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Assessing the Potential for Critical Thinking Instruction in Information Literacy Online Learning Objects Using Best Practices

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Abstract

Critical thinking, while often used as a mere buzzword, is clearly relevant to the mission and expertise of librarians who teach. Even in online information literacy instruction, critical thinking remains an important goal. This study attempts to determine the ways and extent to which online information literacy learning objects follow best practices for teaching and assessing critical thinking. In this study, the researcher evaluated a sample of information literacy online learning objects in the Association of College and Research Libraries repository of peer-reviewed instruction materials, PRIMO, using a literature-based rubric. The resulting analysis provides evidence of the extent to which information literacy online learning objects adhere to best practices for teaching and assessing critical thinking.

Keywords: critical thinking, information literacy, online learning object, tutorial, online learning, distance learning, distance education, assessment

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Assessing the Potential for Critical Thinking Instruction in Information Literacy Online Learning Objects Using Best Practices

Critical thinking is a universally desired goal for students in higher education, and academic librarians are in a position to intentionally promote critical thinking in their information literacy instruction. Librarians often offer instruction in the form of online learning objects (OLOs) that can be accessed asynchronously by distance students or students accessing the OLO outside of class time. These information literacy OLOs have the potential to encourage critical thinking, but it is currently unclear the extent to which they do so. The author of this study previously developed a literature-driven rubric for assessing the extent to which information literacy online learning objects follow best practices for teaching and assessing critical thinking (Goodsett, 2020). The current study applies that rubric to a sample of OLOs from the PRIMO (Peer-Reviewed Instruction Materials Online) database.

The purpose of this study is to answer the following question: In what ways and to what extent do information literacy OLOs follow best practices for teaching and assessing critical thinking in higher education? This question resulted in the following study objectives:

- Explore the extent to which information literacy OLOs promote various critical thinking skills and dispositions using a previously developed, literature-driven rubric
- Develop a set of recommended methods for incorporating critical thinking best practices in the development and facilitation of information literacy OLOs

Background

The evaluation described in this study uses a best practices rubric developed by the researcher in a previous study (Goodsett, 2020). The rubric specifically evaluates the extent to which information literacy online learning objects foster critical thinking. The formation of the best practices rubric was guided by a thorough literature review limited to sources that provided or analyzed experimental evidence (as opposed to anecdotal evidence or theories). The instructional and assessment strategies that had the most significant

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evidentiary backing were mapped onto the rubric so that its research-based underpinnings were clear. The best practices rubric and scoring scale can be found in Appendices A and B respectively, although those interested in using the rubric themselves may want to read the previous article for a more in-depth literature review.

Literature Review

While the peak of scholarship about critical thinking occurred in the 1980s and 1990s, critical thinking remains an important goal of higher education. Well-known critical thinking scholar, Robert Ennis, defined critical thinking as "reflective and reasonable thinking that is focused on deciding what to believe or do" (Ennis, 1985, p. 45). Ennis' definition, and many others in the literature (Facione, 1990; McPeck, 1981; Paul & Elder, 2001) conceive of critical thinking as the use of evidence, reasoning, and metacognition as a basis for making decisions or taking action. Habits of thinking that employ these criteria are difficult and require practice and "slow thinking" (Kahneman, 2011); therefore, another important element of critical thinking is what Siegel (1980) calls a "critical spirit," or the disposition and motivation to use critical thinking regularly.

Librarians have wondered about the relationship between information literacy and critical thinking for decades. In the 1980s and 1990s, librarians began to see their roles change to encompass instruction, and scholars expressed concern that most librarians thought "bibliographic instruction" merely involved helping students use library tools to search for information (Bodi, 1988; Gibson, 1995). This attitude was reflected in the "back to basics" movement of library instruction, which urged librarians to limit their instruction strictly to teaching how to use tools (Reece, 2005). Librarians who resisted this limitation called on their colleagues to move beyond these simple "point-and-click" skills and foster critical thinking (CT) skills (Albitz, 2007; Alfino et al., 2008; Bodi, 1988; Daugherty & Russo, 2010; Gibson, 1995). Since the back-to-basics movement, the focus of library instruction has shifted considerably toward higher order skills, as demonstrated by the Association of College and Research Libraries (ACRL, 2015) *Framework for Information Literacy for Higher Education*. However, recent scholarship about the changing relationship between these two concepts is minimal.

In the areas of psychology, philosophy, and education, considerable scholarship exists exploring the effectiveness of various instructional methods for teaching critical thinking in

the classroom (Abrami et al., 2015; Halpern, 1998; King, 1995; King & Kitchener, 2004; van Gelder, 2005). The discovery of equivalent strategies in the online environment has been more challenging, however. Strong online instructional design is an important prerequisite for critical thinking instruction online, and a number of frameworks for teaching online are helpful for this task (Johnson & Aragon, 2003; Mandernach, 2006; van Gelder, 2005). However, none of these frameworks specifically address critical thinking, nor do they focus on online teaching for information literacy. A combination of these online instruction best practices, the literature about effective critical thinking instruction in-person, and scholarship about critical thinking and information literacy instruction can, together, serve as a baseline for evidence-based design of information literacy OLOs.

Methods

Population and Sample

This study attempts to determine the ways and extent to which information literacy OLOs follow best practices for teaching and assessing critical thinking. To accomplish this analysis, the researcher examined a sample of information literacy online learning objects in ACRL's repository of peer-reviewed information literacy online instruction materials, PRIMO. This database was chosen for the study because it consists of OLOs that the profession has designated of highest quality through a peer-review process.

When this study was conducted in spring 2018, PRIMO consisted of 313 learning objects that were reviewed by instruction librarians who are members of the PRIMO Committee via a rigorous set of standards. The committee uses criteria such as the instructional design of the submission, the innovative use of technology, the accuracy and organization of the content, and the submission's potential to be used as a model for other institutions (Association of College and Research Libraries. Instruction Section [ACRL IS], n.d.). While none of the criteria require the online learning object to teach critical thinking, the committee does look for submissions that "offer opportunities to utilize higher order thinking skills" (ACRL IS, n.d.). However, each submission is scored as a whole, and learning objects that reach a designated score are added to the database, regardless of whether each criterion was met. This study provides useful data about how many and which submissions meet the criterion about higher order thinking and, more specifically, which may solicit critical thinking.

