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Chan, L. et al. 2002. Budapest Open Access Initiative. New York: Open Society Institute. Available at: <http://www.soros.org/openaccess/read.shtml> [Accessed: 18 November 2015].

# Developing online instruction according to best practices

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## Abstract

To meet the growing online and face-to-face library instruction needs of a large research university, a team of librarians set out to develop asynchronous online instruction of sufficient quality to supplement and replace classroom teaching. This report describes the best practices that were identified from a review of the literature, the instructional design process that was used to implement these practices in a pedagogically effective way, the results of pilot testing of the instruction, and implications for future practice. The result is a template for development that can be used by other librarians seeking to develop robust, effective, and accessible online learning objects, whether to reach out to online learners or improve the scalability of information literacy instruction.

## Keywords

digital learning objects; higher education; information literacy; instructional design; online learning

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## 1. Introduction

The University of Houston, a large urban research university, has experienced significant growth over the past decade, including increased enrolment and the expansion of its online-only and hybrid course offerings. Librarians in the University Libraries' Liaison Services department, and particularly on the department's four-person Instruction Team, have worked at the same time to increase the reach of information literacy (IL) instruction across the university, working closely with numerous academic departments and targeting instruction especially towards high-impact, high-enrolment core courses. The department and the Instruction Team, however, both have limited personnel and staff hours to devote to instruction, while demands for library instruction continue to increase.

In order to address both online course growth and limited instructional capacity, librarians on the Instruction Team decided to develop asynchronous, self-paced online learning objects. These learning objects would be expected to be able to either supplement or fully replace face-to-face library instruction sessions, and thus would be expected to meet the same high pedagogical standards that the team had already established for teaching in person. After examining a number of existing materials produced by vendors, the team concluded that none of these were able to fully meet their expectations for quality and content and decided instead to hire an Instructional Design Librarian (IDL) and develop their own learning objects as an in-house project. The objective of this project would be to create a set of online lessons teaching core IL

concepts, while conforming to instructional design principles and established best practices, in order to provide flexible and scalable online IL instruction.

The aims of this article are to identify best practices for the creation of asynchronous online IL instruction as established by the literature, and to describe the instructional design process the University of Houston Libraries' Instruction Team developed in order to produce its online lessons in accordance with these practices. It will also discuss the results of developing the lessons, including their usage and incorporation into the curriculum by university faculty, and the evidence of their impact on student learning. Finally, it will provide recommendations derived from the team's experiences for other librarians producing their own online learning objects and suggest directions for future research and development.

## 2. Literature review

When reviewing the literature for this project, the principal focus was on best practices in development and assessment of asynchronous learning objects. A robust body of literature exists comparing the efficacy of online learning objects to that of face-to-face instruction, but this was considered to be out of scope for the current discussion, as our focus was solely on developing online learning objects.

A general set of best practices has emerged from the literature on both learning object development and learning object assessment, concentrated in four key areas: content, structure, implementation, and assessment. In the area of content, in general, multiple authors stress the importance of either avoiding or defining any library jargon used in learning objects (Reece 2005; Noe & Bishop 2005). Blummer and Kritskaya (2009) suggest aligning content to an existing set of standards, such as the *ACRL (Association of College and Research Libraries) Information Literacy Competency Standards for Higher Education*. There is less consensus, however, over whether learning objects should stress higher-level IL concepts over mechanical skills. Some authors feel strongly that learning objects can and should engage students at the conceptual level (Dewald 1999a; Reece 2005), while others contend this point (Hrycaj 2005; Lindsay, Cummings, Johnson, & Scales, 2006). Nichols Hess (2014) recommends focusing on the delivery of content over attempts to be humorous or entertaining; other authors suggest that student motivation and engagement could be better secured by including multimedia (Dewald 1999a; Dewald 1999b; Sachs et al. 2013) and ensuring that content and activities are as relevant and authentic to real-world applications as possible (Dewald 1999b; Reece 2005; Blummer & Kritskaya 2009; Rapchak 2017). Rapchak (2017) also makes a number of specific recommendations on how to use and combine multimedia elements, including: combining words with pictures and audio with video; avoiding unnecessary animation in favour of static images; omitting anything not essential to learning the content; and using a conversational tone in text and narration.

