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Investigating Task Understanding in Online Repositories Equipped with Topic Map Indexes: Implications for Improving Self-Regulatory Processes in Graduate Learners

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Recherche scientifique avec données empiriques

Abstract

Theories of cognitive information retrieval can work in concert with those of educational psychology to better formalize self-regulatory processes, such as task understanding, in online learning. Results from a prior statistical exploration of 38 graduate learners using a topic map (ISO 13250) index to browse an online repository of instructor-annotated essays in order to complete an ill-structured essay task indicate improved performance and task understanding. This follow-up study analyzes the inductive content of interviews and computer-based user traces for a theoretical sample of 12 of these 38 learners, showing how the semantic nature of the topic map enabled them to pursue distinct paths to browse essays according to individual task understanding and information need.

Keywords

Topic Maps (ISO 13250), online learning environments, self-regulated learning, cognitive information retrieval

Résumé

Les modèles de recherche d'information cognitive et de la psychologie de l'éducation peuvent travailler de pair pour mieux formaliser les processus reliés à l'autorégulation, comme la compréhension des tâches, dans un contexte d'apprentissage virtuel. Les résultats d'une étude antérieure de 38 élèves de maîtrise et de doctorat, lesquels utilisaient une carte thématique (ISO 13250) pour parcourir un ensemble d'épreuves écrites annotées et ainsi compléter une épreuve écrite mal structurée, semblent indiquer un rendement et une compréhension accrus de leurs tâches. Dans cette étude complémentaire, l'analyse inductive des entrevues et des fichiers journaux traces d'un échantillon théorique de 12 de ces 38 élèves montre comment la nature sémantique de la carte thématique a permis aux élèves de suivre des cheminements distincts en parcourant les épreuves écrites annotées selon leur degré de compréhension des tâches et leur besoin d'information.

Mots-clés

Les cartes thématiques (ISO 13250), les environnements d'apprentissage virtuels, la théorie d'autorégulation, le modèle de recherche d'information cognitive

Investigating Task Understanding in Online Repositories Equipped with Topic Map Indexes: Implications for Improving Self-Regulatory Processes in Graduate Learners

Introduction

There is a paucity of research on the development, implementation and evaluation of indexing technologies in e-learning course management systems and online repositories used for educational purposes (Shaw & Venkatesh, 2005). Moreover, very few approaches to the development of repository-based indexes have recognized the need to factor in the cognitive notion of stakeholder problem representation in the design of indexing technologies (Venkatesh, Shaw, Dicks, Lowerison, Zhang, & Sanjakdar, 2007), which would enable resultant ontologies to be based on work tasks (Venkatesh, 2008b). The purpose of this paper is twofold. First, it outlines a theoretical argument for why the development of indexes for online repositories should necessarily lie in the intersection of theories of information retrieval and educational psychology. Second, it presents the results of a follow-up study that expands on prior work (Venkatesh, 2008b) addressing 38 graduate learners' use of an indexing tool, namely topic maps technology (International Organization for Standardization [ISO] 13250: ISO/IEC Joint Technical Committee 1, 1999, 2002), which was designed to improve certain aspects of their academic self-regulated learning as they navigated a repository to complete an ill-structured writing task. The present qualitative study sheds new light on the relationship between learners' understanding of an ill-structured writing task and their information needs as they browsed large corpora in an online learning environment.

Theoretical Framework

Task understanding as a critical component of self-regulation

Self-regulated learners apply both cognitive and metacognitive strategies to complete academic tasks, taking into account contextual and task-specific conditions (Winne & Hadwin, 1998). While much is known about how to build self-regulatory competencies using sound instructional design principles, educational psychologists still struggle to understand and describe the interactions between the individual components of self-regulated learning (SRL). Perhaps this is an artifact of classic conceptions of SRL as a complex, process-oriented theoretical construct. This epistemological assumption makes it difficult to tease apart how learners view the rationale for completing an academic task and how well they monitor their performance in terms of the instructor's assessment criteria.

Task understanding, a critical phase in SRL when viewed from an educational psychology perspective, draws on two distinct but interacting elements, viz., individuals' perceptions of the academic task and of themselves as learners within a particular academic context (cf. Winne & Hadwin, 1998). Learners' perceptions of the academic task include both the nature of the task and the associated assessment criteria. Learners recursively refine and reflect on their perceptions of the nature of the task, including (a) the rationale for performing the task; (b) the procedures to be undertaken to perform the task and the required outputs; (c) the materials that are available to perform the task; and (d) the conditions under which the task must be performed (Venkatesh, 2008a). Learners also need to grapple with the assessment criteria that the instructor uses to judge their task performance. It therefore appears that task understanding involves a close interaction between learners' and the instructor's perceptions of the academic task. In addition to task-associated elements, task understanding is influenced by the learners' knowledge of self-as-learner, including

preferred learning styles and learning needs, prior content and task-specific knowledge, and context-specific motivational and emotional anxiety and efficacy.