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While the PRIMO Committee does not define "online learning object" or what kinds of formats are accepted into their database, for the purposes of this study, the researcher defines online learning object as a modular unit of interactive content designed to teach one to two learning objectives and that is accessible online. PDF documents, static content, and entire online courses would not qualify as online learning objects under this definition. Any OLO that was not accessible to the researcher at the time of the study (whether through technology errors or log-in barriers) was not included in the sample.

Due to the prevalence of broken links and obsolete technology in PRIMO tutorials created before 2012, the learning objects reviewed for this study consisted only of PRIMO materials created in the last five years (2013–2017). This reduced the sample to 71, although some PRIMO submissions consist of a collection of tutorials rather than a single learning object. When each tutorial was counted individually, the total number of tutorials was 261. To extract a meaningful sample from this collection, the researcher numbered each learning object, including the individual learning objects within a single PRIMO submission. Then, she used a random number generator to select online learning objects to be included in a representative sample. The sample consisted of 158 OLOs, a sample size that results in a 95% confidence level and a confidence interval of 5 (Australian Bureau of Statistics, n.d.).

Scoring and Analysis

For each OLO in the sample, the researcher used the previously referenced, literature-based rubric of best practices for critical thinking instruction and assessment in information literacy learning objects (see Appendices A and B) to determine a score in each of three major categories as well as an overall score. The major categories of the rubric are critical thinking instructional strategies (CTIS), critical thinking assessment strategies (CTAS), and online learning elements (OLE).

The content of the tutorials was also mapped against the list of frames from the ACRL *Framework* and the list of critical thinking skills developed by the American Philosophical Association (Facione, 1990). This mapping process did not contribute to the scores of each online learning object, but it did produce data about the prevalence of online information literacy instruction that targets particular frames and critical thinking skills.

Results

Highest Overall Scores

Overall scores for each OLO were calculated in two ways: by adding all of the scores for each element (raw score, RS) and by counting the number of elements present (element score, ES). Together, these overall scores provide information about the number of elements used in the sample OLOs and how well the strategies were employed.

The overall raw score (RS) mean for the sample of 158 OLOs was 9.19, and the overall element score (ES) mean was 4.37. The maximum number of points possible for an RS was 42 and for an ES was 14. A very high score would not necessarily indicate an OLO was better at following best practices, as it would be perhaps overwhelming and detrimental to include every single critical thinking instructional and assessment strategy in one OLO. For this reason, it is more useful to compare average and individual scores against the highest score given in the sample.

The OLOs with the highest raw score (RS=20) were "My Learning Essentials Online: Finding a Job: Writing an Effective CV" and "Research Success Tutorial Suite: Identifying Keywords." There were three OLOs that received the highest element score (ES=9). In addition to the two OLOs that had the highest RS, OLOs with the top ES included the OLO titled, "Exploring Academic Integrity Tutorial" (see Appendix C for links to all OLOs mentioned).

Each OLO was assigned up to three ACRL frames and critical thinking skills. Twenty-five OLOs were not assigned any ACRL frame, and 36 were not assigned any critical thinking skills. Overall, the ACRL frame "Searching as Strategic Exploration" was assigned most often (75 times), followed by "Information Creation as a Process" (31 times). See Figure 1 for all frames. It is important to note that many of the OLOs examined were created before the ACRL *Framework* was adopted, so they were likely not attempting to teach to a particular frame. Among the critical thinking skills, "Querying Evidence" was assigned most often (61 times), followed by "Examining Ideas" (38 times). "Analyzing Arguments" was only assigned once, and "Conjecturing Alternatives" twice. See Figure 2 for all critical thinking skills.

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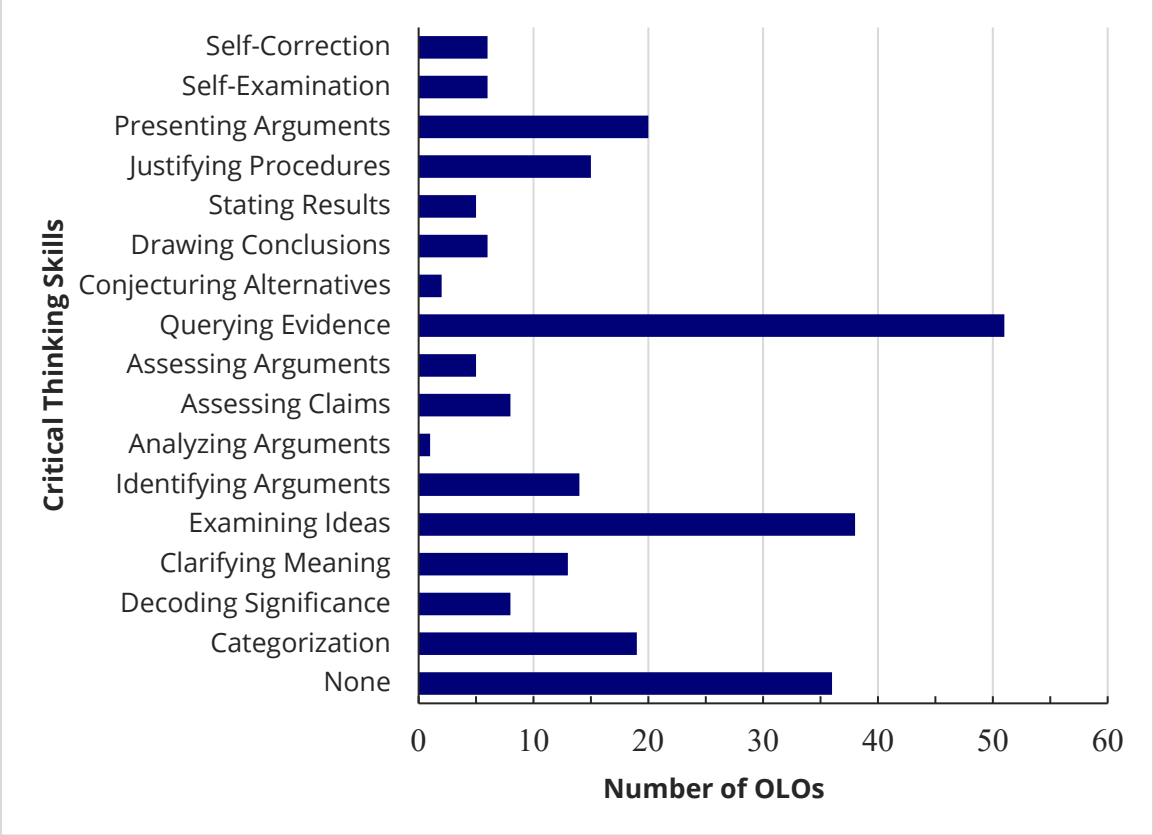
Figure 1. ACRL Frame Designation of OLOs (*n* = 158)

