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Using Decision-based Learning to Develop Expert Information Literacy Behaviors in Engineering Undergraduates

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Abstract

The ACRL *Framework for Information Literacy in Higher Education* describes desirable information literacy competencies in terms of novice and expert behaviors. One may reasonably argue that it is outside of the scope of a university education to fully achieve the expert level of behavior described. However, choices in designing information literacy instruction can improve chances of a measure of expertise being developed even prior to graduation.

One element of expertise that is often overlooked in instructional programs is the framing of the conditions under which certain methods of inquiry or analysis are to be used. Often, the conditions of use are obvious inside of the academy, given the context of the assignment or unit of study. However, when that context is removed and students are given a real-world problem, they may struggle to identify the proper tools to use because they have yet to develop a schema that guides this kind of decision making. This understanding or "conditional knowledge" – knowledge of when to use the tools at one's disposal – is one of the key distinguishing attributes of experts. One method for helping students explicitly develop conditional knowledge is called Decision-based Learning (DBL).

This paper describes continuing efforts to employ DBL techniques in undergraduate information literacy instruction, in furtherance of expert literacy skill levels identified in ACRL's Framework (a work-in-progress). It summarizes results of recently published studies in this area and explores different areas within the domain of college-level information literacy where developing conditional knowledge may provide the largest gains in information literacy education. Focus is placed on concepts of particular interest to engineering undergraduate students. Finally, the paper provides examples of possible ways of incorporating DBL to teach these principles and provides observations from a pilot implementation of these example DBL models.

Introduction

In 2015 the Association of College & Research Libraries (ACRL) introduced the Framework for Information Literacy for Higher Education (hereafter identified as "the Framework") [1]. Written in response to a "dynamic and often uncertain information ecosystem in which all of us work and live" this framework provides guidance for information literacy instructors so that they can more effectively build depth of understanding within students to prepare them to engage with this complex information landscape.

Within the six frames comprising the Framework, complex information behaviors are suggested as a response to the challenge of navigating the complex information landscape. Instead of simple binary "checkbox" rules governing engagement with information, the Framework suggests that behaviors related to information should be context sensitive. In other words, the literate person in today's environment must realize that how one engages with information depends on various conditions, for example, information need or setting of use. Thus, a piece of information or an author that may be unacceptable for use under one set of conditions may be acceptable under another set. Table 1 summarizes a few of the behaviors described in the

Framework, along with the conditional aspect of that behavior; a more extensive table is included in the appendix.

As can be seen, the Framework describes information practices in terms of both novice and expert behaviors (sometimes novice behaviors are implied); attaining expert level knowledge on how to interact with information often relies upon understanding the conditional aspects shown. Indeed, Bransford, Brown, and Cocking [2] (see also [3]) suggest that a key attribute separating novice from expert is conditional knowledge, which acts to help experts know *when* to apply procedural or conceptual knowledge. Thus, successful teaching of conditional knowledge alongside these other forms of knowledge is important to helping further a student's level of expertise developed prior to leaving the academy [4]. The challenge for instructors is how to build such knowledge or expertise within the constrained framework of a university education.

Teaching conditional information explicitly. Conditional knowledge often comes as a result of years of accumulated practical experience [2]. In this case, a learner builds her own schema for action based on repeated observations and application of knowledge under varied circumstances. The progression from novice and expert thus often happens organically through the learner's commitment to continued education if such schema-building did not occur as part of her formative education. Indeed, it is even possible (and perhaps common) to learn a particular concept or method in a university environment, but never really comprehend how to apply that knowledge [5]. This may be at least in part due to the structure of coursework in a university setting. For example, an engineering instructor may teach principles of static failure theory over the course of a semester, and because the principles are logically grouped into units of study, the question as to which principle to apply to a particular problem is obvious by virtue of the context of the assignment within that unit of study [6]. By contrast, a real-world problem encountered after graduation enjoys no such context [7]. In addition, the difficulty of creating one's decision-making schema naturally becomes greater as the number of possible tools or approaches increase, or as the decisions otherwise become more complex.

Having years of practical experience is not the only possible way to build a level of expertise that includes conditional knowledge. Swan, Plummer, and West [4] contend that intentional focus on building conditional knowledge can help improve the level of expertise developed in a university program. Problem-based learning, capstone projects, and other teaching methods[1] may all help strengthen student conditional knowledge [5], [6], to a greater or lesser extent.

