LI & HEARST, 2003). The database enables the researcher to view, navigate, and subscribe to case content by researchers' tag(s). In addition, the database also makes it possible to see all the tags that have been applied by all the researchers to the case study. One researcher can compare their tags to another researcher's to learn about the kinds of terms that

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are applied to certain information. Thus, using the 4C database, researchers can create a personal view of all indexed (i.e., tagged) content, attach personalized tags attached to any indexed item and view, navigate, and subscribe to indexed content by researcher, tag(s) or any combination of these. [46]

As Figure 7 illustrates, the researcher is also able to see all tags that were applied by researchers of the case study. Tags for a case study are automatically available to the researcher. Furthermore, the researcher can read through tag lists and find other relevant case studies. Finally, Figure 7 shows related tags that are all the tags that include literacy "and" another tag term. Tagging has the potential to develop meaningful links across cases: the "cases" are indexed when they are stored in memory (or entered into the database). However, accessing this knowledge could also reflect the conditions under which the data are retrieved. The previous experience or case could be reframed in a way that was similar to the current one and retrieved as it was re-conceptualized or "tagged".

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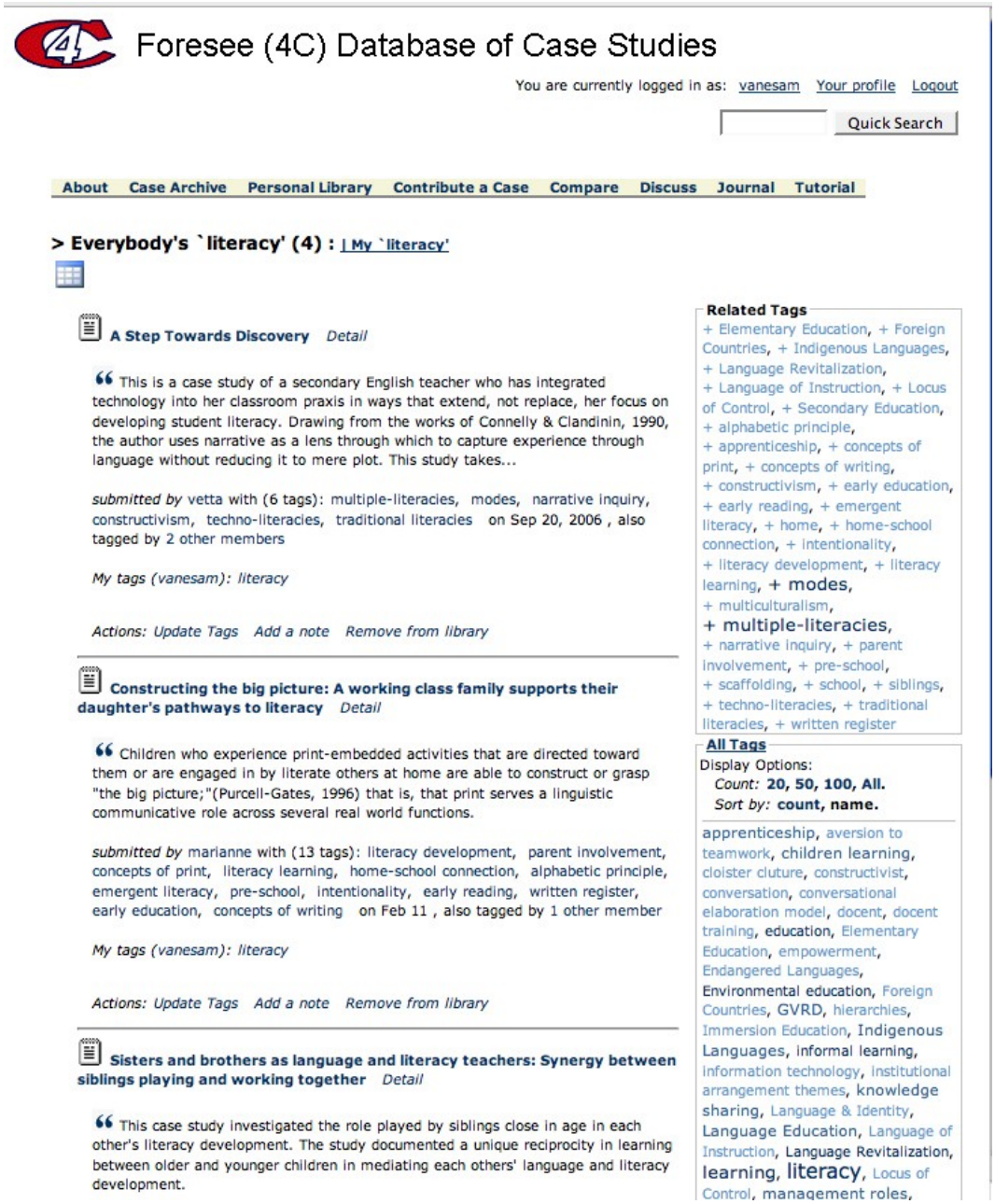

Figure 7: The "Literacy" tag "and" other tags [47]