Figure 2. Critical Thinking Skills Designation for OLOs (*n* = 158)



Each OLO was evaluated against criteria in three categories: critical thinking instructional strategies (CTIS), critical thinking assessment strategies (CTAS), and online learning elements (OLE). For each criterion, OLOs could be scored up to three points (see Appendix B). Of the 16 OLOs that made up the top 10% RS, the mean CTIS score was 6.81 (as compared to the overall mean in that category, 1.73), the mean CTAS score was 4.50 (overall mean: 2.17), and the mean OLE score was 11.56 (overall mean: 5.28). Of the 12 OLOs that made up the top 10% ES, the mean instructional strategies score was 2.67 (overall mean: 0.91), the mean assessment strategies score was 2.17 (overall mean: 1.18), and the mean online learning strategies score was 3.42 (overall mean: 2.28). For a list of OLOs with the highest score in each of the three main categories, see Appendix C.

Best Teaching and Assessment Strategy Scores

The CTIS and CTAS sections measured OLOs against best practices for specific methods. Some OLOs scored particularly well regarding these specific methods. The number of OLOs that scored highly for use of each strategy, percent of OLOs that used it, and the mean score for OLOs that used the strategy were calculated for comparison (see Table 1).

Table 1: Critical Thinking Instructional Strategies

Strategy	Highest Score Assigned[a]	Number of OLOs with Highest Score	OLOs That Used Strategy		
			Number of OLOs[b]	Percentage of OLOs	Mean Score for OLOs[a]
Discussion	2	1	2	1.27%	1.5
Inquiry-Based Learning	3	4	26	16.46%	1.97
Authentic/ Real-World Problems	3	3	36	22.78%	1.8
Graphic Organizers	3	4	20	12.66%	1.75
Reflection	3	14	29	18.35%	2.31
Practice and Repetition	3	3	30	18.99%	1.65

[a] out of 3

[b] out of 158

A similar analysis was performed for CT assessments in the sample of OLOs, revealing patterns in the scores of specific assessment strategies (see Table 2).

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Table 2: Critical Thinking Assessment Strategies

Strategy	Highest Score Assigned[a]	Number of OLOs with Highest Score	OLOs That Used Strategy		
			Number of OLOs[b]	Percentage of OLOs	Mean Score[a]
Feedback	3	23	78	49.37%	2.29
Multiple-Choice Question Construction	2	18	75	47.47%	1.24
Open-Ended Questions	3	13	33	20.89%	2.15

[a] out of 3

[b] out of 158

Limitations

Before exploring the application of best practices for teaching critical thinking in this sample, it is important to recognize several mitigating factors and limitations. First, some of the OLO creators in this sample may not have been attempting to teach critical thinking. Ascertaining the intent of the OLO creator was not possible within the scope of this study. However, OLOs that teach basic, lower order thinking skills provide an important foundation for learning critical thinking skills (Gibson, 1995). Unless students understand the mechanisms by which to find information, they will not be able to evaluate and use it critically. Therefore, the OLOs that were assigned low scores in this study should not be undervalued. One implication of this study is that not every information literacy OLO teaches critical thinking, and perhaps not all should.

An additional consideration in this study is the absence of context for each OLO. Faculty or librarians may pair an OLO with in-class activities or with other homework. These additional exercises may promote critical thinking more effectively than the OLO alone. In fact, a simple OLO that does not engage higher order thinking may improve in-class instruction and provide better opportunities for critical thinking instructional strategies in the classroom. It was not, however, within the scope of this study to determine the context for each OLO's delivery.

Clearly, teaching critical thinking is challenging under any circumstances. Teaching it in an online environment is, perhaps, more challenging. Online learning objects may be limited in their ability to promote critical thinking because they are short, completed with no supervision, and restricted in their engagement. However, studying their potential to

promote critical thinking has clear value and utility. OLOs may be viewed many times by many students, making them an efficient method for imparting educational content; OLOs might be the only way introduced new content to distance students; and OLOs can be paired with classroom instruction for greater impact. For these reasons, OLOs should remain a focus of critical thinking educational research.

The methods of this study also present some limitations. The generalizability of these results is limited, as the scores given to each learning object may have been subject to researcher bias. Because this research was conducted as part of the researcher's master's thesis, she was unable to collaborate with another researcher to ensure reliability. Additional studies conducted with multiple researchers using inter-rater reliability measures would result in more reliable data.

Discussion

This study attempted to answer the question "In what ways and to what extent do online information literacy learning objects follow best practices for teaching and assessing critical thinking in higher education?" Although limitations to the study prevent the researcher from advancing a definite answer to this question, the data do reveal some insights important to beginning to answer it.

As demonstrated by the literature, there is significant overlap between information literacy and critical thinking. However, the overall mean RS of OLOs in the samples was fairly low (9.19) compared to the highest scoring OLOs (RS=20), and the percentage of OLOs that used critical thinking instructional and assessment strategies was low for each strategy. OLOs created to teach information literacy should, perhaps, use more of these strategies and use them in a more robust way. In addition, as Gibson (1995) points out, tools and technology may change, and focusing too heavily on them reduces transferability of skills. Concentrating on higher order thinking and underlying concepts improves the usefulness of the OLO and student retention of the material.

Best Practices, the ACRL Framework, and Critical Thinking Skills

Because each OLO in the sample was assigned ACRL information literacy frames and American Philosophical Association critical thinking skills during the study's scoring process, it was possible to compare these assignments to the use of best practices. Examining these matches reveal relationships between a focus on particular skills or frames and the

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success of individual OLOs in following best practices for teaching and assessing critical thinking. In this case, examination showed that the highest scoring OLOs often were associated with frames and critical thinking skills that emphasized search strategies.

Although all of the OLOs in the sample were accepted into the librarian-curated PRIMO database, not all objects were assigned an ACRL frame in the course of this study. Some OLOs explored topics that are only tangentially related to information literacy, such as study habits, building a CV, and note-taking. However, of the OLOs that were assigned an ACRL frame, the top-scoring OLOs (both RS and ES) were assigned "Searching as Strategic Exploration" most frequently, and this frame was assigned most frequently by far across the sample (74 times). Many of the OLOs focused on the basic mechanisms of searching, such as database functionality, keyword development, and research question construction.

