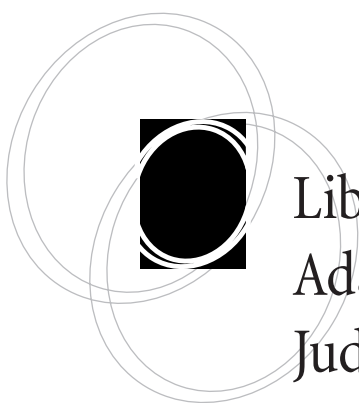




Library Instruction and Adaptive Comparative Judgment to Foster Visual Literacy Skills

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abstract: As students are increasingly required to consume visual information, so too are they expected to create such information. In a Midwestern research university, students in an engineering technology portfolio class assembled a visual career board and visual résumé. The instruction and research team collaborated to provide an active learning module on visual literacy that integrated library instruction with an assessment-based pedagogical approach called adaptive comparative judgment (ACJ). This exploratory case study demonstrated that the combination of library instruction with ACJ successfully supported students in gaining visual literacy skills. Additionally, it highlighted the importance of students developing the ability to articulate visual literacy principles.

Introduction

School and work increasingly require visual literacy skills. Just as educators are expected to provide the tools needed for students to critically evaluate and create written text, instructors must give students the tools to critically assess and produce visual information, enabling them to communicate visually. Librarians' expertise in teaching information literacy (IL) carries many of the same skills into visual literacy instruction. As Benjamin Harris states, "Information Literacy instructors and advocates have become increasingly

...instructors must give students the tools to critically assess and produce visual information, enabling them to communicate visually.

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aware of the fact that students require some of the same assistance provided in relation to written sources as they learn to locate, evaluate and use images.”¹ A visually literate student can “read/decode/interpret visual statements, as well as write/encode/create visual statements.”² Yet, as Tracey Bowen says, “The realm of visual literacy is complex, dynamic, and ever-changing as the sociocultural and technological landscape shifts.”³ Although visual literacy is not a new literacy, it remains in process and asks for flexibility and adaptability to meet the requirements for new technologies. Just as it is necessary

... there is a need for assessment that incorporates impactful, intentional image creation which requires higher-level thinking by students.

for librarians to evaluate the effectiveness of IL instruction, it is equally important to assess visual literacy teaching and to develop assessments that meet the nature of an ever-changing visual information landscape, to gain an ongoing and fluid understanding of what our students need.

Assessments that produce evidence of critical thinking in relation to literacy are present in the library literature, but they

are most commonly described in the context of assessing work with text, not images. Further, the literature pays little attention to evaluating visual literacy beyond locating and analyzing images. Thus, there is a need for assessment that incorporates impactful, intentional image creation which requires higher-level thinking by students.⁴ Applied relatively recently to education, the assessment-based pedagogical approach of adaptive comparative judgment (ACJ) utilizes visual comparisons to gauge student understanding. Due to its visual nature, the instruction and research team found it to fit the nature of the study. Additionally, since instruction librarians have limited time to teach in program-specific classrooms, an assessment tool that doubles as a teaching aid adds to the librarian’s impact.

The guiding research question for this case study was “How does co-created curriculum using academic library resources with an ACJ tool impact student visual literacy learning outcomes?” The assignments for the study included creating a career vision board and a visual résumé. An engineering technology course was a good fit for evaluating the effectiveness of bringing in a librarian for visual literacy instruction because the program is transdisciplinary, employing a mix of experts from different disciplines and experience to work with students. Where an engineer and an engineering technologist differ, broadly speaking, is that the technologist works with engineers, putting theories into practice. For example, as the *Occupational Outlook Handbook* states about an electrical and electronics engineering technician (or technologist), “Electrical and electronics engineering technicians help engineers design and develop electrical and electronic equipment.”⁵ Although this project was set in an engineering technology classroom, where students regularly assess design to implement theories into practice, the project has broader applications that reach across disciplines. Because the meaning of visual literacy (VL) can be discipline-specific, the work was framed around a definition intended to apply across multiple fields of study: “The VL concept combines skills in visual reading (interpreting, meaning making), visual writing skills (using or creating images), as well as visual thinking and learning abilities and other VL skills.”⁶



Review of the Literature

Visual Literacy and Academic Libraries

Definitions of visual literacy differ across disciplines, based on how a field uses and contributes to it. As Jennifer Brill, Dohun Kim, and Robert Branch observe, “A common definition of visual literacy remains absent.”⁷ The definitions are continuously defined and redefined, and the terms used, such as *visual communication* rather than *visual literacy*, vary based on the discipline.⁸ John Debes, one of the most important figures in visual literacy, first coined the term in an audio recording “Visual Literacy” in 1969.⁹ Debes said:

Visual Literacy refers to a group of vision-competencies a human being can develop by seeing and at the same time having and integrating other sensory experiences. When developed, they enable a visually literate person to discriminate and interpret the visible actions, objects, symbols, natural or man-made, that he encounters in his environment. Through the creative use of these competencies, he is able to communicate with others.