As a more specific aspect of content, the subject of interactivity and/or active learning is frequently discussed, and many authors identify it as a key component of online learning. A concerning point of note, however, is that authors' definitions of 'active learning' often seem too generous to be effective. Dewald (1999a), for example, defines active learning as 'exercises conducted by the student online' (p.27), and Dewald, Scholz-Crane, Booth, and Levine (2000) associate it with clickable text, words, icons, and buttons (p.38), neither of which by themselves constitute a genuine active learning experience. Indeed, Dewald's work in general frequently seems to use the term interchangeably with interactivity, in spite of the emphasis that Dewald et al. (2000) place on the distinction between the two. Hrycaj (2005) offers only a slightly more satisfying definition that active learning occurs when the user is asked to provide a response and then receives feedback on that response. This trend may be ameliorated somewhat by the high number of authors who stress that online activities should mimic authentic practice, but these loose definitions may in some cases have artificially inflated the numbers of existing

learning objects considered to include active learning. Multiple authors do, however, encourage developers to fight technological limitations in order to create activities that genuinely engage students in higher-order skills (Dewald et al. 2000; Reece 2005; Rapchak 2017). Reece (2005) specifically recommends strategies for designing learning objects to maximise knowledge transfer. Multiple authors emphasise the need to provide rich feedback in order to increase learning from quizzes and activities (Reece 2005; Somoza-Fernández & Abadal 2009), and suggest that the effectiveness of active learning in online learning objects may be increased by being combined with classroom teaching (Dewald 1999a; Dewald et al. 2000).

When structuring learning objects, a large number of authors recommend including a degree of flexibility, so that learners may proceed along different paths based on their level or their choices (Dewald 1999b; Reece 2005; Blummer & Kritskaya 2009; Somoza-Fernández & Abadal 2009; Veldof & Beavers 2001). Another frequent topic of discussion in structure is the need to minimise cognitive load, which multiple authors suggest accomplishing by chunking content or highlighting key terms and concepts, or both (Dewald 1999b; Nichols Hess 2014; Scales, Nicol & Johnson 2014; Rapchak 2017). Many authors also stress the importance of clear navigation and usability (Dewald 1999a; Reece 2005; Blummer & Kritskaya 2009; Somoza-Fernández & Abadal 2009; Veldof & Beavers 2001), and a number also suggest including a list of objectives (Dewald 1999a; Reece 2005; Somoza-Fernández & Abadal 2009; Nichols Hess 2014). Somoza-Fernández and Abadal (2009) recommend listing the time required to complete the learning object at its beginning, and Nichols Hess (2014) recommends designing learning objects according to Universal Design for Learning (UDL) principles. Rapchak (2017) also stresses the importance of allowing user control, such as pause buttons for video, and the ability to move forward, move backward, and repeat content in learning objects.

When implementing learning objects, multiple authors suggest that course-related use will be more effective than stand-alone (Dewald 1999a; Veldof & Beavers 2001; Noe & Bishop 2005). Several also recommend collaborating with faculty and other campus stakeholders (Blummer & Kritskaya 2009; Lo & Dale 2009). Appelt and Pendell (2010) support this with a negative example, in which faculty input was not sought early enough in the process, resulting in some frustration and conflict with librarians. Many authors stress the importance of including options for users to contact a librarian directly, whether for help or to provide feedback (Dewald 1999a; Reece 2005; Blummer & Kritskaya 2009; Bracke & Dickstein 2002). Nichols Hess (2014) also indicates the importance of aligning standards and goals of online learning objects with those of face-to-face library instruction.

For the assessment of learning objects, Dewald et al. (2000) provide the most robust suggestions, recommending that assessment be linked to course objectives, learner-focused, of benefit to both instructor and students, and both formative and summative. Meanwhile, other authors place a high value on user research and needs assessment (Blummer & Kritskaya 2009; Veldof & Beavers 2001). Somoza-Fernández and Abadal (2009) indicate the importance of pre-testing, while Orme (2004) highlights the need to move beyond written post-tests and evaluate student performance with authentic research activities.

