Topic Maps as Indexing Tools in E-Learning: Bridging Theoretical & Practical Gaps Between Information Retrieval and Educational Psychology

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Abstract: This paper describes an empirical study investigating the use of topic map technologies in an online course management system. Theories of cognition and psychology have long informed the production and implementation of instructional interventions in online learning environments. The author sheds some light on how theories of cognitive information retrieval can better formalise abstract notions of learner cognitions like task understanding and self-regulated learning. The manual development of education-related topic map ontologies must necessarily be based on a combined theory of information sciences and educational psychology. In an effort to illuminate the unified theory proposed herein, discussions are grounded in a practical case-study describing the development and implementation of a topic map currently in use at a large North American University. Results from a mixed method exploration of 38 graduate learners using a topic map index to browse a repository of instructor-annotated essays while tackling an ill-structured essay task suggest improved performance and task understanding over time. Interviews and logfiles show how the semantic nature of the topic map enabled individuals to pursue distinct paths while browsing essays depending on varying levels of task understanding.

Keywords: Topic Maps (ISO 13250), Indexing Technologies, Course Management Systems, E-Learning, Information Retrieval Theory, Educational Psychology

1. Introduction

The management of information and efficiency of information retrieval in a Course Management System (CMS) plays an important role in student learning. There exists significant concern that learners are unable to effectively use search-and-retrieval tools in CMSs to locate relevant information in completing a scholastic task [1]. Most CMSs employed in higher education have little capability to search for content within a course, or outside of a course, (e.g., in a related repository, digital library, or even the World Wide Web). An online course might include a page listing a set of Uniform Resource Indicators (URIs) that describe a particular topic, but a typical CMS has very little or no content management functionality. Information retrieval capabilities in a CMS are largely dependent on the power of local search engines which generally enable keyword-based search operations. An area of development that is exciting and holds great potential for the educational sphere is advanced search-and-retrieval capability, beyond even that provided by meta-data and hierarchical taxonomies encountered in the current generation of CMSs. One technology in particular, topic maps [2, 3], promises to provide flexible and powerful tools for searching and browsing content within a course, a learning object repository, a digital library, or across the web [4].

2. The Need for Research on Topic Maps Applications in Education

There is a paucity of educational technology-based research on how to harness the knowledge representation and decision-making procedures employed by learners to better enable them to traverse a body of information in, say, a CMS. Although there is growing acceptance and adoption of topic map technology in educational circles, there is very little education-based research concerning non-automated approaches to creating topic maps, or even educational applications of topic maps. There are encouraging signs, however. The development and evaluation of web-based topic maps for educational purposes has been recently discussed in peer-reviewed journal articles [4, 5, 6]. All these peer-reviewed pieces point to the need for work to be done in implementing, evaluating and furthering the use of topic maps in educational contexts. In a recently presented peer-reviewed conference paper, Lenne et al. describe a topic map-based learning environment, which operates on principles derived from organizational memory [7]. In Norway, there are instances of education-related projects using topic maps such as BrainBank [8], as well as the initiative by the Norwegian Education Directorate to build a topic map for the national curriculum [9]. Elsewhere, recent peer-reviewed conference papers [10, 11, 12] have also discussed experimental and quasi-experimental research demonstrating the improved search capabilities of topic
maps over web-based search engines. The discussions presented in the following pages will build upon the established pieces of work mentioned above and contribute new knowledge to the field of educational applications of topic maps by attempting to tease apart some of the theoretical considerations that will, hopefully, enable educators to better build topic maps for CMSs.

3. Topic Maps – A Brief Primer

Topic maps provide a form of indexing that (a) captures and displays the semantic relationships among topics, and (b) anchors resources to topics [13]. The power of topic maps lies in their ability to separate the relationships among topics from the actual resources that instantiate the topics. This separation of resources from the topics allows for flexibility in terms of allowing the user to modify topics and relations without having to recompile a database of resources. It also provides scalability since topic maps can be merged to create interconnected representations of complex domains. Different topic maps can be created to provide user-centred or discipline-centred views of the same resources. Topic maps can be compared, thereby offering insight into alternative conceptualizations of the resources. They can also be conjoined to provide a wider, comprehensive and multi-perspective view of a given domain of knowledge. Topic maps were chosen as an indexing technology for the educational venture reported herein, over Resource Descriptor Framework (RDF) or Ontology Web Language (OWL) due to its inherently intuitive structure and ease of construction. The flexibility and scalability of adding resources (such as essays and eventually, perhaps, articles assigned as readings for the class) and expanding the ontology of the domain using a topic map also tipped the scales in favour of this technology.

