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Search engine paths not taken: Revisiting early insights and exploring future challenges to enrich search methods curriculum (Paper)

Abstract

This ongoing study builds on previous work that established a theoretical model for developing search expertise; that model guided the design of an MLIS course on advanced search methods. To further enrich the course content, the design included a look-back at 1970s design decisions affecting search engines and a look-forward from challenges in today's information landscape, such as algorithmic bias, filter bubbles, and market-driven results ranking. This study is evaluating the course by analyzing peer-to-peer discourse in online discussion forums, using template analysis methodology. This paper reports on the analytical processes and preliminary results, discussing implications and next steps.

1. Introduction

In the 1970s, value-added aggregators of databases were largely command-line search engines used by information professionals and researchers. By the late 1980s and early 90s, web interfaces for these same products were on the rise, and simultaneous developments included front-end search products that grouped databases and like fields to simplify the search process for the freshly-named 'end user' target audience. End users were differentiated from the core audience of information professionals and researchers in that they did solely their own searching and did not serve as an intermediary with expertise in search; they were also not likely to invest much time in learning about search features or database content. Search intermediaries were those information professionals, almost all with MLIS degrees, who understood the nuances of using field and subfield limiters, logical and proximity operators, and, depending on the domain, the controlled vocabularies and classification systems necessary for reliable results (MLA, 2005). Since then, the information landscape has evolved into a jungle by comparison, with algorithms in web search engines that are designed, not for the users, but to collect data *about* those users, driven by market forces. For an MLIS student preparing to join the information professional community—in whatever career environment that may be—the critical concepts, skills, and praxes to be learned are far ranging and ever in motion.

This ongoing study is part of a larger research project on the transformative learning experiences in MLIS students as they grasp core concepts and develop competencies in critical conceptual areas of the information professions, specifically in online searching, information retrieval, and information architecture. The focus of this study is online searching abilities, and it builds on previous work that elicited evidence of threshold concepts (Meyer & Land, 2003) and

characteristics of search expertise, which led to a theoretical model of search expertise (Tucker et al., 2014; Tucker, 2016). Briefly described, “grasping a threshold concept is transformative because it involves an ontological as well as a conceptual shift” (Cousin, 2006, p. 4). This model was then used as the basis for the design of an MLIS course on advanced search methods. The primary aim of threshold concepts is to guide curriculum design (Meyer, Land, & Davies, 2006), and the search expertise model used this construct for the course’s design. The course has been offered six times online at San José State University’s School of Information.

The effectiveness of the course is being evaluated in this study, by analyzing peer-to-peer discourse in online discussions, using template analysis methodology. The initial template was constructed using the threshold concepts from the previous research’s theoretical model and attributes for how understanding the concepts manifested in student search activities and written reflections. The study explored learner experiences in the course and the degree to which they indicated a trajectory toward developing search expertise. The research question is:

RQ What is evident in peer-to-peer discourse that students are learning critical concepts and practices necessary to acquiring search expertise?

2. Background and Research Literature

Online learning environments for MLIS degree programs are commonplace in current times. As shown by Singh and Thurman (2021) in a systematic literature review of articles on online learning from 1993 to 2018, there has been significant growth in the literature over the past three decades. This includes a range of online learning formats, including massive online open courses (MOOCs) and totally online degree programs, the latter including the program in this study (SJSU School of Information, 2021). Online discussion forums are typically one of the course learning activities, and intellectual curiosity and engagement with peers during discussions are supported.

Analyzing learner discourse has long been demonstrated to be effective in information research studies (Budd & Raber, 1996; Frohmann, 1994), and likewise in threshold concepts research (Land & Meyer, 2010). This study benefited from building on the strength of previous work establishing that students are able to externalize their critical learning experiences through their discourse (Rumenapp, 2016). In exploring peer-to-peer discourse in the online learning environment, participants in this study were able to be relatively uninhibited in their discussion posts shared with classmates, with the added advantage of having time to articulate their ideas in asynchronous discussions. As shown in the results below, a marked shift was evident from the first discussion to the last one, as students came to know each other better during the term; they were also less self-conscious about the instructor’s engagement in and observation of their exchanges with each other.

