

Beyond Content Knowledge: Best Approaches to Improve Student Application of Information Literacy Instruction

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Abstract: Instruction conducted face-to-face and via distance education have been utilized by librarians in higher education institutions when providing information literacy instruction to students. While research has shown minimal difference in student learning when comparing these methods of delivery, changes in student behavior have not been thoroughly examined by scholars. Our results give evidence that online asynchronous instruction using tutorials were the most effective relative to face-to-face instruction and online synchronous instruction in the application of information literacy concepts in subsequent student projects. Various forms of follow up can improve instruction delivered in this method.

Introduction

For librarians in higher education institutions, concerns surrounding the effectiveness of information literacy instruction for distance education when compared to face-to-face instruction have continuously been examined in the field of Library and Information Science. Scholars such as Zhang et al. (2007) and Anderson and May (2010) noted that more research was needed when evaluating the impact of providing information literacy instruction to students that extends beyond student preference and the advantages or disadvantages of different delivery methods. Others such as Withorn et al. (2020) and Li et al. (2021) emphasized the importance of research in the development of assessment tools beyond self-reporting when evaluating the impact of information literacy instruction on long-term application in various scenarios found in different fields or in real-life situations. Due to the COVID-19 pandemic, librarians have found it necessary to provide information literacy instruction through distance education despite the lack of detailed planning, design and training often undertaken by librarians when considering new pedagogical approaches to instruction (Martzoukou, 2020). Understanding how students learn and apply information literacy concepts after instruction delivered face-to-face and through distance education delivery methods is vital for improving how instruction is conducted by librarians. In this study, the researchers seek to evaluate whether information literacy instruction in face-to-face, online asynchronous, and online

synchronous environments affects student application of their skills through the completion of subsequent projects. Research questions explored in this study include:

1. How did affordances of modality (face-to-face, online asynchronous, or online synchronous) impact the development of information literacy skills?
2. How did affordances of modality (face-to-face, online asynchronous, or online synchronous) impact students' ability to apply information literacy skills in subsequent projects?
3. How did students use information literacy skills when working on projects?

Literature Review

Despite previous research comparing information literacy instruction conducted face-to-face and through distance education showing no significant difference in student learning (Andersen and May, 2010; Beile and Boote, 2004; Gall, 2014; Holman, 2000; Kraemer et al., 2007; Kougogiannakis and Wiebe, 2006; Nichols et al., 2003; Schimming, 2008; Shaffer, 2011; Silver and Nickel, 2005; Zhang et al., 2007), scholars have continued to examine them in different learning situations in order to improve the effectiveness of instruction. In their review of research studies comparing face-to-face and computer assisted instruction, Zhang et al. (2007) found that while both were equally effective for teaching basic library skills, this conclusion could not be unequivocally stated due to a number of issues they found in how data was collected, measured, and analyzed across the ten studies they examined. When reviewing how these studies evaluated the effectiveness of instruction on student learning, they noted that many used identical pre- and post-tests often distributed in short succession when evaluating student performance. Zhang et al. describe the decision to conduct pre- and post-tests in this manner as an impediment to understanding how students internalize information literacy concepts and whether a certain delivery method resulted in better retention. They also indicated that the research methods used in these studies created additional difficulties in comparing both delivery methods in and across disciplines as the studies showed significant differences in the degree of hands-on and interactive instruction used. This scrutiny of research instruments and design used in studies examining the effectiveness of information literacy instruction highlights the continued problem found by scholars in the field in how findings are deduced and how effectiveness is measured when comparing delivery using different methods (Portmann and Roush, 2004; Walsh, 2009; Sobel and Sugimoto, 2012; Silk et al., 2014). In addition, they raise similar concerns identified by scholars in the Education field regarding media comparison studies (Surry and Ensminger, 2001; Yengin et al., 2010; Lockee et al., 2018). It is for this reason that some scholars seek to revise how information literacy is assessed in order to enact meaningful improvement in increasing student learning (Head et al., 2019).