Cognitive information retrieval

Ingwersen's (2000) theory of cognitive information retrieval (CIR) provides some interesting overlaps with the study of task understanding as a self-regulatory process. Essentially, CIR acknowledges that classification behaviours affect the way individuals perceive how knowledge can be organized. The collective cognitive structures that are represented in an information retrieval system are a result of the social interaction and subject domains as well as science and learning paradigms. Two factors in Ingwersen's model, viz., the *users' cognitive space* and the *contextual environment* surrounding the task, are very important sub-components of the task understanding component of SRL and the instructional design perspectives that stem thereof. According to CIR theory, the task and the user's perception of it is considered just as valuable as the information need. In fact, Ingwersen also points out that the perception of 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 than the corresponding dynamic information need. However, from a cognitive psychology standpoint, perceptions of the work task have been empirically shown to evolve continuously as learners tackle academic tasks (e.g., Venkatesh, 2008b; Winne & Hadwin, 1998). Given these diverging perspectives, there is sufficient reason to refine conceptions of task understanding by taking into account empirical evidence from the fields of both information retrieval and cognitive psychology. This interdisciplinary lens on task understanding might illuminate how instructional designers can achieve the often conflicting objectives of satisfying online learners' information needs and improving their performance on a given academic task. When information need is misconstrued, performance on a dependent task is more liable to deteriorate (Venkatesh, 2008b). Logically, therefore, the design of indexes for online repositories that purport to improve self-regulatory processes should be informed not only by well-known principles for instructional design, but also by guidelines emanating from Ingwersen's theory of CIR.

Learner perceptions related to feedback

Shaikh (2008) has provided empirical evidence of a hierarchical view on how post-secondary learners perceive feedback from an instructor on the quality of their academic work when tackling a task for the first time. For example, self-perceptions such as confidence and motivation take a back seat to how the provider of feedback is perceived by the learner, the student body as a whole and the educational environment. The learner internalizes feedback through a multi-faceted system. The following hierarchical taxonomy is an interpretation of the code map (see Figure 1) for initial tasks and learner–instructor interaction:

– Perception of Provider: Instructor must be seen as a viable source of information. If not, feedback is disregarded.
– Self-Perceptions/Knowledge of Self-As-Learner: Learner's perception of self-worth, esteem, confidence and ability.
– Perception of Task: Inherent worth of the task and transferability to other scenarios.

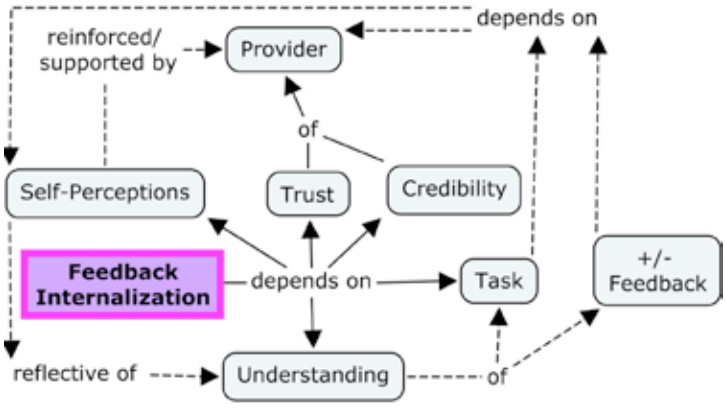


Figure 1: Hierarchical and Ontological Structures of Learner Perceptions of Feedback

The proposed hierarchical and ontological structures of learner perceptions of feedback shed new light on the effects of credibility, respect, trustworthiness, status and a myriad of other factors that influence how students interpret feedback from certain instructors and their conception of "self-as-learner," which we know to be an integral component of task understanding. Further iterations or subsequent attempts of a given task are accompanied by other factors. For instance, the temporal effects of instructor feedback on learners' self-regulation while engaging in an academic task suggest that learners prioritize a triad of perceptions in an ontological scheme, viz., the instructor, self-as-learner and task. Over time and through experience in a learning environment, learners choose which of these three perceptions takes precedence, thereby influencing to varying degrees how they employ cognitions to successfully meet the task completion criteria.

The learner's perception of the provider can become dependent on context, and thereby demoted from a higher tier status. For example, experiential factors play an extensive role in how learners perceive their social interactions and proficiency in a setting, and therefore reliance on instructor support and acknowledgement may decrease. With respect to extraneous variables (for example, context, experience, understanding of task and self, ego, previous interactions and respect), a hierarchical approach may not be all encompassing, and an ontological description, as presented in Shaikh (2008), may merit further investigation.

Theoretical rationale

The research reported herein finds its roots in instructional means to improve self-regulatory processes when attempting to carry out ill-structured writing tasks. A review of the literature (Venkatesh & Hadwin, 2002) shows that these instructional methods are few and far between. Nevertheless, it has been demonstrated that graduate learners' understanding of ill-structured essays can improve over time to better match the instructor's perceptions of the assessment criteria when learners are provided with feedback on both the quality of their essays in terms of the criteria and their self-assessments of performance (Venkatesh, 2008a). It should follow that if learners who perform essay-writing tasks are given access to instructor-annotated writing models stored in an online repository, their understanding of the task and performance on the same will likely improve.