4. Educational Context – Overview

This paper concerns itself with the use of topic maps in an Online Learning Environment (OLE). Specifically, the paper explores the theoretical implications of designing simple ontologies for topic maps to be used in OLEs, from the perspectives of educational psychology and information retrieval. In order to ground the discussion herein, the paper will make reference to a real-life context i.e., essay writing activities for graduate students in the field of education. Thirty-eight learners registered in four different sessions a graduate classroom-based course in a large North American University recently availed of a neo-corpus (i.e., a collection of learner-generated artifacts), the contents of which were indexed using a topic map. The neo-corpus consisted of 132 instructor-annotated student essays; all essays were written for previous instantiations of said course. The 38 learners used the topic map to navigate the essays for a period of seven weeks with the objective of best performing on a weekly essay writing assignment. The topic map was created using Ontopia’s (www.ontopia.net) Ontopoly topic map editor and was rendered using Ontopia’s Omnigator tool. (see Figure 1 for a screen shot of the topic map index). Learners’ use of the topic map was tracked electronically and they were interviewed individually about their perceived utility of the topic map-based intervention and the educational writing tasks they were being asked to perform (see section 7).

Figure 1: Topic Map Index

5. Ontology Development

Given the variety of subjects that the student essays touched upon, as well as the range of grades that they received, the essays were indexed using the topic types of subject and grade. In addition, an author topic type enabled learners to browse by the individual writers of the essays (see Figure 2 for a screen shot of the grade index in the topic map). The ontology was manually developed by the instructor of the e-learning course, in conjunction with students who had previously taken the course.

Figure 2: Grade Index
6. Theoretical Discussion of Topic Map Ontology Design and Implementation

6.1 Topic Maps as Cognitive Tools

To convince CMS designers to adopt topic maps as indexing mechanisms we must demonstrate the latter’s theoretical grounding. In prying apart the cognitive and psycho-cognitive aspects of learning help, this paper builds a stable theoretical platform from where one can launch thoughtful discussions. Sugrue outlines some of the key characteristics that an OLE should adhere to if it is to act as a “cognitive tool” [14] (or as Gavriel Salomon puts it, if the computer is to become an “intellectual partner” of the learner [15]). Cognitive tools allow the learner to share and hence, ease the cognitive load [16] of performing an academic task, and afford opportunities to engage in more meaningful thinking and deep processing. To be classified as a cognitive tool, an OLE should include (a) the ability to represent information as organized in human memory, and allow for its subsequent retrieval; (b) opportunities for social collaboration; (c) authentic activities; and (d) the ability to represent cognitive-based student models of knowledge [14]. In the context of the project reported, topic maps allow the creation of valid representations of the information in the students’ essays (see Figure 3 for a screen shot of the topic map index for an essay), as well as the instructor’s annotations of the essays (see Figure 4 for a screen shot of an annotated student essay), thereby meeting the first and last criteria for acceptance as a cognitive tool. Interactions, as described in the next section, enable topic maps to meet the “social collaboration criteria, and the notion of authenticity is built into the nature of the ill-structured writing assignments. In short, the topic map-based neo-corpus described in the case study herein should be considered as cognitive tools as it meets all the abovementioned criteria.

6.2 Interactions Facilitated by Topic Maps

The neo-corpus of essays described in this paper enables two specific types of interactions [17], namely, learner-learner as well as learner-instructor, in ways that have not been seen before in OLEs. While most CMSs will tout the use of bulletin boards, chats or e-mail to effect interactions between students as well as with the teacher, the organization of student essays using topic maps enables learners to asynchronously tap into the minds of their fellow learners as well as delve deeper into the manner in which the instructor grades the same essays — without actually having to interact directly with them. Salomon’s theory of distributed cognition [18] plays an important role in the cementing the role of cognitive psychology in the development of indexes for CMSs. Salomon has long maintained that cognition is distributed among individuals, and that one constructs knowledge collaboratively through interactions among individuals as well as with artifacts that are relevant to the solving of a problem. Simply put, in the context of this project, the annotated student essays are artifacts in the learning environment and they are transformed, through learners’ interactions, into integral elements in the network of distributed cognition within the OLE. Perhaps future instantiations of the topic map index reported herein can take into account the notion of social tagging, and allow learners to build their own indexes/topic maps of the content. While such an idea would lend more authenticity to the activity of browsing the repository, it would compromise the degree to which the indexes could be considered valid and useful as a learning tool.