To further enrich the context of the search methods learning activities and students’ perspectives, the course covered these dual viewpoints: (1) historical: the context of search design decisions from the pre-Google past; and (2) forward-looking: concerns and challenges posed by trends in search, such as algorithmic bias, filter bubbles, sponsored results, and waning critical thinking among users (Leslie, 2014; Zittrain, 2019; Marchionini, 2019). Specifically, the course took a look-back at fundamental decisions affecting search systems originating in the 1970s (Summit, 1967; Bjørner & Ardito, 2003). Search systems of that time were developed with two target user

groups in mind: the primary group being researchers and information specialists, such as librarians, and the second being anyone else with an occasional need to dip into databases typically available only through subscription portals. The latter group were often assisted in their searches by intermediaries, again typically librarians. Balancing this historical content was a look-forward at the challenges of market-driven search engines that are designed around “making as much money as possible from people’s data” (Bates, 2019, ‘How search really works’)—and not on the user at all.

2.1 Threshold concepts and curriculum design

This brief overview of threshold concepts covers their characteristics and purpose. The original research (Meyer & Land, 2003) out of which emerged the threshold concepts framework (TCF) posited five characteristics:

Transformative: leading to a dramatic shift in perception, understanding, and a consequent level of identity shift. “New understandings are assimilated into our biography, becoming part of who we are, how we see, and how we feel” (Cousin, 2010, p. 2).

Troublesome: difficult, counterintuitive, and/or uncomfortable to grasp. Troublesomeness is “an instigative or provocative feature which unsettles prior understanding, rendering it fluid and provoking a state of liminality” (Land et al., 2010, p. xi).

Irreversible: Once fully understood, the concept is unlikely to be forgotten or un-learned.

Integrative: In accommodating a newly understood concept, the learner unifies it with other knowledge in their understanding.

Bounded: Boundedness is present less often than the four characteristics above (Meyer & Land, 2003, p. 6). When present, it helps to define borders between conceptual areas or can “indicate the limits of a conceptual area or the discipline itself” (Boustedt et al., 2007, p. 504).

Additional characteristics have been explored in more recent years and added to the framework: reconstitutive features, ontological and epistemic shift (associated with the transformative characteristic), and changes in learner discourse. Land et al. (2010) elaborate:

Within the liminal state an integration of new knowledge occurs which requires a reconfiguring of the learner’s prior conceptual schema and a letting go or discarding of any earlier conceptual stance. This reconfiguration occasions an ontological and an epistemic shift. (Land, Meyer, & Baillie, 2010, p.xi).

The primary purpose of threshold concepts research is to support effective curriculum design. The TCF has also been instrumental in research that explores what concepts within a domain—be it academic or professional—truly transform a student’s understanding and world view. Each domain has many important concepts, but not all rise to the level of being transformative, integrative, irreversible, and affecting the learner’s discourse and sense of identity.

2.2 Looking back at user-centered search design

Further relevant research extends across the early evolution of search and the challenges for search design that lie ahead. By the early 1970s, the core features of search systems had been implemented for “the effectiveness of an on-line, *user-directed* [emphasis added] retrieval system” (Summit, 1967, p. 51). The first four of the eight features outlined were:

- Provide a variety of command functions for communication, search, and display of information from which the user can select the most appropriate to his particular problem.
- Provide the flexibility to include additional commands or other operational modes as new search techniques are developed
- Assist the user in search definition and in full employment of system capabilities.
- Allow intermediate user evaluation of search results with subsequent request refinement. (Summit, 1967, p. 51-52)

Notably, this latter capability of iteration and refinement is not present on today’s website search engines (Tucker & Edwards, 2021). Iterative exploration during a search refines not only the results but also the question to be answered, aligned with ‘berrypicking’ in information seeking (Bates, 1989).

2.3 Looking forward from the market-centered search designs of today

The insidious impacts of market forces on current search engines cannot be overstated, and conflicts of interest are evident in search ecosystems as well. This is perhaps most conspicuous in explicit labelling of sponsored search results, yet it is also hidden in artificial boosting of results ranking through metadata manipulations, and goes hand in hand with a lack of governance for algorithmic decision making (Latzner et al., 2016). The digital divide between ad-supported search products and subscription products is ever-widening.