Another instructional method, called Decision-based Learning (DBL), more explicitly focuses on developing conditional knowledge alongside procedural and conceptual knowledge [8], [9]. In contrast to methods that simply provide more real-world practice for students, DBL explicitly defines a model process based on an expert's schema, from which students can build their own schema [4]. This jump-start to schema building can potentially help make a student more prepared for professional contribution. For example, in an engineering environment, developing

[1] For example, in his book *Small Teaching*, James Lang highlights a study suggesting that the method of interleaved learning helps students not only use equations, but also "identify the *type* of problem they were seeing" and select an appropriate solution method for that problem, i.e., it helps develop conditional knowledge [15].

a clear thought process (schema) for selecting the right tool to use based on the conditions given provides the added benefit of providing justification for analysis and design decisions, and thus helps the engineer become more capable [6].

Table 1. Conditional aspects of expert behavior from the Framework [1]

Frame	Expert Behavior	Novice Behavior	Conditional Aspect
(1) Authority is Constructed and Contextual	"Experts know how to seek authoritative voices but also recognize that unlikely voices can be authoritative, depending on need."	A novice relies on "basic indicators of authority, such as type of publication or author credentials." They rely on editors and publishers to establish credibility for the author.	Under what conditions are new voices (including voices outside of one's field) to be given credibility relative to established authorities? How do these considerations influence the degree of credibility given?
(2) Information Creation as a Process	"Experts recognize that information creations are valued differently in different contexts, such as academia or the workplace."	Novices trained wholly in an academic setting may not value or know about creation processes and formats used in the workplace.	Under what conditions are quality indicators such as peer review process essential and when are other information formats or creation processes such as editorial or internal review adequate?
(6) Searching as Strategic Exploration	"Experts select from various search strategies, depending on the sources, scope, and context of the information need."	"Novices tend to use few search strategies," and "may search a limited set of resources." They may select sources because they 'seem right' or they support a belief system they have.	Which resources are most appropriate to search for the given information need? Which search strategy is dictated or most effective for the given conditions?

How Decision-based Learning Works. The DBL process is explained in detail elsewhere [9]. In summary, the process starts by first identifying an expert's decision schema and framing this decision-making in terms of questions an expert (perhaps subconsciously) asks in order to decide which course of action to take. These questions, known as the "expert decision model" (EDM), are then taught to the student in a practical setting: the student is given a variety of problem scenarios to solve, and as she applies the EDM to each scenario, her responses to each question lead to further questions from the EDM and finally to an endpoint that suggests the course of action to take. In the problem scenarios, the instructor carefully chooses the language used to describe key aspects of the problem so that students learn what aspects to focus upon to make decisions. Figure 1 illustrates this process graphically. As shown, the student encounters multiple problem scenarios – in the case of information literacy instruction, perhaps various types of information needs – and determines a solution to each problem stepwise as she makes decisions as guided by each question in the EDM. At the end of the decision path, the student receives feedback about the decisions made, and may receive instruction to revisit a particular decision as needed, so that the correct pathway may be followed.

The correct decision at any point in the EDM may or may not be evident to a student. For this reason, brief training modules are made available at decision points, which contain "just in time, just enough" information to help the student make that decision [9]. As the student applies the EDM to multiple and different scenarios, the questions that help the expert to decide a proper course of action based on problem conditions become more familiar to the student. This can help students identify critical aspects of problems that lead to a successful course of action, and thus can help students build their own problem-solving schemas as they observe where their decisions lead (see Figure 1).