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In Silk et al.'s (2014) study comparing instruction using an online hour-long tutorial and face-to-face instruction on library research, they found that while both methods showed no difference in student knowledge gain, self-efficacy and response-efficacy, there were noticeable findings regarding the measurement of individual behavior in students. Unlike past studies, strict experimental controls were used in the research design of their study such as instruction in both delivery methods coming from the same librarian on the same content, students being limited to eight topics for the final project used in assessment, and instructors receiving training in how to answer student questions that reinforced library instruction. In Silk et al.'s study, individual behavior was connected to a student's success in finding an empirical article online for summary in their final project. They found that students who had conducted their learning online were more successful in finding an article than students who learned in the face-to-face environment. The researchers noted that this result may be connected to the medium of instruction matching the expectations for the project as students learning online would be able to easily apply their new knowledge by being on a computer device and are able to refer back to the tutorial when needed unlike students learning face-to-face who may not have a computer device with them.

In Lietzau and Mann's (2009) pilot study, they examined the use of synchronous web conferencing in different library instruction scenarios. These scenarios included information literacy instruction for students enrolled in an online asynchronous course, one-on-one and group instructional sessions for students and faculty, and a focus group on revisions to the library website with faculty. Participants in each scenario were surveyed with final projects scored for students in the online asynchronous course from sections with and without the use of online conferencing. Lietzau and Mann noted common themes found in responses from surveys across scenarios showed both faculty and students viewing the use of web conferencing as a way to enhance their learning online and provided increased opportunity for interactions. For the online asynchronous course scenario, they noted that final project scores for sections that used web conferencing were higher and students claimed to learn more when compared to sections that did not use web conferencing. While other studies in the field have evaluated the use of synchronous web conferencing for library instruction when compared to other delivery methods, these studies do not significantly advance research in the area of student application of instruction due to the continued focus on student and faculty perception of the technology's use (Hess, 2014; Bennett, 2021).

Overall, past studies evaluating information literacy instruction delivered using different methods highlighted student performance on content learned with pre- and post- tests, evaluation of final projects, and perceptual data of their development. While many studies concluded that overall there were no significant differences in student learning, individual findings spotlighted changes in student behavior in different areas. As information literacy instruction continues to be conducted both face-to-face and through various distance education means, it is important to consider new approaches towards

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evaluating instruction effectiveness. Therefore, this study seeks to advance research and instruction by studying students' ability to apply information literacy skills taught in various settings to determine how instruction impacts future practices.

Setting

The study examined student assignments from four major units across two years from a single 100-level computer applications course at a public university in the Western United States. The computer applications course included both a lecture component involving the general applications of technology and a lab component that provided students with hands-on instruction of various software applications. The lecture is taught by the instructor and the lab component by teaching assistants (TA). In the lab component, teaching assistants manage assistant teaching assistants or ATA who help students during instruction. The course is considered large-enrollment with approximately 300 students from over 30 majors. The lab component involves only a subset of these students with class sizes ranging from 20 – 30 students for the face-to-face and online synchronous sessions, and 15 – 20 students for the asynchronous online sessions. Across the two years examined in the study, two sessions were taught face-to-face, two sessions through online synchronous instruction and two sessions through asynchronous online instruction.

The researchers selected this course due to its focus on applied information literacy and hands-on application of learning. In the lab component, students learn information literacy and computer skills found in different applications and apply them to real-world situations through projects. Projects are completed by students after the last day of instruction for a unit. Skills learned in the first unit covers Boolean searching, library databases and creating citations, which are relevant for future projects in other units.

The end of unit projects allowed researchers to examine student application of citation creation associated with the Association of College and Research Libraries (ACRL) (2016) *Framework for Information Literacy for Higher Education* over an extended period of time had passed since initial instruction. In the ACRL's (2016) *Framework* are the frames *Information Has Value* and *Scholarship as Conversation*, which are connected to helping students foster an understanding of when and why sources are cited. Based on these various factors surrounding the computer applications course, the researchers believed examining student work from this course would provide relevant data that would answer the proposed research questions.