Fortunately, there has been increased attention brought to the racial and gender biases built into the algorithms of web search engines (Tufekci, 2015; Wachter-Boettcher, 2018), and yet they persist. Noble (2018) analyzed media and text searches to show extensive racist and sexist algorithms in place on search engines like Google. She writes, “I want us to have broader public conversations about the implications of the artificial intelligentsia for people who are already systematically marginalized and oppressed” (p. 3).

Another development among web search engines is making advanced search and learn-to-search interfaces harder to find—or doing away with them altogether. Case in point is Google’s learn-to-search mode that used to support users in developing search skills *in real time*, showing how to apply features such as logical operators and filetype and language restrictions (Tucker & Edwards, 2021). These growing interface gaps correspond to gaps in user mental models, too, and reinforce them (Han, et al., 2020). The removal of learn-to-search modes engenders further dependence on simplistic searching and the search engine’s algorithmic reasoning—with less and less trust in one’s own critical thinking. Simultaneous with these changes has come the steep rise in mobile device usage, with search interface designs being simplified with fewer features (Oh & Tang, 2018).

3. Methodology

Template analysis methodology (Crabtree & Miller, 1992; King, 2004) was chosen for this study in large part due to the prior research that led to a structured model of threshold concepts and professional praxes in search expertise (Tucker et al., 2014). This decision for the research design was aligned with the search expertise model’s multi-level structure of how evidence of learning the concepts may manifest in learner activities, experiences, traits, and practices, as shown in Table 1, and which had been used in designing the course. The datasets were the

discussion posts from six sections of the course given over a two-year period, described in more detail below.

Template analysis methodology is a form of thematic analysis, understood to be “a broad category of approaches to qualitative analysis that seek to define themes within the data and organise those themes into some type of structure to aid interpretation” (Brooks, et al., 2015, p. 206). Template analysis does not expect a distinction to be made between descriptive and interpretive themes, nor does it insist on a specific coding structure or being bound to an epistemological position.

Brooks and King (2014) arrived at a flexible six-step process for template analysis, beginning with familiarization with the raw data. In the first step, researchers review the datasets, whether reading interview transcripts, listening to focus group recordings, or, as in this study, reading discussion posts. With large textual datasets, researchers are encouraged to review at least 25% of the data. For this study, this step involved becoming fully familiar with the discussion posts from two of the five discussion forums (described in section 3.2, Course discussion questions).

Preliminary coding of the data is the second step; this can either draw on *a priori* themes, codes, or theoretical models, or work with concepts derived from the first review of data. In this study, the first approach was used: the theoretical model of search expertise, discussed above, that guided the redesign of the advanced search course was the basis of the initial template. The search expertise model’s four high-level threshold concepts and underlying core categories are shown below in Table 1. (The model also represents traits of expert searchers, however, these elements in the model were not used in the course design, as they are not as amenable to being taught.) The third step is actually drafting the initial coding template, done with the expectation in mind that it will change through the course of analysis (shown below in section 3.3, Implementing the template).

After these steps, template analysis researchers should expect the initial template to evolve, “trying out successive versions of the template” (Brooks et al., 2015, p. 204). The iterative nature of this methodology is evident during this stage. Adapting the template to the data as they are analyzed is considered a process of “trying out successive versions of the template” (Brooks, et al., 2015, p. 204), as the researcher works toward refining the template to make it applicable across the datasets. In steps four and five, as coding proceeds, the template is adapted as necessary to fully reflect the data and to reduce redundancies that might emerge. In this study, the first addition to the template was CF-berrypick to reflect specificity for the learner’s awareness of berry-picking (Bates, 1989) as a way for discovery during search to help develop or refine a question. In the last and sixth step, the coding template is stable, and representative of all data, with the coded results ready to be summarized. In this study, coding is continuing and is at steps four and five.

Table 1. Search expertise model's themes and core categories (based on Tucker, 2016).