6.3 Topic Maps Reduce Cognitive Load

According to Sweller's Cognitive Load Theory (CLT) [16], the construction of schemata and the automation of cognitions related to solving a problem are assumed to be key functions in the process of learning. If the learner uses a limited amount of working memory resources to conduct
the construction of schemata and automation of said cognitions, there is a great possibility of learning being inhibited. In accordance with CLT, during problem-solving activities, working memory resources should be devoted to converting the more cognitive-heavy controlled processes to cognitive-light automated processes - the latter allowing problems to be solved with a small amount of effort. A study by Kalyuga et al. [19], using assumptions related to CLT, investigated the interaction between learner knowledge of a domain (high and low) and levels of instructional guidance (problem-solving and worked examples). The authors reported that participants (trainees in mechanical trade) with less experience in the domain benefited more from worked examples, whereas after gaining some experience and hence, greater knowledge of the domain, these same trainees benefited from problem-solving approaches. The topic map developed to navigate the neo-corpus of essays significantly reduced the cognitive load experienced by learners, as was evidenced through learners’ comments during individual interviews. Thirty-four of the 38 learners reported, in conversation, that the topic maps allowed them, in the words of one participant, to “concentrate and focus on internalizing the strategies that would enable them to meet the assessment criteria for the essays”. Interestingly, all 38 learners had limited domain knowledge before using the neo-corpus. As the domain knowledge increased, trend analyses indicated that learners significantly referred less to the neo-corpus and concentrated more on the problem-solving activity, i.e., the essay writing task, thereby supporting Kalyuga et al.’s hypothesis related to CLT. This lends support to the notion that the topic map used to navigate the neo-corpus eased learners’ cognitive load, thereby enabling them to apply themselves to the writing task.

6.4 Topic Maps as Information Processing Tools

It is also posited in this paper that the development of ontologies for education-related topic maps draws heavily from the now classic theory of Cognitive Information Processing (CIP) [20, 21]. Ill-structured tasks, of which essay-writing is a subset, have been researched under the lens of CIP theory, specifically under the area of cognitive problem representations. Studies reveal that the problem representations of experts are remarkably different from those of novices in a given field, and that an individual’s problem-solving abilities can, in part, be explained by these differences in problem representations [22, 23]. The development of ontologies for the topic map used in the project described herein are based on knowledge representations of the instructor, foremost, as well as from the content described in the essays themselves. By providing the learners with a manifestation of both the instructor’s understanding of a given domain and other learners’ impressions of the content, topic maps can allow novice representations to interact with those of an expert, and perhaps stimulate, in the novice, a renewed and more “expert-like” understanding of a given domain. This lends some credence to the notion that topic maps might be, in and of themselves, a learning tool, because the explicit navigation of the topic and association types might enable meaningful learning. The caveat to be mentioned here is that the act of meaning-making is highly dependent on the validity of the content presented. Trend analyses indicate that learners who navigated through more student essays were more apt to align their understanding of the assessment criteria for the task with those of the instructor’s and improve their performance on the writing assignment.

6.5 Viewing the Intersection between Educational Psychology and Information Retrieval

The use of topic maps to create a user-centred, navigable index of instructor-annotated essays needs to not only be grounded in theories of educational psychology, but also, necessarily, those of information retrieval. This bridge was created due to the need to ameliorate an abstract and rather slippery educational psychology-related phenomenon called “task understanding”. Viewed under a theory of academic self-regulation, task understanding refers to the interaction between individuals' perceptions about an academic task as well as their knowledge of themselves as learners. However, this explication of the process of task understanding has not explored, and hence, is not able to characterize the process by which learners conduct themselves while attempting to complete an ill-structured essay writing task by referring to artifacts stored in an OLE. Researchers in the areas of information seeking and information retrieval, based in the field of library and information sciences, have extensively investigated how individuals behave while looking for information, and have made recommendations on the design of information retrieval systems based on empirical research [24, 25]. Recent literature in the area has focused extensively on how individuals seek out information from online environments such as the World Wide Web, as well as intranets. This literature seems to be a good place to begin formulating an extended theoretical notion of task understanding. Perhaps, most importantly, a relatively new theoretical information retrieval model is in the process of being discussed within the information science research community, namely, Ingwersen ‘s Cognitive Information Retrieval (CIR) [26, 27]. Task understanding, when viewed in the intersection of paradigms of educational psychology and CIR, is dependent on the representations of information objects, the structures of the indexing and retrieval algorithms and socio-contextual elements, apart from just the cognitive structures that learners possess.