Methodology

For the study, instruction was conducted by the same course instructor and teaching assistant using similar teaching pedagogy. Identical instructional materials that aligned with course objectives and the structure of the course were created by both. They also

answered student questions in a way that reinforced instruction and utilized the same end of unit projects across the different instructional mediums.

When answering the research questions proposed in our study, researchers used a mixed methods approach for RQ1 and RQ2, while using a qualitative approach for RQ3. The data used to answer all research questions were collected through the course's learning management system across six sessions between 2019 and 2021.

RQ1 and RQ2: Quantitative and Qualitative Data

For RQ1 and RQ2, researchers reviewed student projects from the first four units of the course. These projects were de-identified and scored using a set criterion. Because the first unit addressed information literacy concepts, these projects were scored based on the correctness of responses. For the remaining three units where students applied skills to Microsoft Word, PowerPoint, and Excel, projects were scored based on the quality of citing sources for applied skills. An analysis of variance (ANOVA) was used to examine differences in results per instructional approach. Data for analyses were organized according to type of instruction (face-to-face, online synchronous, and online asynchronous) and unit.

Open-ended survey responses from the end of course surveys from each session were also analyzed using an open and axial coding strategy to determine common themes regarding affordances that supported student development. The survey included questions about each of the units taught and gave students the opportunity to add written feedback.

RQ3: Student Open-Ended Feedback

For RQ3, students were asked to respond to the question "How has Boolean searching on search engines (like Google or Bing) helped you to develop and implement ideas on your projects?" during the lecture component. These responses were collected through private messages to the instructor and de-identified for the study. We used a content analysis approach to identify themes in student implementation of information literacy skills.

Findings

RQ1: How did affordances of modality (face-to-face, online asynchronous, or online synchronous) impact the development of information literacy skills?

Student performance on the Boolean Searching unit to develop their information literacy skills are summarized in Table 1. Overall, students performed the highest on the face-to-face implementation of the unit with an average of 82.35%, while asynchronous students achieved an average of 75.95%, and synchronous students averaged a 64.93%. The difference between groups was statistically significant with $p < .05$ (Table 2). Therefore,

learning concepts associated with *Information Has Value* and *Scholarship as Conversation* frames worked best in face-to-face settings. Student feedback on the open-ended survey highlighted the affordances of face-to-face instruction, where students could ask clarification questions live. Students indicated that the ability to ask questions and receive immediate feedback throughout the lesson from TAs and Assistant TAs helped them to ensure they had a solid foundation, especially with pre-requisite skillsets. A student noted, “Getting help from the TA and ATA during class was the most valuable part of the class. Even when I fell behind, I could get help and learn stuff.” Although this is possible with synchronous on-line classes via teleconferencing software, in the researchers’ experience, it happens much less with students occasionally typing questions in the chat function. With asynchronous classes, students periodically email questions for clarification about these concepts, but it occurs less frequently than the chat function and includes responses that only the sender can see. Therefore, the interaction in class allows for clarification on deeper levels and the opportunity for all students to hear the response, as opposed to those who read the chat function or direct messaging. Students also reported maintaining more attention during face-to-face sessions compared to other modalities. When participating in synchronous on-line classes, students found it more difficult to sustain focus on content due to outside distractions. Distractors commonly mentioned included others in their household working on different tasks (work, other classes, etc.), accessing media on their phones such as social media and videos, and multitasking during classes with chores and other tasks. These distractors were less common in asynchronous on-line classes due to the ability to stop or pause content. However, asynchronous students indicated that they did not always return to instructional content after stopping or pausing for another task.

Table 1.
Summary Statistics for Boolean Searching Project for Different Modalities

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
F2F Boolean%	51	42	82.35%	0.081569
Async Boolean%	33	25.06667	75.95%	0.104983
Sync Boolean%	64	41.55556	64.93%	0.165969

Table 2.

Single Factor ANOVA for Boolean Searching Project for Different Modalities

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.889492	2	0.444746	3.603918	0.029682	3.058486
Within Groups	17.89391	145	0.123406			
Total	18.7834	147				

RQ2: How did affordances of modality (face-to-face, online asynchronous, or online synchronous) impact students' ability to apply information literacy skills in subsequent projects?