<i>Theme</i>	<i>Core category</i>
<i>threshold concept: information environment</i>	
client or organisation rapport	A: Broad view
concern re. misunderstanding information environment	A: Broad view
knowledge of provider practices	A: Broad view
reference interview from broad view	A: Broad view
search engine rapport	A: Broad view
total environment, sources	A: Broad view
knowing databases generally	B: Subject domain
<i>threshold concept: information structures</i>	
structures of information	A: Broad view
transparency of info retrieval system	A: Broad view
visual way of constructing search	D: Qualities/approaches
cited reference connections	E: Tools & search knowledge
database structure	E: Tools & search knowledge
fields as important, weighted	E: Tools & search knowledge
term weighting, frequency	E: Tools & search knowledge
unpacking the topic, building blocks	E: Tools & search knowledge
<i>threshold concept: information vocabularies</i>	
natural language, keywords	A: Broad view
controlled vocabulary fluency	E: Tools & search knowledge
proximity relationships	E: Tools & search knowledge
using thesaurus	E: Tools & search knowledge
word-term fluency, truncation, synonyms	E: Tools & search knowledge
<i>threshold concept: integration/fusion</i>	
can learn new system easily	A: Broad view
synthesising information	A: Broad view
connection making	A: Broad view
integration, magic factor, light on feet	A: Broad view
styles of search	A: Broad view
combining sources	B: Subject domain
anticipating, visioning, rehearsing	D: Qualities/approaches
combining different tools	E: Tools & search knowledge

3.1 Participants and datasets

Data were collected from six sections of the course on advanced search methods, an elective in the MLIS degree programme. The course sections were offered over a period of two years and had a total of 160 students enrolled, for an average class size of 27. All posts were anonymized for the research project and data were not tracked by student. As such, the ethics clearance process (institutional review board) at the university categorized the study as non-systematic so that higher-level oversight protocols and individual consents were not required. Demographic data on the students were not collected; however, demographics for students in the MLIS program are available through survey data (SJSU School of Information, 2021):

- Ethnic diversity (2015-2021): White 59%; Hispanic 22.8%; Asian 10.3%; Black 4%; American Indian or Alaskan Native 1.3%; other or unknown 2.6%
- Gender diversity (2021): female 75%; male 17%; 8% non-binary, transgender, or other.
- Residency (2021): 55% California; 45% other U.S. states and other countries.
- Current employment type (2021): 44% libraries; 29% education; 27% other.
- Time to complete MLIS degree (as of 2020): 2.5 years or less 45%, 3 to 3.5 years 27%; 4 to 4.5 years 19%; 5 or more years 9%.

3.2 Course discussion questions

Students were instructed to post in response to questions aligned with the course topics, assignments, and readings. In addition, they were told the discussions were “to encourage intellectual curiosity and mutual respect—and not be overly concerned about posting something ‘right’ or ‘wrong’.” The course had five topical discussion forums, with each forum guided by questions encouraging students to reflect on their search experiences, course readings, and to connect their ideas to their peers’ posts; both initial posts and responses to peers were required. They were instructed that their initial posts “need not be lengthy but must be thoughtful, meaningful, and constructive,” and that responses to their peers’ posts were required but needed to be no more than “a few sentences” long.

Focusing here on initial findings most relevant to the theme of this paper, we address two of the discussion forums, the first and last ones. The first forum was called Starting Points, with two objectives: first, to help assess incoming learnings, initial perspectives, and to effect “destabilizing; introspection about habits, beliefs, assumptions; critical reflection on mental models, paradigms” (Tucker, 2020, p. 251); second, to introduce students to the deep history of search engine design and to current issues such as filter bubbles and algorithmic bias. Both objectives established a foundation for the start of the course and elicited lively discussion. Students were asked:

1. After reading transcripts of interviews conducted with Roger Summit and Carlos Cuadra, both early visionaries in the online search industry (Bjørner & Ardito, 2003):
 - What stands out for you as a critical development or perspective that shaped the way we approach searching or databases today?
 - What about these pioneers of the online industry seems to you to have been particularly influential—or particularly surprising?