The critical thinking skills most often used reflect a similar focus: "Querying Evidence" and "Examining Ideas." These skills involve the ability to find and evaluate evidence, and, as explored in the literature, information literacy and critical thinking seem to overlap most at this juncture. Skills like "Analyzing Arguments" were assigned much less frequently, perhaps because close examination of rhetorical arguments is often not emphasized in information literacy instruction.

While the researcher hypothesized that OLOs that explored "Authority is Constructed and Contextual" would score highest in best practices for critical thinking instructional strategies because of the topic's clear relationship with critical thinking, this was not the case. Relatively few OLOs (22, 14%) were assigned this frame, and none of the top-scoring OLOs (both RS and ES) were assigned it. Regarding search strategies, which are well within the wheelhouse of librarians, there appears to be plenty of opportunity to employ critical thinking instructional strategies, and to do so skillfully. At the same time, it may be useful to employ critical thinking strategies in OLOs regarding other aspects of information literacy where there may be overlap, such as with source evaluation.

Presence and Application of Best Practices

Score analysis of the OLOs in the sample reveal how much and in what ways librarians are employing critical thinking teaching and assessment strategies in their online learning objects. Overall, examination of OLO scores showed that some OLOs did adhere to best practices in several ways, and their use of critical thinking instructional and assessment

strategies was robust. However, the average OLO in the sample scored much lower than the highest-scoring OLOs, and even for those OLOs that used many strategies, they were not often robustly executed (see Tables 1 and 2). OLOs tended to use real-world examples, practice and repetition, multiple-choice questioning, and feedback as strategies for instruction and assessment.

While it is difficult to determine the extent to which information literacy OLOs follow best practices for teaching and assessing critical thinking without a control or standard for performance, internal score comparisons show that some OLOs performed very highly in contrast with most of the sample. It is possible to create an information literacy OLO that incorporates many instructional and assessment strategies for critical thinking, as demonstrated by the high-scoring OLOs. Understandably, barriers of time, money, or personnel may prevent librarians from adding these elements. However, when this is not the case, the addition of critical thinking strategies could improve the impact of information literacy OLOs.

Because the sample was scored both in terms of quantity of strategies employed and quality of strategy usage, it was possible to determine if OLOs had both used many strategies and executed them well as compared to the rubric parameters. Overall, RS and ES scores overlapped, showing that the very highest scoring OLOs used many strategies well. This was not the case for OLOs within each major category (CTIS, CTAS, and OLE). The range of RS scores for top ES-scoring OLOs in CTIS and CTAS was wide, indicating that some OLOs used many strategies but did not necessarily use them well.

Overall, more OLOs used the assessment strategies than the instructional strategies. Many of the OLOs also scored highly in the OLE category, both in the number of elements used and the raw score for use of each element. This result may be because the PRIMO rubric itself includes online learning instructional design criteria.

Category Trends

When it comes to CTIS, the most commonly used strategy was real-world/authentic examples, followed by practice & repetition, and reflection (see Table 1). Very few OLOs used discussion, which is not surprising, given the difficult nature of including discussion in a non-synchronous online tutorial. Because librarian-created OLOs are often used asynchronously by students, and rarely by all the students in a course, some rubric strategies could prove challenging to employ. Discussion, examination of ill-structured problems with

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others, and group work, all of which are literature-supported critical thinking instructional strategies, cannot be easily incorporated into an OLO that is viewed once in isolation.

However, judging from the higher scores and more frequent use of some strategies among the OLOs in the sample, some strategies are indeed possible in an asynchronous online environment, and can be executed skillfully. For example, reflection is often a solitary activity, and it can be completed by a student within the platform of an OLO fairly easily. The use of real-world problems as subject matter for an OLO is also possible and potentially valuable within the context of an OLO. Practice and repetition of content is, perhaps, even easier in an OLO than in the classroom, because student answers to assessments in an OLO can determine whether content or assessments should be immediately repeated. OLOs provide an important opportunity to help students begin to recognize the underlying structure of problems, employ the correct critical thinking strategy, and practice identifying problems and strategies for improved performance.

Among the OLOs that used CTAS, feedback (2.29) and open-ended questioning (2.15) had relatively high mean scores (see Table 2), indicating that their use was generally robust. Feedback was the most common CTAS (about half of OLOs employed the strategy), followed by multiple-choice questioning. Mean scores for OLOs that used feedback and open-ended questioning indicate they were used fairly robustly. However, multiple-choice questioning, while used often, had a low mean score (1.24), and no OLOs received the highest score in this area. Overall, many OLOs used simplistic multiple-choice questions with answer choices that did not call for a high level of discrimination. Improving the use of multiple-choice questioning in OLOs is an important consideration, as this type of question is common in OLOs that are designed be completed by many students and need to be graded efficiently. The literature provides some guidance for how this kind of questioning can be improved to better measure critical thinking (Morrison & Free, 2001), and future information literacy OLO creators might find these suggestions useful for improving OLO assessment.

Recommendations for Application of Best Practices

It can be intimidating to create an OLO that requires students to think critically. Because this kind of thinking is more mental work, it may cause some users to disengage. If tutorials are optional, the requirement to think critically may discourage users from continuing through the content. Even if the OLO is required, users will likely try to find the easiest way

to complete the content, which can reduce the impact of the critical thinking teaching and assessment strategies used. Therefore, only critical thinking activities that are rigorous and required are likely to have an impact, and they may lead to lower user satisfaction.

Both the literature and the OLOs in this sample provide guidance for librarians who hope to employ more critical thinking instruction and assessment strategies in their information literacy OLOs. Appendix D provides a list of specific strategies that could be used for each element (discussion, graphic organizers, etc.). Some strategies that show particular potential for application in OLO design include asking students to design their own questions, using real-world problem examples without easy answers, having students arrange ideas or keywords graphically (e.g., in a concept map), and including opportunities for student reflection about their own learning.

While critical thinking instructional strategies may not always be appropriate or desirable, when they can be incorporated into the design of OLOs they have the potential to improve learning, increase impact, and better prepare students for everyday decision-making and problem-solving.

Conclusion

Although the PRIMO Committee uses an extensive rubric to select OLOs for its database, very few of the parameters in this study's literature-driven rubric are present in their evaluation rubric, with the exception of the online learning element criteria. It is likely for this reason that many of the OLOs had a high score in the OLE category in comparison with the CTIS and CTAS sections. It is important to consider the design and execution of online learning elements in best practices for critical thinking instruction. If students are distracted, discouraged, or disappointed by poorly designed OLOs, they may not engage fully with the content, which would prevent them from gaining the critical thinking skills. The PRIMO rubric may also benefit from increased attention to critical thinking instruction and assessment strategies. Employing these strategies can be difficult and time-consuming for instruction librarians, but the potential result is OLOs with a higher level of impact that contribute value to academic programs attempting to promote critical thinking.