Topic Maps – Technological Framework

The question now arises as to what indexing technology can be used to navigate online repositories designed for educational purposes. Looking beyond keyword-based search and retrieval, Shaw & Venkatesh (2005) proposed using topic maps to help online learners traverse information resources based on semantic relationships defined through a manually generated ontology. Topic maps serve as a form of indexing with two purposes, viz., to describe and define the relationships between topics observed in a given domain, and to anchor theseinter-related topics to information resources (Pepper, 2002). Topic maps technology is a better choice over other indexing tools such as Resource Descriptor Framework (RDF) and Ontology Web Language (OWL) due to its inherently intuitive structure, ease of construction, flexibility, and scalability in adding resources and expanding the domain ontology (Venkatesh et al., 2007). In retaliation to the glut of keyword-based retrieval in online learning systems, Venkatesh et al. (2007) proposed using topic map technologies to help learners traverse information resources based on semantic relationships defined through a manually generated ontology. Results revealed that learners using topic maps outperformed those with keyword-based search engines in successfully completing an ill-structured writing task. We are still in the dark, however, on matters concerning the development of psychological processes associated with learning, and on cognition in general, when learners are exposed to these new

forms of indexing. The studies reported herein are therefore among the pioneering works on not just the application of topic maps to higher education (e.g., Dichev, Dicheva, & Aroyo, 2004; Dicheva & Dichev, 2004; Shaw & Venkatesh, 2005; Venkatesh et al., 2007), but also the cognitive effects of using such indexing tools (Venkatesh, 2008b).

Ontology development

An ontology is a structure of interrelated terms that describes a reality, and not just a technique to organize and classify data (Kabel, de Hoog, Wielinga, & Anjewierden, 2004). The ontology for the topic map used in this study emerged from the knowledge base provided in the instructor-annotated writing models, through the lens of a variety of stakeholders, including instructors and learners. The ontology yielded sets of topics and sub-topics, associations among the topics, and external occurrences (i.e., portions of the models) that exemplified topics. The ontology reflects the mental model of an experienced learner navigating the corpus of writing models with the objective of completing a similar writing task, not unlike a task-oriented approach to information retrieval (e.g., Hersh, Pentecost, & Hickam, 1996; Kabel et al., 2004). It is our recommendation that, given a relatively small set of resources for a specific knowledge domain, such as the domain covered by our topic map, the ontology should be developed manually. While it is encouraging that recent projects (e.g., the United States Internal Revenue Services Tax Map; see http://www.sbrg.irs.gov/taxmap/about.htm) have used combinations of machine technologies and manual methods to develop ontologies, our experience shows that manual ontology generation methods provide greater validity and robustness, at least for restricted domains.

Method and Procedure

Thirty-eight volunteers (15 male and 23 female) were recruited from a total of four sessions of a graduate classroom- and laboratory-based "Theories of e-learning" course given by the first author from January 2006 to June 2007 at a large North American university. Learners were pretested for content knowledge and essay writing ability during the first class of each session. Each of the 38 participants wrote a total of six essays over course duration. Assessment criteria used to grade the essays were developed using Biggs' (1991, 1996) SOLO taxonomy, and criteria were explained to all learners before they wrote the first essay. The 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 found and (d) there were multiple perspectives on both the solution and the solution path (Reitman, 1965). Each essay was accompanied by a self-assessment tool, the Task Analyzer and Performance Evaluator (TAPE), designed by the first author to help learners articulate their justifications for meeting the assessment criteria. Essays were submitted and graded online, feedback from the instructor was embedded and the assignments were returned to the learner within 72 hours of submission along with comments on the portion of the TAPE that dealt with learners' justifications of having met the criteria. All 38 learners had access to a repository of 132 instructor-annotated essays (graded using Biggs' criteria) indexed by a topic map (see Figure 2 for the index page).

Due to scheduling constraints, 15 learners enrolled in the regular 13-week fall and winter semester courses were given access to the repository four weeks into the term (after having written three essays), whereas 23 others who were registered for intensive six-week summer courses received access to the repository after writing their first essay. At least one semi-structured time-line interview (Schamber, 2000) was conducted with each of the 38 learners to discuss their use of the topic map.

All participants signed consent forms and all data were collected in accordance with the principles of the American Psychological Association. Ethical approval was obtained from the university's Ethics Committee. While all participants were aware of their instructor's research program, consent forms were made available to the first author only after final grades for the courses were submitted to the university.

The analysis was carried out using a triangulation mixed-method approach (Creswell, 2007). A combination of repeated-measures tests (using SPSS™) and inductive content analysis (using HyperResearch™) revealed how specific self-regulatory processes fluctuated across the instruction period. Using both the entire sample of participants as well as 12 theoretically sampled learners (see Results section for sampling strategy), within-case and cross-case comparisons revealed how performance improvement was affected by, or affected, the theoretical constructs associated with task understanding.