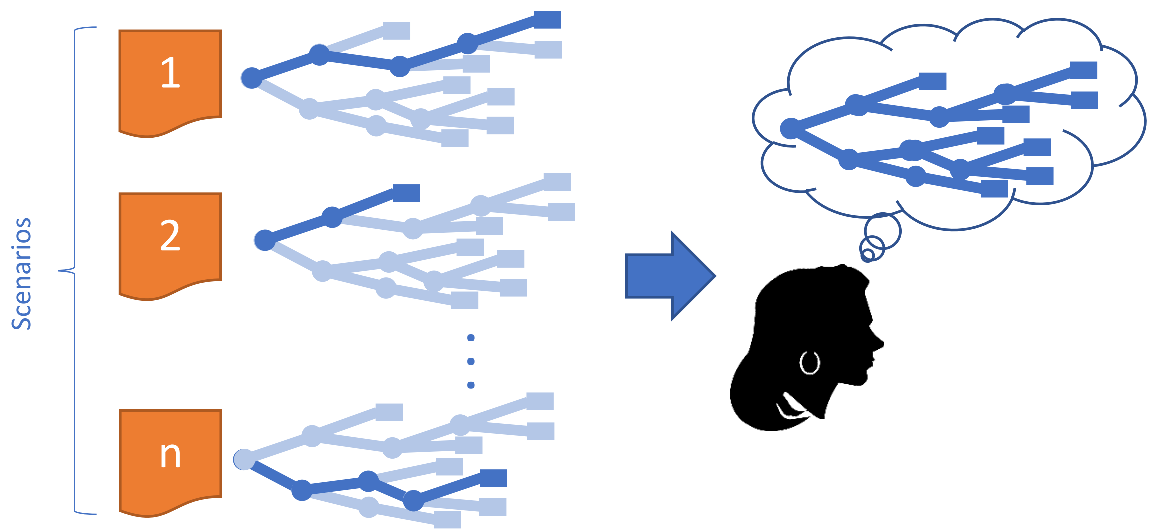

Figure 1. Building expert schemata through practice problem solving using EDM

Prior Studies with DBL in University Curricula

Formal studies with DBL in a university environment are somewhat limited at present, as the method is still relatively new. Nevertheless, the available literature does represent a variety of subject areas and teaching levels, including beginning-level [10] to graduate-level [11] students learning topics in engineering, chemistry, thesis composition, religion, and information literacy. Likewise, DBL has also been applied in a variety of instructional settings, including full semester courses [12], single course units [7] and one-shot instructional sessions [10], [13]. The following is a brief summary of the literature, which includes comparative studies as well as various forms of assessing the method from a student or instructor point of view.

Sansom [7] used the DBL method with a class of approximately 200 first-year general chemistry students, focusing her EDM on solving problems for a unit about heat and enthalpy (subject matter also of great importance to engineering students). The scope of her model took two class periods to introduce, during which the instructor worked 10 problems (scenarios). Students then had an opportunity to practice using the DBL method outside of class. The performance of this class of students on a unit exam was found to be statistically better than that of a comparison group of students taught using traditional lecture methods the previous year. Those students performing the best used the DBL model with a modest number of scenarios outside of class (5-10).

Plummer, Taeger, and Burton [12] implemented DBL in a semester-long religion course to help students organize historical content found in a book of scripture. In a qualitative study of student attitudes towards the learning method, they found students generally characterized the method positively, with some students adding that it helped them make deeper connections with the subject matter.

Nelson [6] used DBL to assist mechanical engineering students select an appropriate static failure theory to apply in analysis. Though not a formal study, student comments taken from course evaluations indicated that these engineering students resonated with the decision-tree structure of the training and wished for more content to be delivered in a similar manner. Nelson also noted good student engagement with the EDM and suggests that the opportunity to use the model for self-study was a positive aspect of the overall method.

In the first application of DBL to the information literacy domain, Katz [10] tested the DBL method with first-year writing students as a method of teaching source evaluation skills. In this study, she categorized the strategies used by students to evaluate different quality of sources and found that those students who were trained using the DBL method chose higher-level strategies than those who were given an alternate computer-based training module.

Owens and Mills [11] applied DBL to teaching masters and doctoral students to evaluate qualitative empirical research studies. An EDM was created to help students select articles for their research and also assist evaluation of student research proposals. Students used the model to evaluate over a dozen articles, and Owens and Mills noted they successfully demonstrated the ability to articulate specific reasons for criticism.

In a formal multi-semester study, the author has previously implemented DBL with advanced writing students, typically in their junior or senior year of university studies [13]. In this case, the EDM included decision points related both to selection of search strategy and evaluation of research sources. Based on pre- and post-instruction scores, the group of students receiving the DBL treatment exhibited a statistically significant increase in test scores over those receiving a more traditional lecture treatment. From usage information provided by the students, those in the DBL group also engaged with the pre-class DBL modules to a greater extent than students in the lecture group engaged with pre-class videos.