As may be evident, the majority of best practices in the literature for online IL learning objects are focused more on the technical than the pedagogical. It can be assumed, however, that the principles of effective pedagogy remain the same regardless of format or context and need only be adapted for an asynchronous digital tool. For example, developers of learning objects can be guided by the 'key principles of effective teaching in higher education' described by Ramsden (1992, p.96): engaging students' interest; generosity and availability to students; appropriate assessment with helpful feedback; clear goals that intellectually challenge students; providing students with a measure of control and independence in their learning experience; and the willingness to learn from students in return. Ramsden also suggests that pedagogy for deep learning is characterised by active learning experiences, personal relevance for students, clear

expectations, and opportunities for choice, all of which are also of particular interest for this type of learning. Gibbs (1988) would also encourage developers of learning objects to go a step further than active learning, in ensuring that even students' independent online work provides the opportunity and stimulus for learners to reflect on their hands-on practice. Digital learning objects may have to engage with all of these principles differently than does classroom teaching, but they are by no means unable to embody them. To do so simply requires developers to move beyond thinking of 'active learning' as nothing but 'interactivity', and find ways to deeply engage students that make use of the unique affordances of the medium and circumvent its limitations. Because of the relative newness of the field, there is still something of a knowledge gap in how best to accomplish this, but Miller (2014) has made a significant contribution in this area with practical guidance on managing the unique cognitive challenges and benefits of online learning. This work directly connects commonly-available online tools to key relevant tasks such as the clear and careful design of learning objectives, management of the attention and motivation of online learners, connecting to learners' personal experiences and prior knowledge, effective assessment, and collaboration, and points to a way forward in deepening online learning experiences.

### 3. Methods

#### 3.1 Instructional design process

The Instruction Team set out to create online lessons conforming to the best practices established by this review of the literature. Over the course of several years of experimentation and revision, the IDL developed a repeatable instructional design process to guide librarians through creating these lessons, from identifying an information need through eventual implementation. This process was at first completed by the Instruction Team, and then later by three- to four-person ad hoc teams of librarians from the Liaison Services department, led by the IDL and the Instruction Librarian. In 2018, the process shifted again to being largely the independent work of the IDL and Instruction Librarian, in regular consultation with instructional leadership and other members of the department.

The instructional design process, which is based heavily on the Dick and Carey instructional design model (Dick, Carey, & Carey, 2015), occurs as follows:

- Identify the goal(s) of the instruction.
- List and sequence all measurable student learning objectives that must be met for the instructional goal(s) to be considered complete.
- Design assessment of those objectives.
- Design pedagogical strategies to help students achieve the objectives.
- Develop a storyboard for the learning object, including all content, functionality, and media to be used.
- Seek feedback on the draft storyboard from students and subject matter experts.
- Develop the full lesson and test its content.
- Pilot the lesson with a test implementation in one or more courses.
- Assess student performance and learning.
- Revise the lesson content.
- When student performance levels are satisfactory, fully implement the lesson.

The final step requires some explication. When a lesson is in the pilot phase, it is uploaded to an online server controlled by the library, from which it is accessible to faculty and students. It can then be offered to instructors for use in their courses. Instructors contact the Instruction Team to express interest in using the lessons, and librarians provide detailed implementation instructions, track the classes where the lessons are in use, and send instructors answer reports on their students' work once the pilot is complete. Full implementation, by contrast, was

originally envisioned as a process of scaling back assessment and revision of the lesson and providing lesson content in Shareable Content Object Reference Model (SCORM) format for instructors to use and track independently, without librarian mediation. In practice, however, transitioning to this final stage has proven problematic, for reasons that will be discussed further below.