The students' application of information literacy skills to their next three projects in class (Word, PowerPoint, and Excel) are summarized in tables 3, 4, and 5. In the first application project, Word, there was no significant difference (Table 6), and the scores were similar with face-to-face instruction having an average of 50.98%, asynchronous instruction having 51.52%, and synchronous on-line instruction having 46.09%. The next application project was completed using PowerPoint after students received feedback on the Word unit. The feedback included information regarding their use of software and application of the information literacy skills. There was a significant difference in performance between the three groups, with $p < .05$ (Table 7). In this unit, the face-to-face group averaged 66.67%, the asynchronous group averaged 68.18%, and the synchronous group averaged 48.44%. The final project, Excel, also included a statistically significant difference between groups, with $p < .05$ (Table 8). The face-to-face group averaged 70.59%, the asynchronous group averaged 87.88%, and the synchronous group averaged 64.06%. Over the course of the semester, each group's application of the information literacy skills improved. In comparing the three groups, the asynchronous on-line group had the highest scores and improvement since its initial implementation. While some findings relate to similar observations made by scholars in the field, other notable findings found in the current study were not widely discussed in the literature.

The affordance, *always available content* was attributed to the highest performance using the asynchronous modality based on the open-ended survey. Many students noted that they rewatched asynchronous videos when they *got stuck* on parts of their projects. A student noted, "I watched the videos to get an idea of the things to learn for the week. But I had to rewatch them when doing my assignments since some things were very specific. I even had to watch older stuff when we had to use it in the current week. It was a lot." Students could not review the content from the face-to-face classes. We were intrigued that the synchronous modality had the lowest application performance over time since

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these class sessions were recorded and available to review. However, upon reviewing the viewership data, the researchers noted that the asynchronous approach had much higher viewership (~80%), while synchronous recorded sessions had ~85% live attendance and ~5% viewership of the recorded sessions. It appears that the viewership of asynchronous sessions may have provided good depth of content and promoted greater follow-up than other modalities. The open-ended survey revealed additional insights regarding the watching and rewatching of content. A theme that emerged was the students' level of responsibility for learning. In the face-to-face and synchronous classes, students discussed the importance of high-quality instruction that they could understand immediately. A student stated, "My TA is pretty good at explaining concepts so I get it. But some of my friends weren't lucky so they were mad when they didn't get something and gave up." This feedback came from a student enrolled in the synchronous implementation and illustrated the focus the students put on perceived quality of live instruction. However, a student in the asynchronous course noted, "It is good that there are videos that I can pause rewind and rewatch when I don't get it. I can watch it till I finish my homework." This insight highlighted the responsibility the student took towards their learning, where they put in the effort to continuously use video resources until they understood it and did not give up. Overall, the modality appeared to impact level of responsibility for learning, where students in asynchronous courses tended to review content needed until they were able to complete coursework.

Table 3.
Summary Statistics for Word Project for Different Modalities

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
F2F Word	51	26	50.98%	0.124902
Async Word	33	17	51.52%	0.101326
Sync Word	64	29.5	46.09%	0.097656

Table 4.
Summary Statistics for PowerPoint Project for Different Modalities

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
F2F PPT	51	34	66.67%	0.156667
Async PPT	33	22.5	68.18%	0.153409
Sync PPT	64	31	48.44%	0.158482

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Table 5.
Summary Statistics for Excel Project for Different Modalities

<i>Groups</i>	<i>Count</i>	<i>Sum</i>	<i>Average</i>	<i>Variance</i>
F2F Excel	51	36	70.59%	0.191765
Async Excel	33	29	87.88%	0.109848
Sync Excel	64	41	64.06%	0.210069

Table 6.
ANOVA for Word Project for Different Modalities

<i>Source of</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.09493	2	0.04746	0.44006	0.64485	3.05848
Within Groups	15.6398	145	0.10786			
Total	15.7348	147				

Table 7.
ANOVA for PowerPoint Project for Different Modalities

<i>Source of</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	0.09493	2	0.04746	0.44006	0.64485	3.05848
Within Groups	15.6398	145	0.10786			
Total	15.7348	147				

Table 8.
ANOVA for Excel Project for Different Modalities

<i>Source of Variation</i>	<i>SS</i>	<i>df</i>	<i>MS</i>	<i>F</i>	<i>P-value</i>	<i>F crit</i>
Between Groups	1.243319	2	0.62166	3.422487	0.03529	3.058486
Within Groups	26.33776	145	0.18164			
Total	27.58108	147				

RQ 3: How did students use information literacy skills when working on projects?