These implementations highlight a few items that seem particularly applicable to the domain of information literacy for engineering students. First, findings that a modest use of the method can provide measurable improvement in student expertise provides a measure of confidence that this method can be effective even with a limited number of touchpoints between students and teachers, a scenario that is encountered frequently in information literacy instruction. Second, student and instructor acceptance and engagement in the method has been generally positive. Considering that information literacy is often taught in a pass/fail setting (without grade motivation), then student engagement with the material conveyed is critical to producing desired instructional results. While the DBL method has been used in a variety of fields and student skill levels, the observed resonance of this structured method with engineering students suggests it may be particularly promising within this student demographic. Third, it is worth noting that the DBL method is designed to explicitly develop conditional knowledge; thus, in each of the applications of the method mentioned, instructors chose elements of their classes that had a significant conditional component. This selectivity in application of the method suggests that those seeking to apply this method should consider which areas of a class may provide the most fruitful results. In the case of information literacy instruction, focus on those skills that engage conditional thinking most deeply, such as those identified in Table 1 and the Appendix, may provide the best candidates for implementation.

Using DBL to Further the Aims of the Framework

Expert Decision Models. Referring back to Table 1, conditional aspects of two frames in the Framework have particularly aligned with the author's desired instructional outcomes for advanced writing one-shot classes for engineering students. The first includes aspects of frame 6, "Searching as Strategic Exploration" (see [1]).

Selecting resources and searching strategies that are appropriate for the information need is a fundamental skill taught in advanced writing library sessions. As students are taught this skill, they may be introduced to a number of library resources, and will undoubtedly be faced with determining where all of these new resources fit with respect to their established "go to" resources, most of which are typically freely offered and web based. Helping students establish a decision-making process relating to when to access new versus previously established information tools can both help students appreciate the value of new resources, as well as understand the differences in application of each of their tools in their developing toolset. For example, Google Scholar™ provides perhaps the most inclusive listing of "cited by" citations for a given work, which is useful if a researcher is interested in maximizing recall; on the other hand, other library-provided citation indexes can offer more precision relating to works in a particular discipline or quality of resources cited. Likewise, in learning the differences in features offered by specific databases with and without citation indexing, students can learn under what conditions each can serve them best. The questions in an EDM focusing a student on such decisions helps identify contextual elements of expert behaviors identified in frame 6 of the Framework.

A simplified version of one sample EDM for a module teaching these frame 6 principles is shown in Figure 2. As shown, the decision model uses just a few questions that help the student identify which resource to use from a list of library and freely available internet resources.

The reader will note that the design of the EDM does depend on the expert – different instructors focus on different aspects of the overall content and will make diverse choices relating to the order of the decisions to be made and the most important decisions in the first place (often this is a matter of preference and organization) [9].