### 3.2 Lesson content and format

**Table 1:** Lessons developed

Lesson	Objective(s)	Content Description
Research Question Development	Develop a strong research question to inform thinking, research, and writing processes	Students begin with a broad topic area and are guided through a mind-mapping process, which helps them explore the topic and identify one or more focal points to develop into a research question. Students begin by brainstorming aspects of the topic that are most interesting, conduct pre-searching on those aspects in a reference resource, narrow their focus by selecting between the subtopics they have discovered, and finally, based on guidance about the characteristics of a strong research question, compose their own.
Evaluating Sources	Evaluate the credibility of a source using a set of criteria	Students begin with a research assignment and one source they have already found, and practice evaluating its authority and value for the assignment. Students are introduced to four novice-level indicators of authority--source type, date, author's expertise, and relevance--and answer questions designed to encourage reflection on their source's appropriateness in terms of each indicator.
Quoting, Paraphrasing, and Summarizing	Differentiate between quoting, paraphrasing, and summarising  Successfully paraphrase and summarise an information source	Students practice distinguishing between quotations, paraphrases, and summaries in terms of their nature and usage, are provided with strategies and criteria for successfully incorporating outside sources into their work, and then practice composing paraphrases and summaries of portions of a professor-assigned text.
Search Terms and Strategies	Develop a search from a research question  Strategically combine search terms in library tools	Students begin with a research question, from which they are guided to identify the most essential concepts, and then brainstorm synonyms and related concepts for these terms. They are linked to an example library database to conduct a set of experimental searches with the terms they have identified, and then prompted to reflect on how each change to their search construction affected the results. Finally, they revise their search based on their observations, and write a brief reflection on what strategies were most successful for their purposes, and why.
Evidence and Source Types	Differentiate between different types of sources and identify those most appropriate for an assignment	Students begin with a research assignment and are introduced to four categories of information sources--current events, opinion pieces, research, and background--and their most appropriate uses in writing. Students are asked to reflect on their assignment and its audience, which of these categories they will need to complete it, and why. Finally, they are provided with quick reference information on the formats in which these types of information most often appear (e.g. news and magazine articles, scholarly journals and books, reference resources) and where to find what they need.

Table 1 shows the lessons that we developed using various versions of this process:

All of these lessons were developed in Articulate Storyline, which produces self-contained, Flash-based online objects that resemble interactive slideshow presentations. Each lesson consists of a set of slides that each may include text, images, interactive elements such as multiple-choice questions or text entry, animations, and narration. These slides are presented together in a navigational interface that provides a clickable table of contents as well as buttons to advance to the next slide or return to the previous. We designed each lesson in such a way that, over the course of its completion, the student would use text entry fields to gradually compose a final product demonstrating their progress toward the lesson's objectives, which could be saved as a screenshot and provided to the professor and peers for feedback. At the end of the Research Question Development lesson, for example, students are able to capture their full, completed mind map, which includes the final research question produced. Storyline was selected in large part for the diverse types of interaction it made available, as well as its capacity to store students' responses on the back end, making them available to librarians for assessment as well as to faculty. It was of critical importance to us in developing the lessons that students learn each skill via authentic, personally relevant practice, and that we could evaluate their development of the appropriate skills and concepts directly from their resulting products.

### **3.3 Lesson context and implementation**

Even as we took great care with the content of our lessons, the context of their implementation has been equally important in ensuring their effectiveness. We support instructors using the lessons in their classes by, at minimum, providing a set of written instructions and recommendations for effective implementation, but in some cases our support has extended as far as collaborating with instructors to completely revise the lesson content to target subject-specific research scenarios and skills. While some of our recommendations are technical in nature, others concern ways that the lesson can be best incorporated into the class structure to support student learning. For example, in a number of cases students have been required to exchange their final products from the lessons for peer review, either in the classroom or online, or to have them available for consultations with the instructor. These methods have been found to be very successful in connecting the lesson content to the rest of the research process and the course content, as well as providing students feedback and error correction on their work. Making the lesson products the subject of subsequent collaborative assignments also helps to mitigate one of the known drawbacks to asynchronous online learning: its isolated nature. Students may complete the lessons individually, but they then engage with that learning experience again in a social learning context, ultimately enhancing the overall experience. As a result of our feedback from faculty about these benefits, we have begun to encourage other instructors to use the lessons in similar ways.

### **3.4 Conforming to best practices**

The objectives of each of our lessons were developed specifically to engage students in knowledge practices described by the ACRL (2015) *Framework for Information Literacy for Higher Education*. The Framework is a guiding professional document which describes IL as a set of core ideas that are dynamic, complex, and interconnected--a significant departure from ACRL's (2000) *Information Literacy Competency Standards for Higher Education*, which prescribed specific performance indicators and outcomes for IL competency. To align with the Framework's perspective, each lesson seeks to introduce students to broader IL concepts, rather than to teach specific tools or skills. Table 2 shows the primary knowledge practices that each lesson helps students to model.