Data sources

Each participant agreed to grant access to the following data:

- Demographic information
- Pre-test of e-learning knowledge and essay writing
- Six written essays
- Written responses to TAPE self-assessment for each essay
- Instructor's performance assessment for each essay
- Instructor's feedback on TAPE self-assessment questions related to assessment criteria
- Interviews related to perceptions of task understanding
- Time-line interviews and computer-generated trace files related to use of the online repository

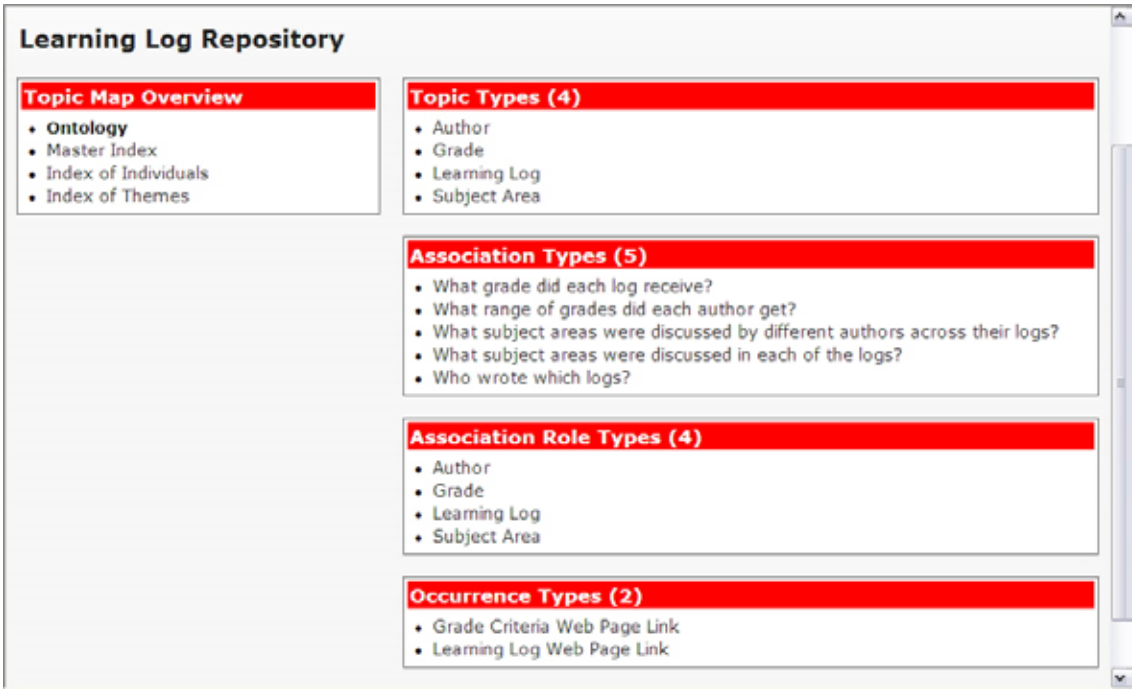


Figure 2: Topic Map Index Page

Results from the Complete Sample

Statistical evidence of improvement in performance and task understanding

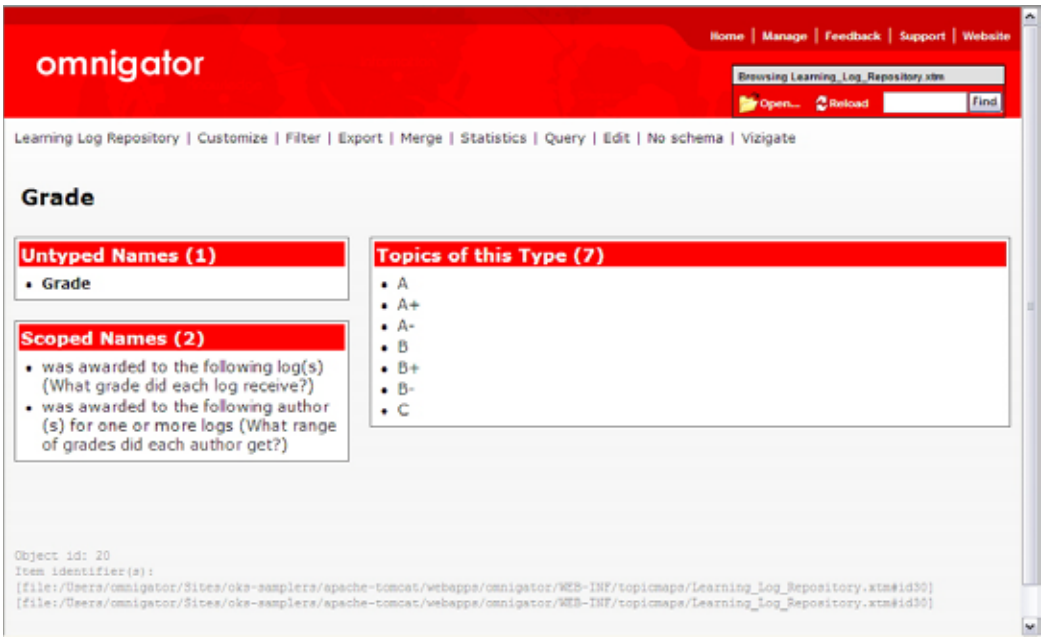
Multivariate procedures reported in Venkatesh (2008b) revealed a statistically significant improvement in essay performance (*partial* η^2=.68; i.e., the explained variance is 68%, yielding an effect size of 1.46). Further analysis reveals that, as the course progressed, fewer learners wrote incorrect justifications in their TAPE responses, χ^2 (5)=12.99, p<.05, N=38, signifying greater task understanding.