6.6 (Topic) “Mapping” Cognitive Information Retrieval Theory to Design Ontologies

Ingwersen has laid out the five major elements of the CIR theory [27]. Instead of repeating what Ingwersen lays out in
his piece, the following section maps some of these CIR elements to the design of topic map ontologies. The first CIR players are the information objects or knowledge sources as entities themselves, including their representations. These representations originate from the author(s) of the sources and necessarily depend on the representation(s) imposed by the indexer (human or machine) of the sources. In developing the topic map to navigate the neo-corpus of annotated essays, the ontology was dependent on the content of the essays as well as the instructor, who was considered a subject matter expert. The second set of CIR players is the system structures, such as the retrieval algorithms, which are normally generated by the designers of an information retrieval system. These system structures depend on the indexer(s) of the sources as well. In a manually-generated ontology such as the one used for the project reported herein, the retrieval algorithm is not machine-dependent, and hence did not need to be considered for the resultant topic map. The third CIR component refers to the interface functionalities of the information retrieval system. These are created by system designers and may consist of cognitive structures imposed by human intermediaries in the information retrieval process. For the project reported, these interface functionalities were already built into the Omnigator software used to display the topic map. The fourth element refers to the users’ cognitive space, which consists of the perceptions about the work task and the situational perceptions surrounding the task. The cognitive space of the user also includes representations of the current state of knowledge, problem and uncertainty states. The author firmly believes that CIR theory would accept that these cognitive spaces also subsume the cognitive and metacognitive strategies that the user has learnt in the past, and is able to draw upon to conduct, for example, means-ends analysis in problem-solving situations. The fifth and final piece of the CIR theory refers to the socio-organizational environments, including situational contexts, domain structures, the work tasks themselves, as well as access to strategies to solve problems. The creation of topic types to describe the various navigable indexes in a topic map enables learners to concretely visualize their cognitive spaces. In the same vein, the ability to browse essays in the neo-corpus via author names, subject area as well as assessment criteria clearly demonstrates the actualization of the work task. The resultant topic map is firmly grounded in the commonalities revealed by the interactions between the theories of CIR, CIP, self-regulation and educational psychology. It is the author’s contention that without this marriage between CIR and cognitive psychology, the ontology design would suffer from the drawbacks that plague most CMS indexing schemes.

6.7 Wrapping One’s Head Around Cognitive Information Retrieval

Ingwersen’s model emphasizes a constant interaction between the cognitive space of the user and the socio-contextualized environment; these interactions influence human behavior during the information retrieval event within the system. Moreover, dynamic interactions and interpretations change the information need and influence, in turn cognition and learning. As Ingwersen exhorts on page 10 of his landmark piece [27]: “... it is essential to uncover the kind of cognitive factors or structures that triggers users’ information needs and problem statements, for example, the reasons for users (mis)conceptions of classification structures or icons in systems. The cognitive nature of representative structures of information objects or knowledge sources are thus of interest directly”. Ingwersen’s conceptualization of CIR theory places great importance on elements of task understanding illuminated by current self-regulation theorists. According to CIR theory, the task and its perception by a user is considered just as valuable as the information need. In fact, Ingwersen also points out that the perception about the work task leads to the perceived information need. In a cognitive sense, the user’s perception of a work task is more likely to be stable over the information retrieval session time than the corresponding dynamic information need. Perception of work task is important, then, to provide the context necessary for the system to retrieve relevant information.