**Table 2:** Framework knowledge practices by lesson

Lesson	Knowledge Practice(s)
Research Question Development	<ul style="list-style-type: none"> <li>● 'formulate questions for research based on information gaps or on reexamination of existing. . .information' (Research as Inquiry)</li> <li>● 'determine the initial scope of the task required to meet their information needs' (Searching as Strategic Exploration)</li> </ul>
Evaluating Sources	<ul style="list-style-type: none"> <li>● 'use research tools and indicators of authority to determine the credibility of sources, understanding the elements that might temper this credibility' (Authority is Constructed and Contextual)</li> </ul>
Quoting, Paraphrasing, and Summarizing	<ul style="list-style-type: none"> <li>● 'give credit to the original ideas of others through proper attribution and citation' (Information Has Value)</li> <li>● 'cite the contributing work of others in their own information production' (Scholarship as Conversation)</li> </ul>
Search Terms and Strategies	<ul style="list-style-type: none"> <li>● 'utilize divergent (e.g., brainstorming) and convergent (e.g., selecting the best source) thinking when searching' (Searching as Strategic Exploration)</li> <li>● 'design and refine needs and search strategies as necessary, based on search results' (Searching as Strategic Exploration)</li> <li>● 'manage searching processes and results effectively' (Searching as Strategic Exploration)</li> </ul>
Evidence and Source Types	<ul style="list-style-type: none"> <li>● 'articulate the capabilities and constraints of information developed through various creation processes' (Information Creation as a Process)</li> <li>● 'assess the fit between an information product's creation process and a particular information need' (Information Creation as a Process)</li> </ul>

While some lessons align closely to a particular frame, others are informed by multiple overlapping frames, as appropriate to the often complex real-world research practices they teach. In most of the existing lessons, students are expected to demonstrate these practices only at very basic levels: they are provided structured, step-by-step guidance through simple procedures connected directly to class assignments. This was a deliberate design choice as early undergraduate learners, usually first-year students, were the intended audience of our initial set of lessons. Future offerings at intermediate and advanced learner levels will ideally be less rigid and more complex in their requirements. We also created this initial set of lessons to mirror our established face-to-face learning activities for early undergraduates wherever possible, allowing students to receive the same instructional content and experience whether or not they are enrolled online. As a result, the lessons can be used with online courses in place of the classroom instruction we would normally provide, or to supplement our limited in-class time with face-to-face or hybrid courses.

Pedagogically, our lessons were designed to conform to the principles laid out by the literature, in a suitable manner for the medium. After some brief initial technical instructions about using their navigational and accessibility features, all lessons begin with a clear statement of their objectives and their connection to a current course. For example, the aforementioned objective of the Research Question Development lesson includes both the goal (to develop a research question) and its purpose (to support other research and writing tasks necessary for

coursework). The lessons are also designed to walk students through real research tasks related to real assignments: Research Question Development helps students develop a research question for an existing research paper assignment, Evaluating Sources helps them critique a potential source already obtained for a paper, Quoting, Paraphrasing, and Summarizing requires them to paraphrase and summarise passages they select from a previously-read class reading, and so on. These aspects are closely aligned to Ramsden's (1992) recommendations around active learning, personal relevance, and clear expectations for deep learning. Students also have some opportunity for control and choice, also at Ramsden's recommendation, in the form of their freedom to work on their own topics and decide on their own starting materials with which to begin the lessons. Furthermore, in accordance with Gibbs' (1988) work on reflective learning, the lessons frequently ask students to engage in reflection on this work after completing it: in Evaluating Sources the student makes a final statement on the appropriateness of the evaluated source and why, for example, and in Search Terms and Strategies the student not only provides their most successful search, but their thoughts on the reasons for its success. We also encourage instructors towards using the products of the lessons for even more in-depth reflection as a class. Rich feedback is provided on closed-ended questions that are used as teaching and practice tools throughout the lessons, and open-ended text entry receives feedback from peers and the instructor when the lessons are implemented appropriately. Every effort is made to ensure that the lessons are engaging experiences, embedded deeply into the context of the course where they are used.