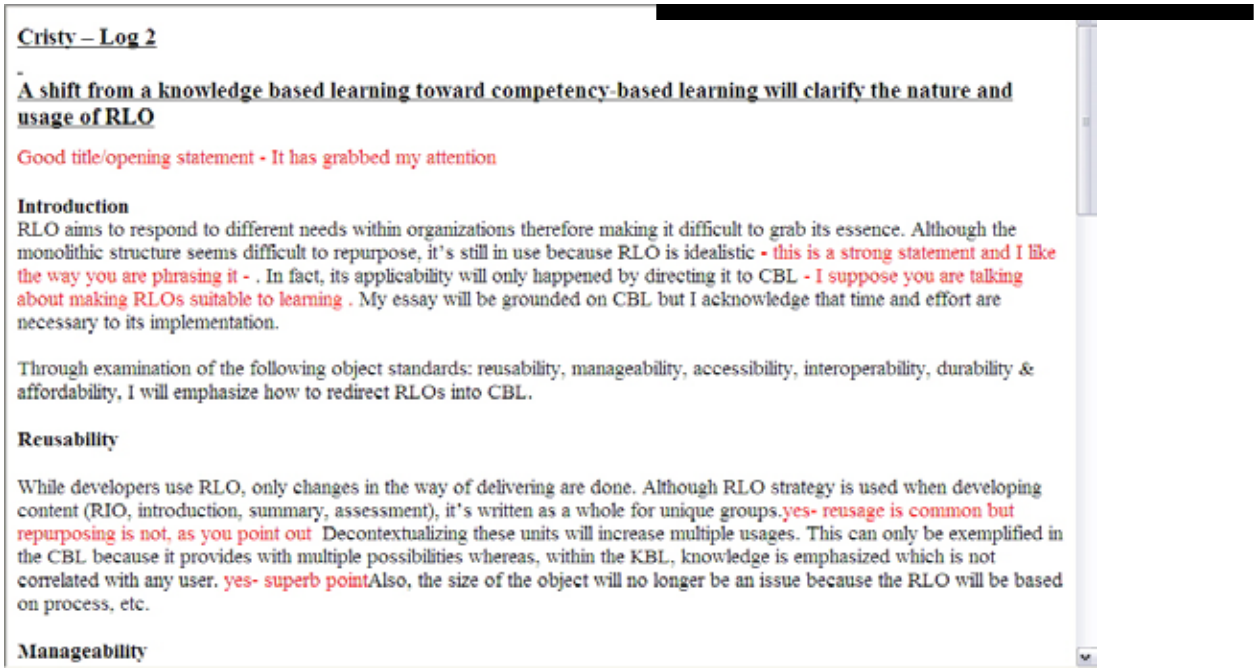
General Navigation Strategies

Thirty-four of the 38 participants reported weekly use of the repository for at least half an hour a week (Venkatesh, 2008b). This was corroborated by the user trace data. For the first three weeks of use, all 34 weekly users reported using the repository to better understand the instructor's grading system. This was evidenced by the overwhelming use of the grade index (see Figure 3), where participants searched for essays based on grades received from the instructor.

Figure 3: Grade Index

Some learners exhibited self-regulatory behaviours to clarify a specific aspect of their task understanding, viz., the instructor's perception of the assessment criteria. For example, 12 participants realized, within three iterations of writing their essays, that the instructor was more verbose in the feedback for essays evaluated in the B and C range, as opposed to those that received an A grade range (see Figure 4 for annotated essay). Hence, these learners searched for essays with an average performance, such as B+ or lower, using the grade index (see Venkatesh, 2008b for a detailed description).





Cristy – Log 2

A shift from a knowledge based learning toward competency-based learning will clarify the nature and usage of RLO

Good title/opening statement - It has grabbed my attention

Introduction

RLO aims to respond to different needs within organizations therefore making it difficult to grab its essence. Although the monolithic structure seems difficult to repurpose, it's still in use because RLO is idealistic - this is a strong statement and I like the way you are phrasing it - . In fact, its applicability will only happened by directing it to CBL - I suppose you are talking about making RLOs suitable to learning . My essay will be grounded on CBL but I acknowledge that time and effort are necessary to its implementation.

Through examination of the following object standards: reusability, manageability, accessibility, interoperability, durability & affordability, I will emphasize how to redirect RLOs into CBL.

Reusability

While developers use RLO, only changes in the way of delivering are done. Although RLO strategy is used when developing content (RIO, introduction, summary, assessment), it's written as a whole for unique groups.yes- reusage is common but repurposing is not, as you point out Decontextualizing these units will increase multiple usages. This can only be exemplified in the CBL because it provides with multiple possibilities whereas, within the KBL, knowledge is emphasized which is not correlated with any user. yes- superb pointAlso, the size of the object will no longer be an issue because the RLO will be based on process, etc.

Manageability

Figure 4: Instructor-Annotated Essay

Interviews also 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 using the subject index (see Figure 5) during the middle and final stages of the course. Learners navigated using the subject index depending on their choice of essay topic, self-perceptions of prior knowledge, writing ability and experience, and perceptions of the instructor.