To answer RQ3, the researchers conducted a content analysis on student responses to an open-ended question regarding their projects. We found two major themes regarding students' ability to apply their knowledge. The first theme was their ability to work more efficiently, as they were able to find content knowledge and supporting media quickly which enabled them to focus on the primary learning objectives. The second theme focused their ability to apply their learning in other classes they were enrolled in. This finding was unexpected, as we focused on their application within the class. These students were pleased that they learned content that was useful to their education, which highlights the importance of the ACRL Framework as foundational knowledge for learners.

Discussion

The researchers believe that online asynchronous instruction is an effective delivery method for developing students' long-term understanding of information literacy and their ability to apply their knowledge. Despite face-to-face and online synchronous instruction providing opportunities for meaningful classroom interactions that allowed students to improve their understanding of information literacy through immediate feedback, students who received asynchronous instruction with less interaction showed stronger development of these skills across final projects. Student comments surrounding the in-depth and always availability of instructional content, and the acknowledgement of their own level of responsibility towards their learning were notable insights from their experience receiving asynchronous instruction. These insights concerning the modality of instruction and approach to learning may have played a role in the long-term development of student's information literacy skills. While there are concerns surrounding students continuing their learning after stopping or pausing instructional content in asynchronous instruction, future research is needed to explore how this phenomenon impacts student learning behavior of information literacy over time.

In terms of information literacy instruction, the researchers believe asynchronous instruction or a combination of face-to-face instruction and asynchronous instruction, often referred to as blended instruction, should continue to be considered. Unlike current models of library instruction that rely on the one-shot seminar, asynchronous instruction or blended instruction provides opportunities for librarians to support student learning using multiple modalities and over the long-term through always available resources.

The researchers also believe that in order to improve online asynchronous instruction librarians must follow-up with students to connect previously learned information literacy concepts to current assignments. In this study, students were taught the information literacy unit preceding the productivity projects where students applied their skills. Verbal follow-up from the course instructor and teaching assistant, through announcements and

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over email were consistently used, which improved student recognition of long-term application of learned concepts. These follow up measures were not extensive, but simply reminders to get students to utilize their existing skill set. Our findings are also relevant to the practice of embedded librarianship, where there is an improved likeliness of follow-up with students than a one-shot seminar. This also creates additional opportunities for collaboration between librarians and faculty to embed information literacy skills as a part of assignments that promote application of knowledge rather than solely increasing ACRL content knowledge.

There are many possibilities for future research based on the study. Because the study focused on projects for one course when evaluating the impact on student learning, findings are limited to only this course. In future research, the researchers would like to consider the examination of multiple courses across the curriculum and follow up with students across their academic career in order to determine the impact of instruction across multiple years after receiving instruction. We also intend to study the application of information literacy skills to different disciplines and course types such as laboratory (hands-on) and theoretical concepts.

This study focused on examining the application of two concepts from the ACRL's (2016) *Framework for Information Literacy for Higher Education*. In the future, we would like to examine the long-term impact of receiving instruction in different delivery methods on other frames. This study serves as a starting point to much future research on the wide range of information literacy skills.

Conclusion

The researchers found that information literacy delivered through online asynchronous instruction resulted in statistically significant findings with students having the highest level of skill application over time. When examining student comments, researchers were able to see that some students recognized the helpfulness of long-term application of information literacy skills they learned for assignments and other classes. As online asynchronous instruction is already being conducted in libraries, the researcher believes that the findings can help improve information literacy instruction conducted by librarians when it is embedded in the curriculum rather than being treated as an add-on.

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