In terms of structure and design, our lessons were also developed to follow established best practices. The lessons are designed to minimise cognitive load by carefully limiting the amount of information provided on each slide, and in many cases confining more complex information and instructions to pop-up windows that students can click to load or dismiss. We eliminate jargon to ease understanding, and keep the audio narration in a conversational tone. Expectations, requirements, and the time required for completion are provided at the beginning of each lesson, and clear navigation is established through software features like next and previous buttons and an always-visible table of contents. These elements provide a great deal of flexible user control of the experience, as does the provided ability to mute narration on any slide, and to pause or repeat narration on select slides where the text is not available on-screen. The lessons were designed with Universal Design for Learning principles in mind, and this is evident in numerous elements of their composition. For example: text on slides is as brief, clear, and simple as possible, to accommodate students with reading disabilities and for whom English is a second language, but also to improve the reading experience for all; and text equivalents are always provided for all narration, not only for users with hearing impairments, but also for those who prefer to absorb information visually. Lessons have also been tested with students using the System Usability Scale (Brooke, 1996), and revised according to the results.

Collaboration with campus stakeholders is a key component in implementing the lessons. We work with faculty, instructors, and instructional designers as partners when piloting, and look to them for input on which IL concepts and skills to address, appropriate sequencing of the lessons for their courses, and technical considerations for implementation. When possible, we ask instructors to also deliver a satisfaction survey to students after using the lessons; additionally, one course instructor made her students available during their regular class time for a focus group session after they had completed two of the lessons. Direct student feedback is invaluable in understanding how to improve the lesson design and content. Faculty also helped us target courses with required research assignments in order to meet students' immediate needs for support; these include such courses as First Year Writing II, Introduction to Biological Science, and Genetics Laboratory.

Assessment for each lesson is intentionally learner-focused, incorporating formative and summative assessment for the benefit of both students and instructors. Formative assessment

allows learners to evaluate their own understanding throughout the learning process; in our lessons, this comes in several forms, such as guided reflection, practice questions, and specific feedback for correct and incorrect responses to closed-ended questions. Summative assessment allows instructors to evaluate students' learning at the end of a lesson, and is completed using students' finished product from the lesson and assessment tools, such as benchmarks and rubrics. Each lesson's finished product is used for summative assessment by the instructor. A team at the Libraries also assesses student work from the lessons - not to assign grades, but in order to evaluate the lessons' effectiveness and make revisions to the design and content. The goals of instructors' assessment of student work and our own are substantially different, and for this reason faculty participating in the pilots have not been a part of the Libraries' internal assessment process, but use their own independent criteria to evaluate students' performance in the lessons in relation to course content.

In order to simultaneously evaluate students' learning and the functionality of the lesson, the Libraries' assessment is both quantitative and qualitative. Minor sub-objectives may be evaluated quantitatively: for example, an evaluator might answer 'yes' or 'no' to whether each student correctly identified the audience of their paper, or evaluators may assess whether a concept was communicated effectively based on the student's subsequent responses to a multiple-choice knowledge check. The more critical measure of a lesson's success, however, is usually a rubric developed to determine whether the lesson's intended product was effectively completed, which is cross-checked and discussed between multiple evaluators due to its subjective nature. It is primarily students' rates of successful or unsuccessful completion of the final product that drives how we revise the lessons to attempt to stimulate deeper thinking, and that carries the most weight in determining whether a lesson is 'finished'.

## 4. Findings

Between the autumn semester of 2015 and the spring semester of 2018, the Libraries' lessons were incorporated into a total of 92 unique class sections, with some classes using only one lesson and some using multiple lessons, for a total of 234 uses. Allowing for less-than-full classes and students who may have completed the same lesson for more than one class, the total number of students who completed the lessons was approximately 2,500 - nearly half of the 5,739 students entering University of Houston's freshman class in 2017 (not all students who completed the lessons were first-year students, but first-year students were the primary target demographic for the lessons). Of the classes which completed the lessons, 58 were biology classes, 28 were English composition classes, five were biochemistry classes, and one was in Human Development and Consumer Sciences. Sixty-nine of the classes were delivered face-to-face, 16 were hybrid, and seven were online.