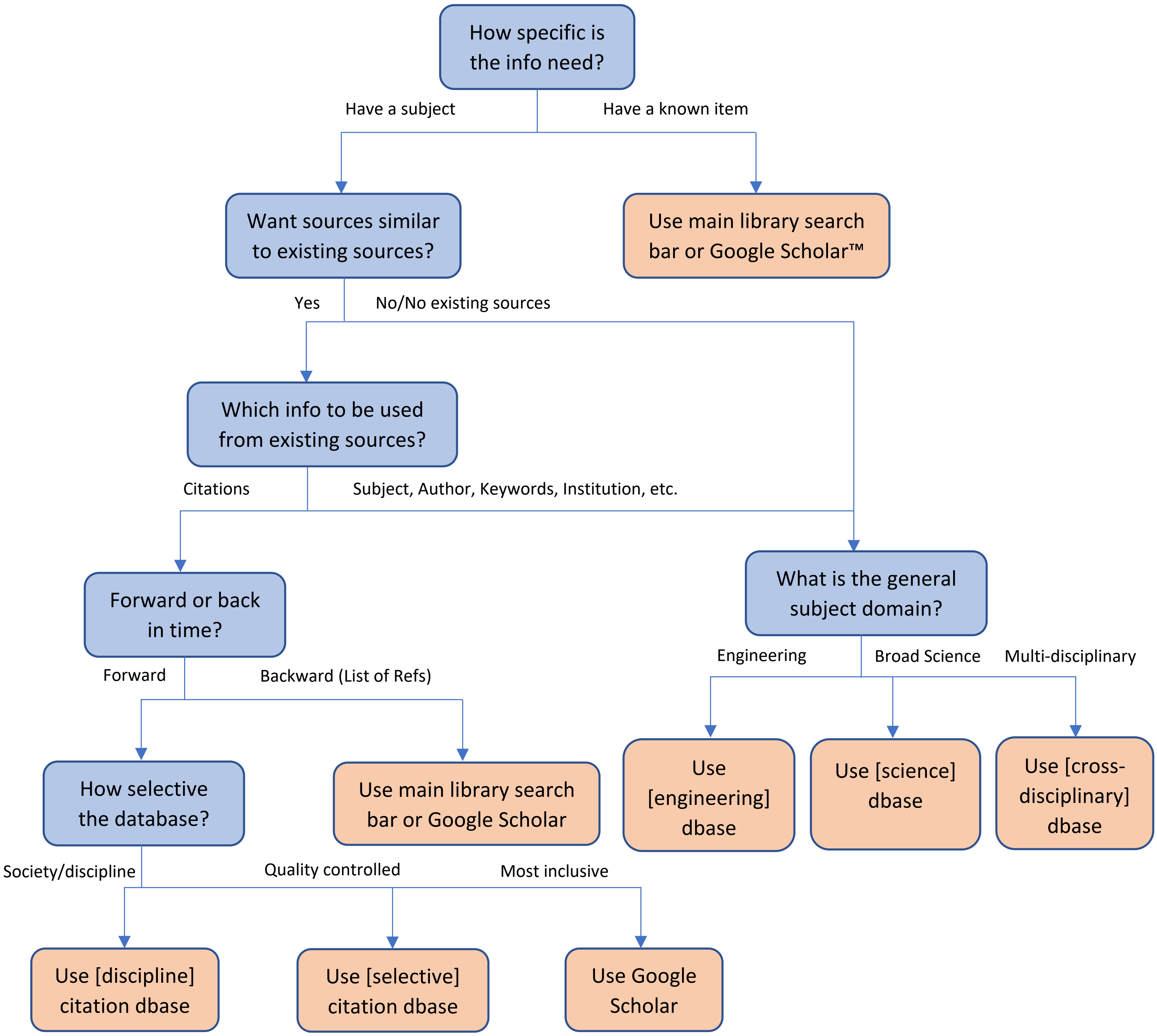

Figure 2. Sample EDM for teaching advanced writing students conditions for using different information resources (see also [14])

In the case presented in Figure 2, the instructor may use this simple decision model to address the trivial information searching case first (a known item), by asking how specific the information need is. If the information need is very specific (a known item), then the model points students to appropriate use of the library general search box and/or Google Scholar. If the information need requires a more general search (topic based), the model then looks at the somewhat more complex case – that of finding new information using that from existing articles in hand – by asking the student whether the sought information leverages similarity to existing sources of information. This introduces students to citation indexes and other aspects of an indexed record that they can use to find related sources, ultimately pointing them to appropriate databases to search. The final searching case – that of finding new information by using keywords to represent a search topic – is represented in the model by the path taken if similarity to existing information is not a chosen/available option. This then prepares students for a discussion of how to search databases using keywords.

The second frame from the Framework, that of "Information Creation as a Process" [1], challenges information literacy students to understand contextual requirements for different information formats and information created under different processes (see Table 1). Teaching this competency with appropriate depth within the time constraints of a one-shot can be challenging, particularly if the searching strategies discussed above, along with sufficient practice time and individualized searching help, are also a priority for one-shot sessions (as they are at the author's institution). Indeed, in previous instructional plans (see [13]) the author found that combining search strategy in the same lesson as source evaluation limited the depth with which this important element could be explored and practiced by students.

To remedy this, the author has created an EDM for a pre-class assignment that focuses exclusively on source evaluation principles and thus provides for a look at a wider variety of engineering-related sources and prompts students to think more deeply about a series of questions to ask when evaluating sources. This approach assumes all discussion of search strategy can take place during an in-class session. A simplified version of this EDM is shown in Figure 3.

As shown, the initial question[2] in the EDM focuses on different information creations, aligning with frame 2 of the Framework. To help students consider types of content that would be most relevant to future engineering careers, journal articles, conference papers, trade magazines and other editorially reviewed information sources, and self-published sources, including research preprints, were selected as the principal sources in the model.[3] Recent activity by publishers in

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[2] In the module, the first question is actually whether the source adds new information to the research, but for the purpose of this discussion and to simplify the diagram, this question has been omitted.
[3] It should be noted that, for the sake of completeness, the EDM actually includes decision paths for industry consensus documents (standards), and documents published through legal review (patents), although students in advanced writing classes are not asked to complete any scenarios using these paths. These paths will be exercised in the future with courses that focus on this type of document.