Unfortunately, there is no "magic recipe" for effective critical thinking instruction (Abrami et al., 2015, p. 303). Many contextual factors influence what instructional strategies are most appropriate, including the students' needs, expectations, and motivations; whether the

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instruction is in person or online; and what resources are available to the instructor. Teaching critical thinking is challenging, especially in an online environment, even if these contextual considerations can be met. However, this study demonstrates that incorporating best practices for teaching and assessing critical thinking in online learning objects is possible. Librarians have the opportunity to acknowledge the relevance of critical thinking to their instructional content and goals and to employ relevant instructional and assessment strategies to improve information literacy instruction. While more research is required, this study sheds light on potential ways forward for instructional librarians who value critical thinking in higher education.

References

Abrami, P. C., Bernard, R. M., Borokhovski, E., Waddington, D. I., Wade, C. A., & Persson, T. (2015). Strategies for teaching students to think critically: A meta-analysis. *Review of Educational Research, 85*(2), 275–314. https://doi.org/10.3102/0034654314551063

Albitz, R. S. (2007). The what and who of information literacy and critical thinking in higher education. *portal: Libraries and the Academy*, *7*(1), 97–109. https://doi.org/10.1353/pla.2007.0000

Alfino, M., Pajer, M., Pierce, L., & Jenks, K. O. B. (2008). Advancing critical thinking and information literacy skills in first year college students. *College & Undergraduate Libraries, 15*(1-2), 81–98. https://doi.org/10.1080/10691310802176871

Association of College and Research Libraries. (2015). *Framework for information literacy for higher education.* http://www.ala.org/acrl/standards/ilframework

Association of College and Research Libraries. Instruction Section. (n.d.). *PRIMO: Peer-reviewed instruction materials online.* https://acrl.ala.org/IS/instruction-tools-resources-2/pedagogy/primo-peer-reviewed-instruction-materials-online/

Australian Bureau of Statistics. (n.d.) *Sample Size Calculator.* https://www.abs.gov.au/websitedbs/d3310114.nsf/home/sample+size+calculator

Behar-Horenstein, L. S., & Niu, L. (2011). Teaching critical thinking skills in higher education: A review of the literature. *Journal of College Teaching & Learning, 8*(2), 25–42. https://doi.org/10.19030/tlc.v8i2.3554

Bodi, S. (1988). Critical thinking and bibliographic instruction. *Journal of Academic Librarianship, 14*(3), 150–153.

Butchart, S., Forster, D., Gold, I., Bigelow, J., Korb, K., Oppy, G., & Serrenti, A. (2009). Improving critical thinking using web based argument mapping exercises with automated feedback. *Australasian Journal of Educational Technology, 25*(2), 268–291. https://doi.org/10.14742/ajet.1154

Daugherty, A. L., & Russo, M. F. (2010). Reinforcing critical thinking and information literacy skills through assignment design. *Louisiana Libraries, 72*(3), 26–29.

Dochy, F., Segers, M., Van den Bossche, P., & Gijbels, D. (2003). Effects of problem-based learning: A meta-analysis. *Learning and Instruction, 13*(5), 533–568. https://doi.org/10.1016/S0959-4752(02)00025-7

Du, X., Emmersen, J., Toft, E., & Sun, B. (2013). PBL and critical thinking disposition in Chinese medical students—A randomized cross-sectional study. *Journal of Problem Based Learning in Higher Education, 1*(1), 72–83. https://doi.org/10.5278/ojs.jpblhe.v1i1.275

Dwyer, C. P., Hogan, M. J., & Stewart, I. (2012). An evaluation of argument mapping as a method of enhancing critical thinking performance in e-learning environments. *Metacognition and Learning, 7*(3), 219–244. https://doi.org/10.1007/s11409-012-9092-1

Dwyer, C. P., Hogan, M. J., & Stewart, I. (2015). The effects of argument mapping-infused critical thinking instruction on reflective judgement performance. *Thinking Skills and Creativity, 16*, 11–26. https://doi.org/10.1016/j.tsc.2014.12.002

Ennis, R. H. (1985). A logical basis for measuring critical thinking skills. *Educational Leadership, 43*(2), 44-48.

Ennis, R. H. (1993). Critical thinking assessment. *Theory Into Practice, 32*(3), 179–186. https://doi.org/10.1080/00405849309543594

Facione, P. (1990). *Critical thinking: A statement of expert consensus for purposes of educational assessment and instruction. Research findings and recommendations* (ED315423). ERIC. https://files.eric.ed.gov/fulltext/ED315423.pdf

Gibson, C. (1995). Critical thinking: Implications for instruction. *RQ, 35*(1), 27–36.

https://pdxscholar.library.pdx.edu/comminfolit/vol14/iss2/4
DOI: 10.15760/comminfolit.2020.14.2.4

Goodsett, M. (2020). Best practices for teaching and assessing critical thinking in information literacy online learning objects. *The Journal of Academic Librarianship, 46*(5), Article 102163. https://doi.org/10.1016/j.acalib.2020.102163

Haladyna, T. M., Downing, S. M., & Rodriguez, M. C. (2002). A review of multiple-choice item-writing guidelines for classroom assessment. *Applied Measurement in Education, 15*(3), 309–333. https://doi.org/10.1207/S15324818AME1503_5

Halpern, D. F. (1998). Teaching critical thinking for transfer across domains: Disposition, skills, structure training, and metacognitive monitoring. *American Psychologist, 53*(4), 449–455. https://doi.org/10.1037/0003-066X.53.4.449

Heft, I. E., & Scharff, L. F. V. (2017). Aligning best practices to develop targeted critical thinking skills and habits. *Journal of the Scholarship of Teaching & Learning, 17*(3), 48–67. https://doi.org/10.14434/v17i3.22600

Heijljes, A., Van Gog, T., Leppink, J., & Paas, F. (2014). Improving critical thinking: Effects of dispositions and instructions on economics students' reasoning skills. *Learning and Instruction, 29*, 31–42. https://doi.org/10.1016/j.learninstruc.2013.07.003

Johnson, S. D., & Aragon, S. R. (2003). An instructional strategy framework for online learning environments. *New Directions for Adult and Continuing Education, 2003*(100), 31–43. https://doi.org/10.1002/ace.117

Jonnasen, D. H. (1997). Instructional design models for well-structured and ill-structured problem-solving learning outcomes. *Educational Technology Research and Development, 45*(1), 65–94. https://doi.org/10.1007/bf02299613

June, S., Yaacob, A., & Kheng, Y. K. (2014). Assessing the use of YouTube videos and interactive activities as a critical thinking simulator for tertiary students: An action research. *International Education Studies, 7*(8), 56–67. https://doi.org/10.5539/ies.v7n8p56

Kahneman, D. (2011). *Thinking, fast and slow*. Macmillan.