It is a curious fact that the Libraries' online lessons have remained most heavily-used with face-to-face classes since the time of their initial creation, in spite of the stated goal of increasing the reach of library instruction to online courses. This phenomenon is probably due to some combination of a number of factors: firstly, face-to-face courses continue to outnumber those online for undergraduates at the University of Houston, especially among the foundational courses that have thus far been the primary audiences of the lessons; secondly, biology labs account for the largest volume of use of the online lessons, and are of necessity face-to-face courses; thirdly, the earliest lessons developed were on topics chosen to supplement, rather than replace, face-to-face library instruction, and online instructors may not yet have realised that they can now use the lessons as an equivalent to in-person library instruction; and finally, many of the instructors with whom the Instruction Team has developed the strongest relationships, and thus who have been the quickest to adopt the lessons into their teaching, teach primarily in face-to-face settings. In any case, however, the Instruction Team has a vested interest in increasing the use of lessons in hybrid and fully online classes.

Student performance varies across the lessons, and assessment of student performance is the primary driver of lesson revisions. As of autumn semester of 2016, approximately 65% of students were found to be meeting the main objective of the Research Question Development lesson at an acceptable level or above, and 87% of students were arriving at a research question that improved on their initial topics according to the established criteria. This was deemed sufficient for the lesson to be considered complete and ready for implementation. The other lessons remain in the assessment and revision cycle, although some are nearing satisfactory performance levels (which vary by content). Table 3 shows the lessons currently available and the percentage of students meeting objectives for each, as of the most recent assessment period at this time of writing.

**Table 3:** Percentage of students meeting objectives by lesson

Lesson	Students Meeting Objectives
Research Question Development	65%
Evaluating Sources	59%
Quoting, Paraphrasing, and Summarizing	59%
Search Terms and Strategies	67%
Evidence and Source Types	Insufficient pilot data available

Student feedback on the lessons has also been encouraging. Not only have survey and discussion results helped us to eliminate technical problems and points of confusion about content, but a majority of students have expressed gratitude for the lessons and a sense that their guidance has been helpful in research and writing. The most commonly cited benefits have been a sense of improved organisation and clarity in the research process. The most encouraging piece of feedback we have ever received, however, was a complaint that the lessons required ‘too much thinking!’.

In spite of these performance levels, implementation of the lessons has thus far fallen short of our original vision, in which they would be used independently by instructors in SCORM format. Though the librarian-mediated model of the pilots is labour-intensive, the pilot period has been so lengthy that by now this model is also stable, well-understood, and widely-adopted by faculty. When we finally arrived at a satisfactory revision of the Research Question Development lesson and were faced with the prospect of convincing faculty to implement it in a new and more complex way without our assistance, it was a more daunting one than we had anticipated, especially amid the demands of other simultaneous lesson development processes. As a result, the use of all lessons continues to proceed in the pilot format for the time being, until such time as a more strategic approach to converting to SCORM packages can be developed.

## 5. Discussion

The high number of courses using the lessons indicates strong adoption overall. Our findings, however, show a clear need for increased and more targeted outreach towards online and hybrid course instructors. Additionally, student performance indicates that the lessons are generally meeting objectives at or near an acceptable level. Acceptable performance has been defined as when students perform at a developing level, meaning that we see significant improvement in their skills after completing the lessons, but weaknesses may remain. Across all

lessons, more than 50% of students are meeting objectives at the developing level, which is acceptable progress given the starting skill level of the early undergraduate population, the complexity of the lessons' content, and the fact that online learning at the Libraries is still a work in progress.

There have been several limitations in our development process. First is the slow evolution of our process itself, which was refined over several years, and continues to evolve. The team's focus on instructional quality has sometimes meant that we failed to see 'the forest for the trees', and were slow to recognise areas where the overall process was in need of improvement or holding us back. For example, early on the IDL worked very closely with instructional leadership on lesson development, due to being new to the Libraries and to project management; over time, however, this communal decision-making process became more cumbersome than it was helpful, but the team was so busy creating more lessons that it took some time to recognise this fact and adjust. It is important for instructional designers to review the design process regularly and ensure that it is as agile as realistically possible.

Additionally, as development software, Articulate Storyline has its limitations. We have been able to use Storyline's text entry options to create exercises where students enter data about their research processes, which is then displayed later for students to build on further; answers provided via many of Storyline's built-in quizzing options, however, cannot be displayed again in this manner, limiting the types of interactions in which we can usefully engage students. As of development time, Storyline also lacked important functionality such as a native option to print or screen capture individual slides. The output of Storyline is served to users via Flash, presenting some access, accessibility, and usability challenges, and some students have reported crashes and instability when using the lessons. Uploading multiple versions of content to Articulate Online, the cloud-based LMS we use to store lessons in pilot phase and make them accessible to students, can overwhelm its ability to create reports of student answers, which has resulted in the loss of several batches of valuable assessment data. Although Storyline was originally selected because it met our needs in terms of supported features, it might have been helpful to more critically investigate its technical functioning and how that would affect instruction as well. We recommend considering both pedagogical and functional features when selecting a software for instructional design, although with the caution that no software choice will be perfect in every aspect.