2. After reading about filter bubbles (Pariser, 2011), opposing articles on the effects of Googling on mental processes (Carr, 2008), and related topics:
 - Has Google changed the way we think, the way we approach research, the way we read?
 - Has it changed the way *you* think?

This discussion also served to determine how valuable it was for the students to look, both back and forward at the search engine industry, by (i) revisiting early insights from nearly 50 years ago when design decisions were being made to support sophisticated searching, and (ii) critically thinking about the challenges and opportunities presented by the current search environment.

The last discussion forum, called Reflections, had a short list of topics for students to consider:

- Important take-aways about what you learned;
- Surprising aspects of this field and the online industry;
- How the course was useful to you;
- Where you seeing yourself applying the course content in your career.

They were encouraged to use illustrations from their final projects which were still in progress. Students could do their final projects in any of three different creative formats: training packet, essay, or client project. This provided an opportunity to integrate their new knowledge into their work in their chosen format, supporting the threshold concepts objective of integrating and internalizing their new understandings.

3.3 Implementing the template and coding the data

As described above, to implement template methodology, the initial template was developed from the search expertise model that had been the basis of the course design, shown above in Table 1. The template may be modified during coding to reflect codes that surface during data analysis, with these new codes inserted and annotated to show the reasoning for their inclusion. A spreadsheet (GoogleSheet) was used for this purpose, making it easy to track the coding units, their mnemonics, and the status of each code, primarily whether the code was in the initial template (deductive) or added (deductive). A section of the coding template is shown in Figure 1.

Coding Template		Coding Mnemonic	Initial code (deductive) Or date added to template (inductive)
information environment			
	broad understanding of info environment	IE-enviro	initial
	client/organization rapport	IE-client	initial
	concern re. misunderstanding info environment	IE-misunder	initial
	knowledge of provider / content creator practices	IE-creator	initial
	reference interview from broad view	IE-ref-interview	initial
	search engine rapport	IE-engine	initial
	total environment, sources	IE-sources	initial
	knowing databases broadly	IE-databases	initial
information structures			
	structures of information, broadly speaking	IS-broad	initial
	transparency of info retrieval systems	IS-transparent	initial
	visual way of constructing search	IS-construct	initial
	cited reference connections	IS-cited	initial
	database structure	IS-databases	initial
	fields as important, weighted	IS-fields	initial
	term weighting, frequency	IS-termweight	initial
	unpacking the topic, building blocks	IS-unpacking	initial
information vocabularies			
	natural language, keywords	IV-keywords	initial
	controlled vocabulary fluency	IV-controlled	initial
	proximity relationships	IV-proximity	initial
	using thesaurus	IV-thesaurus	initial
	word-term fluency, truncation, synonyms	IV-fluency	initial
concept fusion			
	can learn new system easily	CF-learning	initial
	synthesizing information	CF-synthesis	initial
	connection making	CF-connection	initial
	integration, magic factor, light on feet	CF-integration	initial

Figure 1. Initial coding template, based on theoretical model.

An entry from the coding log (codebook) is shown in Figure 2, where one student's post was coded to two themes, Information Vocabularies—controlled vocabulary (IV-controlled) and Information Environment—knowledge of provider/content creator practices (IE-creator).

Thematic code mnemonics	Coding Unit (discussion post extract)
IV-controlled IE-creator	I was excited to learn about the platform of LexisNexis where current information abounds then, on the other hand, it was surprising how long it can take for controlled vocabulary to change. I realize how much I expect everything to be immediate.

Figure 2. Codebook entry: coding unit showing *in vivo* extract from discussion post.

Using the spreadsheet, results can easily be sorted by specific coding mnemonic, top-level code (example: IE for Information Environment), or code type (inductive or deductive). The dataset filename was formatted to enable clustering by metadata, such as for the discussion forum, if desired. As the coding progressed, so too did the coding template. As noted above, template analysis researchers should expect the template to evolve as coding and analysis continue.