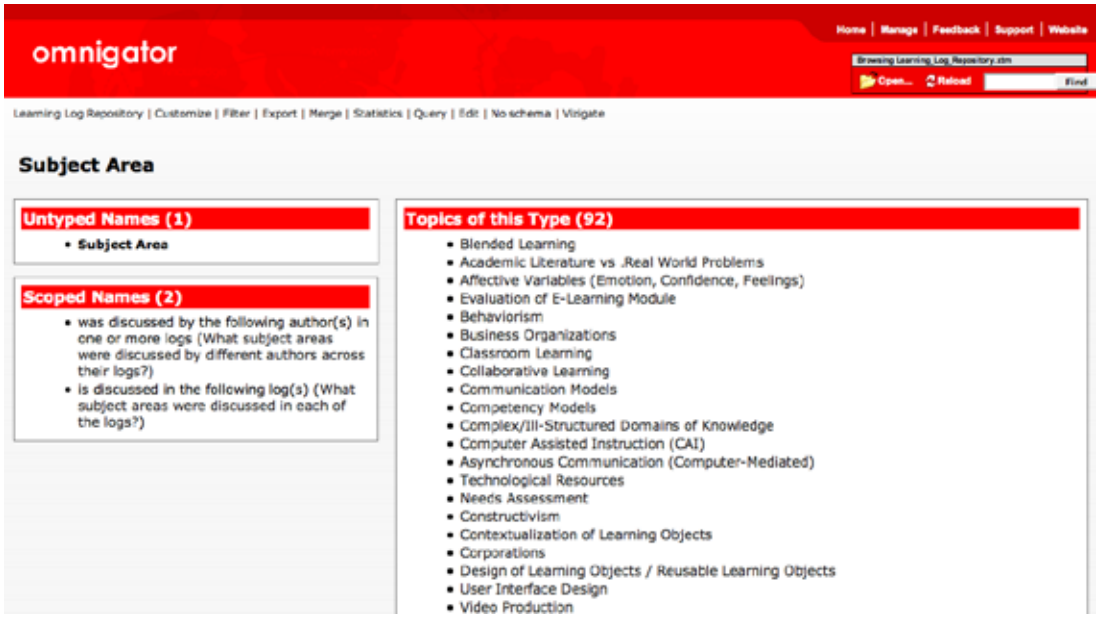


Figure 5: Subject Index

Findings and Discussion from the Analysis of the Theoretical Sample

Rationale for using a theoretical sample

Venkatesh's (2008b) initial investigation revealed mainly the statistical details of how self-regulatory mechanisms in a single group of 38 learners influence their essay writing ability. Unsurprisingly, Venkatesh (2008b) also found that learners' task understanding with respect to ill-structured writing assignments is dependent on a myriad of factors, especially when they are confronted with information retrieval overhead. These include the usual suspects, viz., traditional cognitive psychology constructs of perceptions about the rationale for completing the task, task assessment criteria and knowledge of self-as-learner. Ingwersen (2000) contends that when learners navigate a search-and-retrieval system, their cognitive notion of task understanding remains more stable than their perceptions of information need. On the other hand, while learners' navigation strategies (which are dependent on their information need) should ideally be grounded in their task understanding, it is generally accepted that this understanding evolves, for better or worse, as they attempt to complete an academic task (e.g., Venkatesh, 2008b). In addition, Shaikh (2008) illustrates the *temporal* effects of instructor feedback on learners' self-regulation while engaging in an academic task. Essentially, Shaikh (2008) contends that learners prioritize a triad of perceptions in an ontological scheme, viz., the instructor, self-as-learner and task. Over time and experience in a learning environment, learners choose which of these three perceptions take precedence, which influences to varying degrees how they employ cognitions to successfully meet the task completion criteria. The divergence of opinions and findings raises the question as to whether the CIR model, as conceived by Ingwersen, is incompatible with theoretical constructs associated with self-regulatory processes, and if so, could some of these differences be partially explained by the shifting hierarchy of perceptions outlined by Shaikh (2008)? Our rationale for conducting a follow-up qualitative content analysis is rooted in this conundrum.

By treating the group of learners as a single unit in a case study (e.g., Venkatesh, 2008b), we are unable to tease apart the facets of task understanding that might influence learners' performance improvement, information needs and navigation strategies over time. By shifting the unit of analysis to a theoretically sampled group of learners, we respond to both Shaikh's (2008) and Venkatesh's (2008b) call to better illuminate which aspects of task understanding might be affected by, and in turn affect, performance. In addition, we could better unravel the enigma of whether task understanding remains stable across an information retrieval task or whether it responds to higher-level self-regulatory mechanisms and is continuously refined, and hence unstable.

Selection of participants

Of the 38 participants, 12 were selected as a theoretical sample based on iterations required for performance improvement. Learners were first selected based on earning a B range or lower (i.e., B+, B, B- and C) grade for their first essay. These learners were then placed into two categories: improvement to an A range grade after two versus three or more attempts at the essay-writing task. This categorization placed seven individuals, three of whom were females, in the *two-essay improvement group* (2IG) and five females in the *three-essay improvement group* (3IG). Our sampling strategy allows us to observe how task understanding fluctuated across a number of psychological dimensions (Venkatesh, 2008b), as well as the role that time on task played in the relationship between performance improvement and task understanding (Shaikh, 2008).