Finally, our level of buy-in from other librarians with instructional responsibilities has been lower than we would have preferred. The vast majority of work on designing our online lessons was confined to the Instruction Team until relatively recently, due to the team's relevant expertise and job duties. After developing some of the earlier lessons, we began working to encourage their use by other librarians and investigate needs around implementation, but at this stage we found in the larger department less clarity about the project, and less interest in using the lessons, than we had hoped. In response, we worked to incorporate communication with subject liaisons directly into the development process, and to increase communication between librarians with instructional design responsibilities in the department and those without. Even if a design project lives only with certain instruction librarians, we strongly recommend building into the instructional design process provisions for clear and regular communication with other librarians with instructional responsibilities, so that promotion and use of the resulting learning objects can be maximised.

## 6. Conclusions

Despite these limitations, this project has essentially met its original objective. Although most remain in the piloting and revision stage, we have indeed developed a set of online lessons, and each focus on a core IL concept. We have demonstrated here how our process for developing these lessons has conformed to best practices established by the literature on developing asynchronous online instruction, and on pedagogy in general. Finally, despite the gradual pace at which instructors have adopted the lessons, where they have been adopted, they have proven to provide flexible and scalable options for online IL instruction.

Given the success of this project, other librarians engaged in developing online instruction can take away a number of imperatives from the Instruction Team's experiences.

### 6.1 Adhere to evidence-based best practices

As this paper has demonstrated, there is a substantial body of research establishing best practices that asynchronous online instruction should follow in order to best support student learning. Past surveys of existing online learning objects produced by academic libraries, however, have found significant percentages to underperform in areas where best practices have been established (Hrycaj, 2005; Somoza-Fernández & Abadal, 2009) and to fail to meet accessibility standards in their content (Clossen & Proce, 2017). Librarians developing online instruction would benefit from carefully reviewing the literature and formulating strategies to incorporate best practices before beginning the instructional design process.

### 6.2 Collaborate with faculty

Partnerships with faculty have been crucial throughout this development process, from suggesting skills that online instruction should address in students to providing a real-world classroom venue in which lessons could be piloted and assessed. Involving faculty in the development of online IL instruction benefits all participants: librarians benefit from faculty members' insight into and access to students, while faculty receive priority access to new tools to improve their students' research skills.

### 6.3 Use teamwork judiciously

Developing lessons as a team has had mixed effects on multiple aspects of the process. On the one hand, in the earliest stages of development, the Instruction Team was able to pool the experience and various skills of multiple instruction librarians to determine which approaches would be most effective while still being technically feasible. On the other hand, however, working as a team seems to have significantly slowed the pace of development, due to the cumbersome nature of communal decision-making and the need to coordinate multiple busy schedules; efforts to speed up production have included the elimination of development teams, in favour of the new model where a single developer regularly consults other department members. It is also questionable whether keeping development within the Instruction Team did much to increase buy-in across the department and the Libraries, and branching out to consult with others outside it may have been more effective in raising awareness of the lessons' content and increasing transparency around their development. There are many complexities to be considered with regard to the utility of designing online instruction as a team, and this approach should be evaluated and implemented carefully to be effective.

### 6.4 Anticipate an imperfect process

Online asynchronous learning objects, as a mode of instruction, are still more or less in their infancy, as is the discipline of their development. Few librarians have training in instructional

design for an online setting, and even fewer have relevant experience. Software for creating these types of tools, furthermore, is still evolving and limited in its current capabilities. It is therefore reasonable to expect, when developing online learning objects, that progress will be made slowly, that additional expertise may need to be sought or developed through training, and that what can be accomplished in the end product may be limited. It is important to be flexible, patient, and reflective about the effectiveness of one's process as online instruction is being developed for now, while remaining hopeful that the future may bring tools and skills that will enable much smoother production of increasingly sophisticated resources.

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