7 Research Statement

This study involved the creation, implementation and evaluation of a web-based, specialized, learner neo-corpus environment using a topic map technology as a front-end navigational and information retrieval tool. The design of the system facilitated the navigation of a corpus of student-generated essays based taxonomies grounded in (a) the knowledge representations of instructor and/or learner, (b) the assessment criteria being applied in grading the essays and (c) the content of the essays. The technology afforded by the topic map tool allowed access to specific portions of these student essays to view instructor annotations on how the essay conforms to or digresses from the assessment criteria. In terms of taxonomy development for categorizing of the essays, a combination of Hersh et al.’s idea [24] for task-based information retrieval and Kabel et al.’s procedure [25] of developing task-based ontologies was adopted. Upon extensive discussions/structured interviews with the various stakeholders, the ontology for representing the assessment criteria for the writing task as well as the interrelationships between the criteria were made explicit. In order to represent the ontology in a topic map, the ontology was transposed into a set of topics (with various topic types), associations (with various association types) and occurrences (c.f., Steven Pepper’s discussion [13] on the TAO of topic maps). See Figure 1 for a view of the main topic map index created for this research study.

7.1 Research Questions
This paper provides answers to the following pressing questions:

(a) How are learners’ perceptions of the assessment criteria for an ill-structured writing task influenced across time while exposed to an intervention in the form of a neo-corpus environment of annotated student essays?  
(b) Does the use of an instructional intervention in the form of a neo-corpus environment of annotated student essays promote a better aligned understanding of the assessment criteria for an ill-structured writing task?  

8 Method

8.1 Procedure

Thirty-eight student volunteers, 15 of whom were male, were recruited from a total of four sessions of a graduate, classroom and laboratory-based “theories of e-learning” course given by the author, between January 2006 and June 2007, at a large North American university. Pretests of content knowledge and essay writing ability were conducted during the first class of each session. A total of six essays were written by each of the 38 participants over course duration. Assessment criteria used to grade the essays were developed using Biggs’ SOLO taxonomy [28, 29]; criteria were made explicit to all students before the writing of the first essay. This writing assignment was classified as ill-structured because (a) the goals of the essay were not well-defined, (b) the constraints imposed by contextual factors were not readily apparent, (c) the solution to the essay-writing problem was not easily known and (d) there were multiple perspectives on both the solution and the solution path [30]. Each essay was accompanied by a self-assessment tool, the Task Analyzer and Performance Evaluator (TAPE), designed by the first author to help students articulate their justifications for meeting the assessment criteria. Essays were submitted and graded online, feedback was embedded and the assignments were returned to the student within 72 hours of submission along with comments on the portion of the TAPE that dealt with students’ justifications of having met the criteria. Learners had access to a repository of 132 instructor-annotated essays (also graded by the instructor using Biggs-based criteria) indexed by a manually constructed topic map (see figure 1 for the index page) over the course of instruction; log files of the topic map usage were collated for each learner. Semi-structured time-line interviews [31] were conducted with each learner, at least once, to discuss their use of the topic map. Consent forms were prepared and all data were collected in accordance with principles outlined by the American Psychological Association; ethical approval was obtained from the university’s Ethics Committee. While all participants were aware of the research program of their instructor, consent forms were only made available to the first author after final grades for the courses were submitted to the university.

8.2 Data Sources

Each participant agreed to give access to the following data:
- Demographic information
- Pre-test of e-learning related knowledge and essay writing
- Six written essays
- Written responses to TAPE for each essay
- Instructor assessment of performance on each essay (score:0 to 100)
- Instructor feedback to TAPE questions related to assessment criteria
- Interviews and logfiles related to use of topic map-based repository

8.3 Results of Investigation

The analysis was carried out using a triangulation mixed-method approach [32] – a combination of repeated measures tests and case study qualitative methods were used to uncover the nature of changes to learners’ task understanding. The entire cohort of 38 participants were treated as one intact group as there were no statistically significant differences seen in their pretest scores or as regarding their understanding of the assessment criteria across the four sessions, gender and prior work experience. All 228 essays were scored by two independent raters who were chosen based on their past university teaching experience, excellent command of the English language and high levels of prior content knowledge. Fleiss’ Kappa was calculated to be 0.87. Univariate repeated measures analyses revealed a steady, statistically significant linear improvement in terms of performance on the essays, $F(5,33)=14.18$, $p<.001$, partial $\eta^2=.68$, ES=1.46. As the course progressed, fewer students wrote incorrect justifications in their TAPE responses, $\chi^2(5)=12.99$, $p<.05$, $N=38$, signifying an increased level of task understanding.