Coding scheme

Based on Shaikh's (2008) and Venkatesh's (2008b) theoretical derivations of task understanding as well as the protocol of the time-line interviews, we propose that the task understanding construct be subdivided into three distinct cognitive features:

perceptions of assessment criteria/rationale, knowledge of self-as-learner and perceptions of instructor/instructor feedback. In addition, we coded for the information need construct, as Venkatesh (2008b) has reiterated that it is integral to building a more holistic conception of task understanding in the information retrieval field. Our analysis compares learners in the 2IG and 3IG for the three above-mentioned theoretical components of task understanding.

Perceptions of assessment criteria/ rationale

Overall, the 12 learners' perceptions of the assessment criteria/rationale for conducting the essay-writing task, after writing at most three essays, were aligned with those of the instructor's, regardless of whether or not they were exposed to the online repository. Interviews pinpointed commonalities regarding perceptions of task rationale and assessment criteria. Comments across both groups included, "…[the instructor] is looking for understanding of the topic you are talking about, whether you can link it to theories, [the] use [of] examples and if you gave opinions," "...[using] some theory and real-life examples [and being] balanced – not too much theory and [should not be] lacking on the opinion side," and "it is a piece where you can showcase one or two sides of a topic…[that the instructor] is looking for relevance to learning theories and course content…to examine one's opinion, prove why you have it and show where it comes from." While some misjudgements of this facet of task understanding were frequent in the early stages of essay writing, what became clear from the time-line interviews as well as the responses to the TAPE self-assessment was that learners used different strategies to correct their misconceptions, depending on the tools available to them. Learners reported using the subject area search to ascertain which topics were of interest and how they might or might not "reinvent the wheel." In this way they gained a deeper understanding of what the instructor expected, and could then adapt their attempts at the academic task with these guidelines in mind.

The TAPE self-assessments were considered a worthy reflection, or more specifically, an attempt at an "objective self-assessment," of one's work, therefore allowing learners to compare their initial and evolving task understanding with the instructor's comments and perceptions. All three learners (one from 3IG) who received access to the online repository four weeks into the instruction used the repository regularly thereafter. Learners therefore cycled through various development stages of their perceptions of the assessment criteria, as evidenced in their TAPE self-assessment responses and interviews. In accordance with Ingwersen's theory of CIR, perceptions of the assessment criteria and rationale did in fact stabilize over time, regardless of learners' information need.

Knowledge of self-as-learner

At the outset of the analysis, it became clear that knowledge of self-as-learner played the most crucial role in instigating navigation strategies in repository use. In fact, some clear distinctions were seen between the two groups of theoretically sampled learners. Learners in the 3IG preferred to use classroom discussions to choose subjects to search for while navigating the repository, whereas those in the 2IG overwhelmingly initiated search activities based on the instructor's perceptions and feedback on their essays. Eventually, learners in the 3IG shifted their search strategies to better reflect the need to align with the assessment criteria. For example, one learner in the 3IG began to search the repository using the grade index in order to "… know what I was doing wrong" only after having written her third essay. Her previous search strategies were limited to topics that were discussed in her class. What is of special note is that this 3IG learner decided to focus her repository search on essays with an A- grade to better understand how to achieve an A grade. The majority of the other learners, from both groups, who were interested in learning about the instructor's assessment criteria tended to seek out essays that had a B or C grade. At the opposite end, one high-performing learner in

the 2IG remarked on how she " … steer[ed] away from [using the] grade [index] because I don't want to learn by grade; I want to learn the material." Personal preferences seemed to dictate how learners navigated the indexes available to them in the repository. These preferences worked over and above the perceptions of assessment criteria in guiding learners' navigation strategies.

Being "intimidated by others' work" or the fear of "looking like an idiot," expressing confusion with regard to the ill-structured nature of the task, feeling "tortured" by constant personal debates on the subject matter and task, taking pride in developed navigation strategies, feeling assured through anonymity and finding "comfort" in names and contexts that seemed familiar are merely a few examples of how learners' perceptions of self-as-learner affected their interactions with the online repository and the assimilation/acceptance of presented matters, ideals and the repository itself. As stated by a 2IG learner, "the beauty of working with such an environment is that it is so easy to get lost in them…and you can search for so long. I want to learn; I want to read everything." For such learners, the repository provides an environment where educational voyeurism deserves merit and can be associated with a deeper understanding of its nature and significance. In addition, the data revealed that self-regulated individuals are more likely to seek extrinsic sources of motivation (e.g., feedback from the instructor) in building task understanding. On the other hand, learners who were unable to disassociate grades from feedback and effort and who also lacked the necessary traits to be considered self-regulated were far more likely to abandon the ill-structured task. A learner in the 3IG who was progressing rather slowly felt that "If I didn't get the high score, I think I would have stopped writing the [essay]s altogether."