Kerkman, D. D., & Johnson, A. T. (2014). Challenging multiple-choice questions to engage critical thinking. *InSight: A Journal of Scholarly Teaching, 9*, 92–97. https://doi.org/10.46504/09201408ke

King, A. (1995). Inquiring minds really do want to know: Using questioning to teach critical thinking. *Teaching of Psychology, 22*(1), 13–17. https://doi.org/10.1207/s15328023top2201_5

King, P. M., & Kitchener, K. S. (2004). Reflective judgment: Theory and research on the development of epistemic assumptions through adulthood. *Educational Psychologist, 39*(1), 5–18. https://doi.org/10.1207/s15326985ep3901_2

Kowalczyk, N. (2011). Review of teaching methods and critical thinking skills. *Radiologic Technology, 83*(2), 120–132.

Kraus, S., Sears, S. R., & Burke, B. L. (2013). Is truthiness enough? Classroom activities for encouraging evidence-based critical thinking. *Journal of Effective Teaching, 13*(2), 83–93. https://uncw.edu/jet/articles/vol13_2/kraus.html

Kuhn, D., & Dean, D. (2004). Metacognition: A bridge between cognitive psychology and educational practice. *Theory Into Practice, 43*(4), 268–73. https://doi.org/10.1207/s15430421tip4304_4

MacKnight, C. B. (2000). Teaching critical thinking through online discussions. *EDUCAUSE Quarterly, 23*(4), 38–41.

Magnussen, L., Ishida, D., & Itano, J. (2000). The impact of the use of inquiry-based learning as a teaching methodology on the development of critical thinking. *Journal of Nursing Education, 39*(8), 360–64. https://er.educause.edu/-/media/files/articles/2000/12/eqm0048.pdf

Mandernach, B. J. (2006). Thinking critically about critical thinking: Integrating online tools to promote critical thinking. *Insight: A Collection of Faculty Scholarship, 1*, 41–50. https://eric.ed.gov/?id=EJ902858

McAlpine, L., Weston, C., Beauchamp, C., Wiseman, C., & Beauchamp, J. (1999). Building a metacognitive model of reflection. *Higher Education, 37*(2), 105–131. https://doi.org/10.1023/A:1003548425626

McPeck, J. E. (1981). *Critical thinking and education.* St. Martin's Press.

https://pdxscholar.library.pdx.edu/comminfolit/vol14/iss2/4
DOI: 10.15760/comminfolit.2020.14.2.4

Miri, B., Ben-Chaim, D., & Zoller, U. (2007). Purposely teaching for the promotion of higher-order thinking skills: A case of critical thinking. *Research in Science Education, 37*(4), 353–369. https://doi.org/10.1007/s11165-006-9029-2

Morrison, S., & Free, K. W. (2001). Writing multiple-choice test items that promote and measure critical thinking. *Journal of Nursing Education, 40*(1), 17–24. https://doi.org/10.3928/0148-4834-20010101-06

Noblitt, L., Vance, D. E., & Smith, M. L. D. (2010). A comparison of case study and traditional teaching methods for improvement of oral communication and critical-thinking skills. *Journal of College Science Teaching, 39*(5), 26–32.

Orique, S. B., & McCarthy, M. A. (2015). Critical thinking and the use of nontraditional instructional methodologies. *Journal of Nursing Education, 54*(8), 455–459. https://doi.org/10.3928/01484834-20150717-06

Osman, M. E., & Hannafin, M. J. (1992). Metacognition research and theory: Analysis and implications for instructional design. *Educational Technology Research and Development 40*(2), 83–99. https://doi.org/10.1007/BF02297053

Park, M. Y., McMillan, M. A., Cleary, S. R., Conway, J. F., Murphy, L., & Griffiths, S. K. (2013). Practice-based simulation model: A curriculum innovation to enhance the critical thinking skills of nursing students. *The Australian Journal of Advanced Nursing, 30*(3), 41–51.

Paul, R., & Elder, L. (2001). *The miniature guide to critical thinking: Concepts & tools.* Foundation for Critical Thinking.

Reece, G. J. (2005). Critical thinking and cognitive transfer: Implications for the development of online information literacy tutorials. *Research Strategies, 20*(4), 482–493. https://doi.org/10.1016/j.resstr.2006.12.018

Schell, R. & Kaufman, D. (2009). Critical thinking in a collaborative online PBL tutorial. *Journal of Educational Computing Research, 41*(2), 155–170. https://doi.org/10.2190%2FEC.41.2.b

Siegel, H. (1980). Critical thinking as an educational ideal. *The Educational Forum, 45*, 7–23. https://doi.org/10.1080/00131728009336046

Su, S. F., & Kuo, J. (2010). Design and development of web-based information literacy tutorials. *The Journal of Academic Librarianship, 36*(4), 320–328. https://doi.org/10.1016/j.acalib.2010.05.006

Szabo, Z., & Schwartz, J. (2008). Better teaching methods for teacher education: Blackboard discussions improve critical thinking. In M. R. Simonson (Ed.), *Annual proceedings of selected research and development papers presented at the annual convention of the Association for Educational Communications and Technology* (pp. 368–381). https://files.eric.ed.gov/fulltext/ED504371.pdf

van den Boom, G., Paas, F., van Merrienboer, J., J., & van Gog, T. (2004) Reflection prompts and tutor feedback in a web-based learning environment: Effects on students' self-regulated learning competence. *Computers in Human Behavior, 20*(4), 551–567. https://doi.org/10.1016/j.chb.2003.10.001

van Gelder, T. (2001). How to improve critical thinking using educational technology. In G. Kennedy, M. Keppell, C. McNaught & T. Petrovic (Eds.), *Meeting at the crossroads: Proceedings of the 18th annual conference of the Australasian Society for Computers in Learning in Tertiary Education.* (pp. 539–548). Biomedical Multimedia Unit, University of Melbourne. https://www.ascilite.org/conferences/melbourne01/pdf/papers/vangeldert.pdf

van Gelder, T. (2005). Teaching critical thinking: Some lessons from cognitive science. *College Teaching, 53*(1), 41–48. https://doi.org/10.3200/CTCH.53.1.41-48