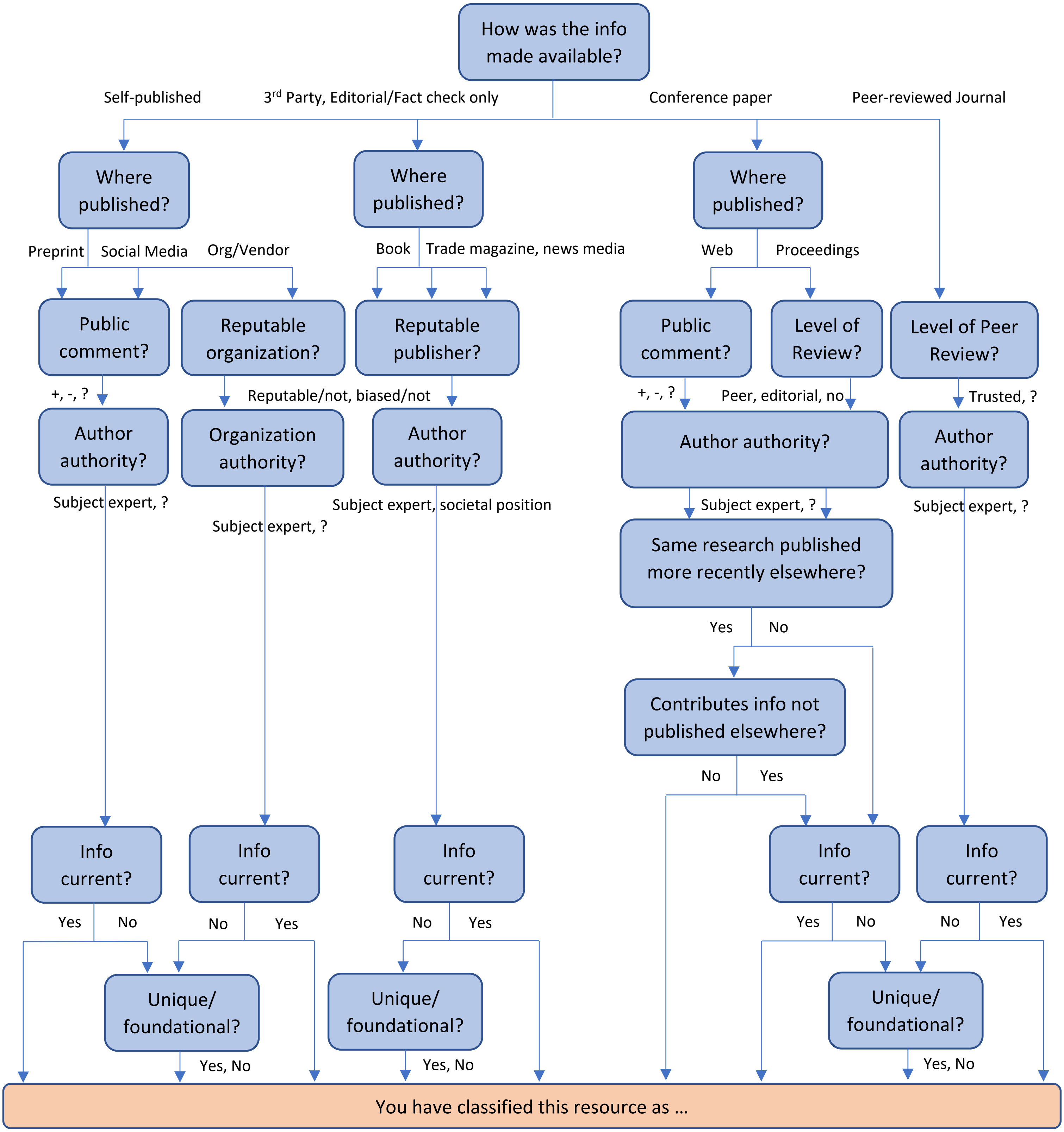

Figure 3. Sample EDM for teaching source evaluation principles relevant to upper division engineering students

the engineering domain to provide preprint servers and include preprints in database search results demands that this type of literature be understood by students, especially with respect to the information creation process.

Based on the medium of publication (proceedings, journal, preprint, website, book, etc), the EDM next challenges the student to consider questions relating to the quality of the process used. This includes the level of review used in the publishing process, or other similar quality-related factors appropriate for the medium, including public review or reputation. Students then are challenged to question author (or organization) authority and currency of the information. To highlight some important considerations relating to conference papers in various technical disciplines, in the conference paper decision track (see Figure 3) students are also asked to question whether a conference publication has been followed by a peer-reviewed publication in an archival journal (e.g., by the sponsoring organization), as is sometimes the practice in various engineering/technology disciplines.