4. Results

Students' sharing of their ideas and experiences in the two discussion forums, described above, resulted in rich and articulate posts, both in their initial posts and their responses to each other. Posts that exemplify the most prominent themes in the results from the two discussions are shown in the table below, with memo annotations where needed to provide further context.

Table 2. Illustrative quotes analyzed to thematic codes.

<i>Thematic codes</i>	<i>Quote from discussion post</i>
CF-integration CF-combinetools	<p>"You don't know what you don't know until you know what you don't know. I actually signed up for this class thinking that I probably wasn't going to learn much of anything new. I have always loved searching, I see it like a puzzle to solve or a treasure hunt, which appeals to my gamer nature. I also knew that I liked Dr. Tucker's teaching style. So I signed up, thinking I would maybe pick up a tip here or there, but I wasn't expecting anything earth-shattering. I have never been so happy to be proven wrong. My incorrect assumption about this class came from, you guessed it, 'I'm good at Googling.' Now that my eyes have been opened to the many tools and techniques that can be used for searching, I realize how very little I knew when I started this class." (P15202)</p> <p>Memo: strongly concept fusion, transformative, integrative</p>
IV-controlled IE-creator	<p>"I was excited to learn about the platform of LexisNexis where current information abounds then, on the other hand, it was surprising how long it can take for controlled vocabulary to change. I realize how much I expect everything to be immediate." (P15205)</p>
IS-cited CF-connection IE-enviro IE-rapport	<p>"One notable database that I feel would be useful in the future is the Web of Science, particularly their citation maps. Figuring out how many times an article is referenced in other publications shows how popular the text is and how influential it was when written. Finding that last written article also makes my papers more relevant and current. Another added benefit is having the most recent article for a particular subject in order to use its bibliography to build a history of recent and past events leading to its publication." (P15206)</p> <p>Memo: breadth of understanding what citation maps reveal</p>
CF-synthesis CF-anticipate CF-berrypick IV-fluency	<p>"[People] ask a really vague question and slowly circle in towards what they really want. That point has really stuck with me, particularly with my __ course that I'm just finishing up this term—wow, it is so true! Knowing just how much information is out there, I'm now trying to ask better, more specific questions in the first place, which has already been a fruitful adjustment to my searching strategies." (P15203)</p> <p>Memo: framing good questions, critical thinking, berry-picking (code added to template)</p>
CF-styles	<p>"I look forward to introducing new terminology, more relatable terminology, to the classroom with regards to different searching practices such as pearl growing and lawn mowing." (P15205)</p> <p>Memo: student's own role as IL teacher means passing on their new knowledge to others</p>

Thematic analysis of the discussion posts revealed two high-level themes that tracked to the template codes:

1. The most prominent insights to emerge from learning about early search engine design developments were:
 - 1.1. Controlled vocabulary, including how it is created, how it varies by source, and how to apply it to search.
 - 1.2. How publishers and other content creators influence both content selection and findability through metadata.
 - 1.3. That choices about fields, subfields, and proximity connectors did not ‘just happen’, but were the outcome of considering user behavior and database content; that this had evolved over many years.
2. Learner-identified take-aways in their final reflections were most prominent on the themes of:
 - 2.1. Humility about one’s prior knowledge.
 - 2.2. Excitement about their new knowledge.
 - 2.3. Elements of ‘concept fusion,’ the higher order concept in the search expertise model, characterized by being able to integrate the three threshold concepts of information environment, information structures, and information vocabularies, and by properties of “visioning (anticipating next moves), being light on one’s ‘search feet’ (dancing property), and profound ontological shift” (Tucker et al., 2014, p. 159).