Yang, Y. T. C., Newby T., & Bill R. (2008). Facilitating interactions through structured web-based bulletin boards: A quasi-experimental study on promoting learners' critical thinking skills. *Computers & Education 50*(4), 1572–1585. https://doi.org/10.1016/j.compedu.2007.04.006

Yue, M., Zhang, M., Zhang, C., & Jin, C. (2017). The effectiveness of concept mapping on development of critical thinking in nursing education: A systematic review and meta-analysis. *Nurse Education Today, 52*, 87–94. https://doi.org/10.1016/j.nedt.2017.02.018

https://pdxscholar.library.pdx.edu/comminfolit/vol14/iss2/4
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Appendix A: Literature References for Rubric Factor Criteria

Standardized Criteria	References
Instructional Methods	
Discussion	• The OLO asks students to explore a subject through open-ended questioning (Abrami et al., 2015; A. King, 1995). • The OLO uses case studies, debates, or other engaging strategies to encourage student discussion (MacKnight, 2000; Szabo & Schwartz, 2008; Yang, Newby, & Bill, 2008). • The OLO asks students to respond to one another about a complex or controversial topic (MacKnight, 2000; Szabo & Schwartz, 2008; Yang, Newby, & Bill, 2008).
Inquiry-Based Learning	• The OLO explores methods of constructing or determining thoughtful questions in response to problems or decisions (A. King, 1995; Magnussen, Ishida, & Itano, 2000; Miri et al., 2007; Yang, Newby, & Bill, 2005). • The OLO asks students to develop one or more relevant questions about research sources or as a research focus (A. King, 1995; Magnussen, Ishida, & Itano, 2000; Miri et al., 2007; Yang, Newby, & Bill, 2005).
Ill-Structured Problems/ Problem-Based Learning	• The OLO uses ill-structured problems to encourage discussion (P. King & Kitchener, 2014; Jonassen, 1997). • The OLO uses complex authentic or real-world examples (June, Yaacob, & Kheng, 2014; Kraus, Sears, & Burke, 2013; Noblitt, Vance, & Smith, 2010). • The OLO asks students to explore or address a real-world problem that requires higher order thinking skills (Dochy, Segers, Van den Bossche, & Gijbels, 2003; Du, Emmersen, Toft, & Sun, 2013; Heft & Scharff, 2017; Kowalczyk, 2011; Miri, Ben-Chaim, & Zoller, 2007; Orique & McCarthy, 2015; Schell & Kaufman, 2009).
Concept Mapping	• The OLO asks students to organize information graphically to illustrate or explore a concept, argument, or scholarly conversation (Butchart et al., 2009; Dwyer, Hogan, & Stewart, 2012; Dwyer, Hogan, & Stewart, 2015; Orique & McCarthy, 2015; Park et al., 2013; van Gelder, 2001; Yue, Zhang, Zhang, & Jin, 2017).

Reflection	• The OLO asks students to reflect on their own decision-making, problem-solving, or thinking processes (Halpern, 1998; Johnson & Aragon, 2003; Kuhn & Dean, 2004; McAlpine et al., 1999; Osman & Hannafin, 1992).
Practice & Repetition	• The OLO requires or encourages students to repeat parts or the entire module when reinforcement is necessary (van Gelder, 2005). • The OLO exposes students to critical thinking concepts multiple times (Heft & Scharff, 2017; Heijltjes, Van Gog, Leppink, & Paas, 2014; Miri et al., 2007; van Gelder, 2005). • The OLO explicitly demonstrates or explains the underlying structure of a complex question beyond the surface details (Halpern, 1998).
Assessment Methods	
Feedback	• The OLO gives students feedback (van Gelder, 2005). • The OLO feedback is customized to the student's response (van Den Boom et al., 2004; van Gelder, 2005).
Multiple-Choice Question Construction	• The OLO uses multiple-choice questions that are accompanied by an option or requirement for students to justify their answers (Ennis, 1993; Kerkman & Johnson, 2014: Morrison & Free, 2001). • The OLO uses multiple-choice questions that require understanding of two or more concepts to be answered correctly (Haladyna, Downing, & Rodriguez, 2002; Morrison & Free, 2001). • The OLO uses multiple-choice questions that have options which are plausible enough to require students to discriminate among them (Haladyna, Downing, & Rodriguez, 2002; Morrison & Free, 2001).
Open-Ended Questions	• The OLO asks students to provide open-ended responses to questions that require higher lower order thinking (Behar-Horenstien & Niu, 2011; Miri et al., 2007).
Online Learning Elements	
Instructor Help/Support	• The OLO interface clearly indicates how students may get more help (Su & Kuo, 2010). • The help features of the OLO are available throughout the module (Su & Kuo, 2010).

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Navigation	• Students are able to control the pacing and order of material in the OLO (Johnson & Aragon, 2003). • Students are able to find and access specific, labeled sections of the OLO (van Gelder, 2005).
Personalized Presence	• There is a clear indication of who created the OLO or who is responsible for the content (Johnson & Aragon, 2003). • A named avatar or narrator with a personality guides the student through OLO content (Johnson & Aragon, 2003).
Scaffolding/Graduation	• The contents of the OLO are scaffolded such that the material becomes more difficult as the student progresses (van Gelder, 2005). • Students can choose or test into a level of difficulty in the OLO appropriate to their skills and experience with the content (van Gelder, 2005).
Interactivity	• The OLO consists of a game with clear goals, an artificial conflict, and distinct rules (Johnson & Aragon, 2003). • The OLO includes meaningful interactive design elements, such as drop-downs, scroll-overs, and drag-and-drop features (Su & Kuo, 2010). • Students are asked to demonstrate the skills or activities that they are attempting to learn through a simulation or role-playing exercise within the OLO (Johnson & Aragon, 2003).