The time-line interviews were analysed using an inductive content analysis methodology in HyperResearch®. Using individual students as unit of analyses, within case and cross-case comparisons revealed changing perceptions of task understandings across the participants. In general, student-generated perceptions of task understanding improved as the course progressed. Four participants reported not using the topic map to help them with the essay writing assignment as they felt that they had already “figured out how to tackle it” (in one participant’s words). The 34 other participants all reported weekly use of the repository, as was evidenced by the tracking data; each of them accessed the environment for at least half an hour a week. Use of the environment tapered off towards the last two weeks; 17 participants reported having gained mastery of the assignment and were able to focus on writing their essays without having to use the scaffolds provided by the repository. For the first three weeks of use, all the 34 weekly users reported using the repository to better understand the grading system used by the instructor. This was evidenced by the overwhelming use of the grade index
Evidence of self-regulatory behavior was seen in the fact that participants quickly realized that the instructor was more verbose in the feedback given to essays that scored in the B and C range, as opposed to the A range of grades (see figure 4 for annotated essay). Hence, essays which did not receive a high grade were more popular with the participants.

Finally, interviews revealed that all 34 weekly users had well-developed and valid representations of the assessment criteria by the end of the fourth week of browsing the repository. Subsequently, these 34 users showed individual differences in browsing the repository during the middle and final stages of the course. A majority of them used the repository using the subject index, thereby accessing essays based on the topics that had been discussed by the students (see figure 5 below for subject index).

9 Educational Significance

The author believes that the topic map-approach towards information retrieval is extensible and flexible, thereby offering numerous benefits to both content management and interventions promoting SRL. First, topic maps afford the possibility both to extend and to enrich views of content. Second, topic maps allow different languages or vocabulary to be used to describe the same content thereby increasing learner flexibility. Third, topic maps are scalable, thereby allowing the development of expanded views of content through the conjoining of maps created by different users describing the same corpus of knowledge.

Despite the convenience of the sample, the results of our evaluation are encouraging for future interdisciplinary investigations of this nature. Combining elements of the CIR theory with those of SRL allowed us to design a system where users found relevant content based on a semantic structure defined from a given perspective. Our results also provide encouraging evidence that the semantic structure of a topic map is itself possibly useful to particularly novices in a domain, as it provides what amounts to an externalization of some view of the contents derived from more expert or more informed sources. This semantic structure may be viewed as edifying by the user and may support learning about the structure and meanings inherent in a domain, or defined within the culture of experts working in the domain.

10 Conclusion – Why Should CMSs adopt Topic Maps?

Topic maps allow designers of OLEs to build enriched representations of academic work tasks, which can be viewed both from the perspective of the content covered in the task as well as from the perspective of the criteria used by the instructor in grading the academic task. While “subjects covered by essays” and “grade” might seem like obvious topic types to help describe the instructor-annotated essays in the neo-corpus, the preceding theoretical analysis of merging elements of educational psychology and information retrieval provide solid backing for the development of navigation indexes for CMSs of the future. Convincing designers of CMSs to adopt topic maps as an indexing scheme is not an easy task, but the following are arguments, offered by an anonymous topic map expert of a 2005 draft of this paper, that might help tilt the scale in favor of designing the next generation of CMSs with the help of topic maps:

1. The subject-centric nature of topic maps (topics as the core building block, constituting points of collocation) both helps learners to identify the core concepts within some new piece of knowledge that they are seeking to acquire, and substantially aids “findability’/ “searchability”, thus reducing the time spent searching and increasing the time available for knowledge acquisition.
2. The associative nature of topic maps (associations as the device that links topics into a meaningful structure) provides for ease of navigation, and even more importantly, perhaps -- reflects the way in which learners acquire new knowledge, i.e. by associatively fitting it into pre-existing knowledge structures that have already been acquired. The notion of schema reconstruction, popular within both the CIR and CIP theories, would easily explain this powerful feature of topic map-based indexes.
3. The classificatory nature of topic maps (i.e., the way in which topic maps encourages the classification of topics and associations into types) might conceivably help learners to acquire an overall understanding of the key concepts within a domain before having to bother about the details of the individuals, thus providing a more step-by-step approach to acquiring the knowledge.

References