5. Discussion

In addition to the high-level thematic patterns outlined above, a third pattern emerged that is noteworthy. An overarching pattern was that students were less inhibited in their posts to the final discussion (Reflections) than in the first (Starting Points), as they had gotten to know each and the instructor better. Their willingness to share their affective experiences as integral to their learning take-aways was progressive, and a strong indicator that the new knowledge was being integrated (Rattray, 2016). There was evidence of community formation and of personal growth, both in confidence and in their identity formation with respect to the new knowledge. As reported earlier,

These [online] discussions support the speaking of ideas and reflections for many students whose online ‘mask’ (Todd, 2008) may embolden them to speak out what they might not express in a face-to-face, synchronous setting. Their discussion posts at this later stage in the term demonstrate confidence in expressing ideas that represent a summative evaluation of learning and the affective experience. (Tucker, 2020, p. 250)

The results reported here support the choice of template analysis for the research question and the study’s aims. Because the initial coding template was constructed from an existing model for acquiring search expertise that studied a similar participant sample (Tucker et al., 2014), the methodology of template analysis was a good fit. Coding of the discussion posts from the other three forums is the next stage in the study. The datasets from the six sections of the advanced search methods course, taught over four semesters, produced 2,681 posts, from a total of 160 students enrolled, for an average number of posts per student of 17. However, some posts were

short expressions of agreement or supportive chiming-in that are important to community building, but which are not rich sources of evidence of specific learning. Further modifications to the template are expected as these stages of coding continue which, as discussed, is recommended in template analysis methodology in order to fully and accurately reflect themes in the data that could not be anticipated in the initial template.

Covering the wider context of search engine history and present-day concerns in search design enriched the student learning experiences being discussed with their peers. Their perspectives on the evolution of search and on the challenges in the search industry going forward—both of which are critical for new information professionals to grasp—are reflected in the evolving template. Template methodology is already proving to be a strong foundation for the analysis needed. The combined approach—using the search expertise model, enriched by search design perspectives and challenges—means that the research is promising both for evaluating the effectiveness of the course and for looking beyond to understanding the competencies and confidence of the participants who may contribute to search design themselves during their careers (Asadnia et al., 2022). The search expertise model encompasses abilities to anticipate and stay “light on one’s search feet”, yet adding the specifics of grasping critical factors such as algorithmic bias, market forces, and sponsorship of results to a searcher’s knowledge is bringing more profound meaning to the study’s analytical processes. Indeed, the questions posed about critical thinking (‘is Google making us stupid’) were provocative and led to a high level of interaction. Other researchers have reported using similar discussion questions in recent years (Marty, 2022).

Because the results reported here are from two of the five discussion forums, they do not reflect the entirety of the courses’ discussions, however, they point to implications of the methodology and to the students’ learning experiences specific to the look-back and look-forward in the design of search engines. The findings showed the value of integrating a theoretical model, that had been applied to curriculum design, into the coding template used in analysis and validated through the methodology explicated here. There were strong early indicators that the students gained understanding of the threshold concepts and learning objectives built into the course.

Next steps for the research are to continue the coding and analysis of the remaining datasets and to explore how the template becomes more rigorous through further complexity. From there, further refinements to the course design are anticipated.

6. Conclusion

Methodological contributions from this study are in the combining of template analysis with an established theoretical model for the domain, in this case, for search expertise. This approach—analyzing datasets from peer-to-peer discourse in online discussion forums—represents a way to explore student learning experiences that they have externalized with their classmates. Second, the contribution to curriculum design methods is an approach to integrating threshold concepts into course content, and thematic analysis using a template to then assess the course design.

Specific course content that addressed both a look-back at 1970s design decisions affecting search engines and a look-forward from challenges in today’s information landscape, such as algorithmic bias, filter bubbles, and market-driven results ranking, enriched the students’ learning experiences, evidenced in their posts. They engaged with provocative questions in the

discussions that called upon them to wrestle with ideas about how search engine designs originated, how they have evolved, and what concerns lie ahead.

Two primary outcomes from the study were: (1) validating the suitability of template analysis methodology for purposes of analyzing learner discourse where an existing theoretical model has been established and used for course design; and (2) supporting the value of including both look-back and look-forward content in a search methods course, serving as ways to (i) enrich students' understanding of the information environment and (ii) integrate awareness of issues that affect how they conduct their own searches and how they teach others how to search.

7. Limitations

The results from this study are preliminary and, as such, the findings reported here and discussion of implications are positioned as preliminary for purposes of transferability or generalizability. Study limitations are inherent in the participant sample that was limited to 160 students in an MLIS degree program taking an advanced course on search methods which they had self selected.

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