Appendix B: Best Practices Rubric for Teaching and Assessing Critical Thinking in Information Literacy Online Learning Objects

Area	Rating
Critical Thinking Teaching and Assessment Strategies	0=Strategy not used 1=Use of strategy was weak 2=Use of strategy was moderate 3=Use of strategy was robust, showing evidence of critical thinking theory
Online Learning Elements	0=Element not addressed 1=Evidence of element was weak 2=Evidence of element was moderate 3=Evidence of element was robust

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Appendix C: Online Learning Objects from the Sample Referenced in the Text

Highest Overall Scoring		
Category	OLO Title	OLO URL (accessed spring 2018)
Raw Score, Element Score	My Learning Essentials Online: Finding a Job: Writing an Effective CV	http://www.library.manchester.ac.uk/using-the-library/students/training-and-skills-support/my-learning-essentials/
Raw Score, Element Score	Research Success Tutorial Suite: Identifying Keywords	http://researchguides.austincc.edu/researchsuccesstutorials
Element Score	Exploring Academic Integrity Tutorial	http://libraries.claremont.edu/achontutorial/pages/index.html
Highest Scoring in CTIS, CTAS, and OLE Categories Overall (Raw Score)		
Category	OLO Title	OLO URL
CTIS	My Learning Essentials Online: The Big Picture: Achieving Your Academic Goals	http://www.library.manchester.ac.uk/using-the-library/students/training-and-skills-support/my-learning-essentials/
CTAS	Y Search: Critical Reading	https://ysearch.lib.byu.edu/
CTAS	Analyze Your Research Strategy	https://portlandstate.qualtrics.com/SE/?SID=SV_dco40rNn31xNlBP
CTAS	Developing a Research Question	http://library.wlu.ca/help/tutorials/developing-research-question
OLE	Access and Explore the Library's Business Databases	https://my.berkeleycollege.edu/bbcswebdav/xid-98680789_3
OLE	A Suite of Interactive, Foundational Information Literacy Tutorials: Anatomy of a Citation and Reference	http://www.library.ualberta.ca/tutorials/
Highest Scoring for Each Critical Thinking Instruction Strategy (CTIS, Raw Score)		
Category	OLO Title	OLO URL
Discussion	My Learning Essentials Online: Study Strategies for Success	http://www.library.manchester.ac.uk/using-the-library/students/training-and-skills-support/my-learning-essentials/
Inquiry-Based Learning	A Suite of Interactive, Foundational Information Literacy Tutorials: Creating a Thesis Statement	https://www.library.ualberta.ca/tutorials/
Inquiry-Based Learning	Life Sciences Library Tutorial	http://net.lib.byu.edu/tutorial/lifescience/story_html5.html

Inquiry-Based Learning	Navigate: UWF Libraries Research Tutorials: Formulating a Good Research Question	http://uwf.edu/library/research_help/tutorials/
Inquiry-Based Learning	PICO: Research Questions for Health Sciences	http://www.asu.edu/lib/tutorials/storyline/pico/
Real World Problems	Bowman Library Research Skills Tutorial: Module 2 – Searching	http://www.menlo.edu/library/research/tutorial/
Real World Problems	Being Digital: Information Universe	http://www.open.ac.uk/libraryservices/beingdigital/
Real World Problems	Being Digital: Search Slips and Tips	http://www.open.ac.uk/libraryservices/beingdigital/
Graphic Organizers	My Learning Essentials Online: Revision Strategies: Managing Your Revision Successfully	http://www.library.manchester.ac.uk/using-the-library/students/training-and-skills-support/my-learning-essentials/
Graphic Organizers	My Learning Essentials Online: The Big Picture: Achieving Your Academic Goals	http://www.library.manchester.ac.uk/using-the-library/students/training-and-skills-support/my-learning-essentials/
Graphic Organizers	InfoRhode Tutorials: Start	http://goo.gl/XliUKK
Graphic Organizers	InfoRhode Tutorials: Identify	http://goo.gl/XliUKK
Quality Practice	My Learning Essentials Online: Knowing Where to Look: Your Search Toolkit	http://www.library.manchester.ac.uk/using-the-library/students/training-and-skills-support/my-learning-essentials/
Graphic Organizers	My Learning Essentials Online: Planning Ahead: Making Your Search Work	http://www.library.manchester.ac.uk/using-the-library/students/training-and-skills-support/my-learning-essentials/
Graphic Organizers	Access and Explore the Library's Business Databases	https://my.berkeleycollege.edu/bbcswebdav/xid-98680789_3

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Appendix D: Recommended Applications of Critical Thinking Instructional Strategies in Information Literacy Online Learning Objects

Critical Thinking Instructional Strategies	Applications from Sample	Other Applications Possible
Discussion	• Use social media and a hashtag to continue the conversation	• Use an application like Padlet to encourage students to answer queries publicly and respond to other's answers. • Ask students to provide a one-word response to a query and use the responses to create a word cloud. • Ask students to respond to discussion posts asynchronously in the LMS in conjunction with the OLO.
Inquiry-Based Learning	• Provide many examples of well-developed research questions. • Demonstrate the process for developing a good research question. • Ask students to develop an appropriate research question. • Encourage students to ask certain questions when evaluating a source.	• Ask students to consider all of the possible relevant questions to ask about a source when evaluating it. • Ask students to develop their own questions about a source and then answer them. • Ask students to brainstorm several good research questions for the same research topic.
Authentic/ Real-World Problems	• Ask students to develop questions, keywords, or responses to a real-world problem (work-related, purchase, health decision, etc.). • Give students examples of information problems from outside academia (e.g., cases of celebrities and politicians committing plagiarism).	• Ask students to consider, find, or evaluate evidence both for and against a contentious issue. • Ask students to identify scenarios or experiences from their own lives that are relevant to the OLO topic. • Use recent news stories as examples.

Graphic Organizers	• Ask students to practice organizing their notes graphically. • Ask students to develop a research topic using a concept map.	• Ask students to use a concept map for other purposes (i.e., track scholarly influence, prioritize source types, etc.). • Ask students to create a research plan using a graphic organizer. • Ask students to document their research using a graphic organizer. • Ask students to create an argument map.
Reflection	• Give students a self-assessment to identify specific strategies for improving thinking. • Ask students to reflect on a decision, problem, or scenario.	• Allow students to reflect on their own stake in the research claim or question. • Encourage students to reflect on their biases and change their position on a research topic after examining evidence. • Give students a self-assessment to identify specific strengths or weaknesses in research skills.
Practice and Repetition	• Give students multiple assessments for the same skill. • If a student performs poorly on an assessment, ask or require him/her to repeat content.	• Give students multiple assessments for the same skill, changing the overlaid context significantly to test for transfer. • If a student performs poorly on an assessment task, require the student to repeat it two or three times in a row successfully.

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