Use of DBL in an Information Literacy Instructional Session. In a pilot of this approach, the EDMs described above have been used in pre-class homework assignments and/or as a framework for in-class discussion. This pilot included 20 instructional sessions with a total of 115 engineering and technology students. Each session proceeded as follows.

1. Students were given a homework assignment using the EDM from Figure 3, which included seven scenarios and supporting "just in time, just enough" learning modules (a 20-30 minute assignment). These scenarios included an evaluation of sources from peer reviewed journals, conference papers, a book, a website, and a preprint.
2. Within a week after the homework assignment's completion, the students met together in a live classroom and discussed the various creation processes represented in the homework, and their value. In addition to this class discussion, the instructor (the author) discussed and reinforced the decision-making questions of the EDM by asking the students to recall the questions they were asked in the homework module. In this way, the class was basically reconstructing a simple version of the EDM, which was then written on the chalkboard. These review activities, which took the first 10-15 minutes of the class, were designed to help cement the principles learned in the module and further help the students build their own schemas.
3. This in-class review of the homework was followed by an introduction to search strategy using the decision-making EDM from Figure 2 as a framework for class demonstration of resources available to students. With this model, the students were provided background including considerations for effectively using the general library search bar, citation indexes, and engineering databases. The instructor then demonstrated these resources, including instruction on search structure, followed by student searching for their own topics, with the guidance of the instructor and teaching assistant.

Results & Observations

Teaching practice for the author has evolved over several years and continues to be a work in progress. Early quantitative results previously mentioned, which showed both an increased performance by students and a higher engagement with DBL pre-class material over other more conventional materials [13], has encouraged the author to continue in further development of DBL modules, particularly to improve aspects of decision making that are nuanced and contextual. This has prompted a revisiting of the Framework and a consideration of what that document is really trying to promote. The distillation of concepts presented in the table in the Appendix is largely a result of that effort. This observation points to one of the benefits of creating an EDM: it forces metacognition on the part of the instructor and leads to a clearer definition and even refinement of expert thought processes. Still other aspects remain to be pulled out of the Framework document, as its scope is quite expansive.

The pre-class assignment was designed to support the author's objectives to help students enter class with a more uniform understanding of basic principles, to provide greater depth of coverage, and to provide context for demonstrations of different resources during class.[4] From informal observations by the instructor during the pilot of this most recent model, students generally have come to class better prepared for evaluating sources. Indeed, questions to the class relating to the homework assignment have revealed deeper thinking about how information is created and how various sources differ, particularly conference articles, websites, and preprints. When asked what students remembered about different source types from the homework, students in several instructional sessions remarked that they had never recognized the difference between journal articles and conference papers, and they demonstrated comprehension of the differences in underlying publication processes. The class members have also come to class with thoughtful questions relating to various elements of the EDM, for example, currency of information as it relates to specific technologies or disciplines.

Part of this increased depth of thought may come as a result of how the homework modules are organized: students are given questions to consider and resolve, a process that is likely to lead them to further questioning and pondering. In designing scenarios, the author has found that it is helpful to provide simple, more well-defined, scenarios at first, followed by some with a little more uncertainty [14]. These latter scenarios also challenge the student to deeper thought. The consideration of currency of a source does offer opportunity for adding scenarios that are a little less cut and dried, which then have led to good discussions on what makes something outdated, how technology change rates affect judgments of currency, and when older information might be valued for a particular application.

Certainly, the models shown in Figures 2 and 3 do not purport to be the only, nor the best, set of questions for teaching engineering students principles of search strategy and source evaluation respectively, but rather are examples of how these concepts may be organized based on the objectives of the course and in the DBL framework. In particular, there are many other questions that could be used to help one select appropriate resources for searching than those shown in Figure 2. And, while the model in Figure 3 does generally follow established source evaluation criteria, there may be other process components that different instructors may choose in order to

[4] In prior testing [13], the author had used elements of the EDMs in Figures 2 and 3 as part of a combined model given to students as pre-session homework. As already mentioned, to provide deeper focus on source evaluation, homework for recent sessions have included just the EDM in Figure 3.

highlight specific principles. Likewise, the order of these questions in the model is sometimes not critical, especially as exemplified by the latter questions provided.