Tutorials and support. The 4C database offers tutorials on how to use the database to conduct cross-case analysis. Although researchers can perform cross-case analysis in multiple ways from every page on the database, the database scaffolds the process of cross-case analysis for researchers by:

- suggesting a trajectory involving: clustering cases, performing a squint analysis, selecting comparable cases, comparing cases, and publishing;
- providing icons and a site map to ease navigation through the database;

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- offering a frequently asked questions page, which provides definitions of terms, and
- including contacts to site administrators. [48]

6. How 4C is Different from Computer-Assisted Qualitative Data Analysis Tools and Online Repositories

The 4C database is different from computer-assisted qualitative data analysis software (CAQDAS) and database repositories such as libraries. Researchers often utilize CAQDAS software to code their data, construct categories and create themes. The result of analyzing data using CAQDAS is coded material that is often organized by an individual computer. Cross-case analysis, if conducted, is often done by hand after the data have been coded and contained in the computer. With the 4C database, however, the researcher can combine numerous case studies on any topic of interest (e.g. science education, urban sustainability). 4C members can utilize the database's distributed functionality to perform cross-case analysis from every page. Furthermore, the 4C database enables researchers to find other researchers with similar interests. 4C can establish dialog among researchers in a community and create an online environment that facilitates the discovery and sharing of case knowledge. In its support of collaboration among case study researchers, the 4C database is different from CAQDAS. [49]

The 4C database also favorably compares to scholarly online research library databases (e.g. ERIC, EDUDATA, CiteSeer, Medline, CINAHL, Web of Science, Canadian Education Fulltext, Pro-Quest Digital Dissertations, and The National Library of Canada) or e-libraries where people can post their research (e.g., SSRN http://ssrn.com/). Existing library databases lack user-driven search terms as well as effective ways of facilitating the comparison of case studies. Library searches are generally limited to metadata such as keyword, institution, author, or subject words, and do not adequately support the locating of meaningful case study research, or cross-case analyses. Moreover, traditional indexing methods are used to retrieve and analyze the research studies but these tools do not include research in progress, do not permit uploading and editing of data by the author, or do not involve researchers in building a community of users based on identifying and recommending research. On the other hand, the 4C database supports works in progress and allows further updates of case studies. The 4C database affords researchers with the opportunity to add their perspective or comments to these case studies and share these perspectives with other researchers. The user-driven naming of relationships via tags increases the flexibility and expansion of 4C databases by enabling the researcher to link cases with meaningful terms and to search case studies by these terms. Finally, unlike library repositories, 4C allows different individuals to present and recommend selected case studies of interest on a common problem and facilitates collaboration between these individuals. [50]

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The authors know of no other currently available, single, online tool that supports collaboration amongst case study researchers or allows them to create communities of interest, contribute case study data, discover and analyze existing case studies, perform cross-case analyses, recommend case studies to one another, and foster dialogue about case studies. [51]

7. Conclusion

In this paper, the authors suggest that the fundamental power of cross-case analysis emerges from understanding how expertise can be built and shared. Turning to theories of how people learn, we detected a form of cognitive cross-case analysis as a plausible hypothetical process involved in building expertise. We proposed that case study researchers have mobilized their knowledge of the original case when their cross-case analysis is made public. To support the mobilization of case study knowledge, we introduced the Foresee (4C) Database. The design of the Foresee Database was based upon: 1) the above hypotheses on the development of expertise 2) known techniques in cross-case analysis, such as stacking and qualitative comparative analysis, and 3) emerging Web 2.0 capacities, such as tagging and multi-way interactivity, to construct meaningful relationships. [52]

In terms of user perceptions, findings with case study researchers have been encouraging. The authors asked researchers to comment on the 4C database anonymously after using it. Three typical comments were:

> "This [cross-case] comparison makes it possible for me to develop expertise regarding home-school literacy practices, it helps refine my concepts, and it helps me think about theory in terms of validity across similar events but in different contexts [i.e., Contexts from different studies in the database]. It let me see patterns between concepts and among data. It afforded me the opportunity to take a closer look at my study, and in particular, to look more closely at my data."
>
> "The comparison of those studies [within the database] definitely brought new insight for me. The [comparison] showed me how all of them were carrying the same idea that there must be some kind of meaning to tobacco use prevention or control program in order for it to be successful."
>
> "The potential value of the cross-case analysis that I looked at involved seeing the notion of processes and practices in a new light. This comparison [with other cases in the database] has allowed me to see that my own study is much more built upon literary practices than I had realized." [53]

More research and application awaits the authors. Having taken steps to locate a theoretical framework and develop a set of design principles, we invite others to join this dialogue on cross-case analysis and knowledge mobilization. [54]

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Citation

Khan, Samia & VanWynsberghe, Robert (2008). Cultivating the Under-Mined: Cross-Case Analysis as Knowledge Mobilization [54 paragraphs]. *Forum Qualitative Sozialforschung / Forum: Qualitative Social Research*, *9*(1), Art. 34, http://nbn-resolving.de/urn:nbn:de:0114-fqs0801348.

Revised 7/2008

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