Perception of instructor/instructor feedback

Learners' perceptions of their instructor and the instructor's feedback were instrumental in the development of their task understanding, in all 12 cases across both groups. Learners repeatedly emphasized the importance of having open and accessible instructor feedback on the essays written by their peers. A 3IG learner who initially believed that reading the work of others was beyond her needs as a learner quickly pointed out that, "[I] try and focus on the feedback. The [essay] itself does not help me." Those who had access to the topic map navigated to and read the instructor's feedback on the essays stored in the repository, whereas others used the instructor's feedback on their own essays to ameliorate their perceptions of the task completion criteria. One learner in the 2IG stated that, "I read what I wrote and then looked at your feedback. I used your [the instructor's] feedback mostly to try to improve. It was helpful because sometimes I would get the same feedback over and over. This was good because most of the time, when you write a paper, you don't get that kind of feedback." The data reinforce our belief that individual differences in terms of need and use of instructor feedback depend on previous experience with academic tasks as well as perceptions of the instructor and relevant comments and reflections on the task. In support of this argument, a 2IG learner was quite adamant on the nature of the feedback and its effect on his task understanding. He appreciated "…how the comments were embedded in the [essay] itself [and how] it helped me to understand what I was missing." This learner's self-perceptions therefore become paramount to gain a sense of what he needed to improve his task understanding. In the case of this learner, repetition and overt feedback were essential. Another aspect worth noting was the perceived uniformity of the instructor's feedback. Learners in the 3IG mentioned varying inconsistencies in instructor feedback, whereas the majority of the 2IG expressed a clear appreciation for the explicit and transparent nature of instructor feedback via the online repository. Learners in the 3IG were quick

to judge the instructor's feedback and required further elaboration, in the form of either one-on-one meetings or classroom discussions. This need for clarification and perception of inconsistency may be associated with individual perceptions of self-as-learner with respect to information need.

Information need

Learners' information needs when using the repository were inconsistent and unstable across the 2IG and 3IG. For example, one participant from the 3IG reported her information need as … "[wanting to] know what she had done wrong [in her most recently graded assignment]," reflecting her inherent need to improve. At the other end of the spectrum most learners, regardless of group, anchored themselves to the repository by searching for relevant content for their chosen essay topics. However, one learner in the 2IG made particular mention of using the instructor's feedback to guide her in navigating the repository content. She explicitly searched for the term "Learning Theory" in the subject index because of the instructor's feedback, which suggested that she focus on educational theories to back up the opinions in her essay. Elsewhere, one 3IG learner expressed that "… in the … repository, you have to be lucky enough to find the person who has authored [essays] whose insights you can build upon." In this case, the learner's information need was underdeveloped to the point where she felt that effective navigation of the repository would be largely dependent on chance. In comparison, consider the case of one learner in the 2IG who spoke candidly about " … the beauty of [working in] this … environment is that it is so easy to get lost in them … one thing leads to another and that's where associations come in." This 2IG learner apparently enjoyed exploring the vast network of indexes created by the topic map and harnessed their associative power to her benefit, both to successfully complete the essays (as gauged by her performance) and for her personal edification. However, most learners had specific information needs when exploring the repository. In contrast to Ingwersen's (2000) hypothesis, but consistent with the findings of Venkatesh (2008a), learners' information needs fluctuated (e.g., searching going from the grade index to subject index to author index, not necessarily in that order) as task understanding improved.

Educational Significance

Analysis results from the theoretical sample have implications for instructional design to promote SRL. While it has been established in cognitive psychological terms that learner task understanding is a crucial component of academic self-regulation (e.g., Winne & Hadwin, 1998), the present results offer specific suggestions as to how individual components of task understanding can be ameliorated when learners are tackling ill-structured writing tasks using online information repositories. Learners adjusted their perceptions of the rationale for completing the essay task and the assessment criteria using various resources, including the instructor's feedback on their essays, class discussions, the course outline and the instructor's annotations to other learners' writings. While some reviews (e.g., Venkatesh & Hadwin, 2002) have commented on the lack of direct instruction to improve perceptions of assessment criteria, in the case of graduate learners accessing information online, there seems to be an academic self-regulatory mechanism that enables learners to employ distinct strategies to ensure that they have understood the criteria in the same ways as the instructor. In short, we recommend providing opportunities for learners to view assessment criteria through multiple perspectives and various interactions (e.g., learner–learner, learner–instructor, learner–content).

Our results point to the singular facet of knowledge-of-self-as-learner as a fundamental theoretical construct that influenced how the graduate learners in our study chose to navigate the repository. It would not be too much of a stretch to suggest that learners should be allowed to control their navigation through such online repositories by harnessing the associative powers of indexing technologies

like topic maps. Individual preferences, such as browsing by subject, author, essay or grade could be better facilitated to allow users to create their own topic-centric associations, thereby personalizing their route through the complex webs of information in online repositories. Note, however, that Venkatesh et al. (2007) warn that user-generated indexes should undergo strict content validation, without which the domains represented by technologies such as topic maps are rendered useless due to specious content.

Last but not least, a pressing question that arises from the results is: to what extent is information need, as experienced by graduate learners attempting to improve their performance on an ill-structured essay writing task, context- and/or learner-dependent? We can partially answer this question by taking the easy route and pointing to individual differences and preferences. However, that would belie the complex dance that task understanding and information need engage in when learners employ cognition to retrieve online information. While we are aware that information needs morph as learners attempt to improve their task understanding, our results indicate the need to explore specific conditions that might govern how, when and why changes in learner cognition would influence these needs.

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