It is important to note that while the source evaluation model in Figure 3 is based on established principles, an important difference from a more simplistic "checklist" approach to source evaluation is the addition of nuance to the decision-making process. This is an area where the fundamental focus of decision-based learning on conditional knowledge can help add depth to this learning process. Examples of where the constructed DBL model facilitates this depth of learning include its addressing of different levels of review (not just whether an item has been peer reviewed or not, but including a characterization of the "goodness" or quality of review) and a deliberate decision by the author not to have a binary answer at the end of the process (e.g., "use"/"don't use"). Instead, at the end of this module the student is given a summary of the several factors considered and how the student's progress through the EDM has classified each of the factors. The student is taught to look at the classification as a whole when determining how much credence or trust to put in a particular source. This leads to a less comfortable assessment of relative value rather than a sorting of sources into two piles, where each item in a pile may be mistakenly seen as equally valuable (or invaluable, as the case may be). However uncomfortable for students, this level of critical thinking seems to be what is demanded by the Framework.

Future work relating to this project will include further refinement of the EDMs based on student feedback and learning. In a previous quantitative study using DBL the author suggested the benefit of creating a shorter, more focused decision path, in allowing for better exercise of the model with more scenarios utilizing similar paths [13]. The iteration in this paper attempts to do this; a quantitative study is now needed to see how this approach compares with a longer model covering multiple concepts. Longer term effects of this method are also of interest, e.g., determining what effect the use of DBL in advanced writing students might have on retention of those concepts through the students' later years of study.

Conclusion

To better align teaching methods with desired outcomes suggested in the ACRL Framework, approaches that help build expertise, particularly conditional knowledge, are needed. Promising results obtained from engineering students learning principles of information literacy using the decision-based learning method prompts continuing exploration of the method for developing greater expertise in finding and evaluating information. As part of this ongoing development, two suggestions for expert decision models have been developed and described. Initial responses from students in a pilot implementation of these models have been positive, showing that this method is assisting students to think more deeply about the processes by which information is created.

Acknowledgement

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Appendix

Frame	Expert Behavior	Novice Behavior	Conditional Aspect
(1) Authority is Constructed and Contextual	"Experts know how to seek authoritative voices but also recognize that unlikely voices can be authoritative, depending on need."	A novice relies on "basic indicators of authority, such as type of publication or author credentials." They rely on editors and publishers to establish credibility for the author.	Under what conditions are new voices (including voices outside of one's field) to be given credibility relative to established authorities? How do these considerations influence the degree of credibility given?
(2) Information Creation as a Process	"Experts recognize that information creations are valued differently in different contexts, such as academia or the workplace"	Novices trained wholly in an academic setting may not value or know about creation processes and formats used in the workplace.	Under what conditions are quality indicators such as peer review process essential and when are other information formats or creation processes such as editorial or internal review adequate?
(3) Information has Value	"Experts also understand that the individual is responsible for making deliberate and informed choices about when to comply with and when to contest current legal and socioeconomic practices concerning the value of information."	"The novice learner may struggle to understand the diverse values of information in an environment where "free" information and related services are plentiful and the concept of intellectual property is first encountered through rules of citation or warnings about plagiarism and copyright law."	Under what conditions is it proper to contest current legal and socioeconomic practices concerning the value of information? Under what conditions can rights to use information be asserted?
(4) Research as Inquiry	Experts understand that "the spectrum of inquiry ranges from asking simple questions that depend upon basic recapitulation of knowledge to increasingly sophisticated abilities to refine research	The novice will struggle to ask questions or refine their searches because they don't have enough knowledge to see the gap or understand the disciplinary perspectives. They will become increasingly	Which of the "repertoire of investigative methods" is appropriate for a given need? When does a question need adjusting?

	questions, use more advanced research methods, and explore more diverse disciplinary perspectives."	sophisticated searchers as they grow in discipline knowledge.	
(5) Scholarship as Conversation	"Experts understand that, while some topics have established answers through this process, a query may not have a single uncontested answer. Experts are therefore inclined to seek out many perspectives, not merely the ones with which they are familiar."	Novices seek "discrete answers to complex problems"; they also may only seek out perspectives with which they are familiar. Novices may limit their visibility of issues using arbitrary date limits in search results.	When is a literature search "done"? Under what conditions/ information needs does a simple answer suffice? When do you live with ambiguity on a topic or question?
(6) Searching as Strategic Exploration	"Experts select from various search strategies, depending on the sources, scope, and context of the information need."	"Novices tend to use few search strategies," and "may search a limited set of resources." They may select sources because they 'seem right' or they support a belief system they have.	Which resources are most appropriate to search for the given information need? Which search strategy is dictated or most effective for the given conditions?