Debes’s definition of visual literacy speaks to a skill set traditionally taught in the design disciplines. In 1969, it would have been hard to imagine how thoroughly immersed in a visual information environment today’s students have become. Students across campus are required to both evaluate and create meaningful visual information as part of their academic experience. The majority of university curriculum continues to consist of text, but there is a growing awareness of the importance of visual education.¹⁰ As ever-evolving digital technologies fill the classrooms, different literacies are needed to make sense of the complex information environment in which students learn.¹¹

In this environment, the visual competencies of students in higher education do not always align with instructors’ expectations.¹² In a study by David Green, participating liberal arts instructors incorporated images into their teaching and learning. The difficulties recorded

ranged from where to source reliable images, what technology to use, and frustration with students’ inability to effectively find and consistently evaluate images.¹³ A study that examined Web searching for visual information found that students lacked reliable keyword and Boolean operator skills, and their searching was unorganized.¹⁴ In a study across disciplines by Alison Head and Michael Eisenberg, “Overall, students majoring in arts and humanities were the most frequent evaluators of both Web content and library sources in all cases but one—the information design of charts.” Sixty-two percent of participating students in the sciences reported, “They often, if not always, evaluated the information quality of charts from library sources,” while only 52 percent of students in the humanities did so.¹⁵

IL and visual literacy share similar skills needed for student research: knowing when and what information is needed, where to find the information, and how to evaluate it. Whereas visual literacy instruction through disciplines such as design can reach only a

Students across campus are required to both evaluate and create meaningful visual information as part of their academic experience.



limited number of students across campus, librarians teaching visual literacy in classrooms have the potential to reach learners from all fields of study.¹⁶ The Association of College and Research Libraries (ACRL) articulated the role of librarians in this area of

IL and visual literacy share similar skills needed for student research: knowing when and what information is needed, where to find the information, and how to evaluate it.

instruction by approving visual literacy competency standards in 2011.¹⁷

If librarians provide general visual literacy instruction across the higher education campus, different disciplines can then scaffold that instruction with program-specific knowledge and applications. A form of assessment that complements the nature of visual literacy furthers the impact of such instruction and can inform the work going forward. For this exploratory case study, the authors found ACJ through the software RM Compare (then called CompareAssess) to be an appropriate fit because

of its visual nature and the way it supports both formative assessment (which happens during the teaching and learning process) and summative assessment (evaluation of the final student product).

Adaptive Comparative Judgment

The foundation for adaptive comparative judgment (ACJ) originated in L. L. Thurstone's law of comparative judgment, developed in the 1920s. Thurstone's law is based on the psychological principle that people naturally engage in comparisons while judging the value of something; for example, when they determine how "good" something tastes, they naturally compare it with other things to decide how good it is. Thurstone argued that comparative judgment for both objective knowledge, such as the weight of something, and subjective knowledge, such as handwriting and drawing, could be quantified through equations and comparisons. The result of these comparisons—and the resultant data—can offer reliable and valid data to show the value of one item in relation to another. Thurstone originally applied the method to rank attitudes or beliefs, such as "a series of opinions on disputed public issues."¹⁸ As Ian Jones and Matthew Inglis state, "Thurstone's underlying principle argument of comparative judgement suggests that we should obtain reliable assessment outcomes even though the process is based on 'subjective' judgements."¹⁹ The subjective judgments are a collection of professional knowledge from different instructors and students comparing student work, such as a written or visual piece. Feedback is maximized through the group collective of subjective knowledge, and subsequently, results in high reliability.²⁰

Alastair Pollitt and Neil Murray made the first recent applications of comparative judgment in education in the 1990s, observing how judges evaluated foreign language speaking assignments.²¹ In Pollitt's 2009 assessment project for design and technology portfolios, judges were presented with pairs of digitally scanned portfolios and asked to compare them and assess which was "better."²² Based on the judge's choice and a guiding algorithm, another pair was presented for comparison.²³ Multiple judges evaluated pairs of portfolios in an iterative process until a rank order of all portfolios was



obtained. Pollitt noted that the outcome of this assessment project was that 28 judges made 3,067 judgments to assess 352 e-portfolios with an overall score reliability of 0.96.²⁴ The method uses “the holistic approach to assessment that [teachers/judges] have always advocated for design & technology.”²⁵ ACJ is holistic in that it does not ask judges to provide a score, but rather, asks them to use their expertise and knowledge to make their decision.²⁶

In 2004, Pollitt proposed facilitating ACJ through computer software. Adaptive comparative judgment software presents a pair of works to a judge, who chooses which is “better” and, if prompted by the software, can also provide comments explaining why. As an online tool, the ACJ software platform RM Compare (<https://rmresults.com/digital-assessment-solutions/rmcompare>) can enable judges from different fields of expertise to assess complex and diverse artifacts such as portfolios.²⁷ Bringing together a community of practice who interact with one another to learn to do their work better eliminates the expectation that there is one way to think and produce. Instead, ACJ “assimilates the varied ways in which a given community of experts understand a construct in practice.”²⁸ This approach exposes students to a broad community of mentors and lessens the potential for bias.

Numerous studies have tested the reliability and validity of ACJ.²⁹ The applications have ranged from math assessments to graphic design to open-ended design problems in engineering. A recent study compared one group who used a traditional rubric and scoring method with peers using ACJ. Although students voiced concern about their peers lacking the knowledge that their instructors had, significant benefits included students learning from each other and the ability to practice evaluation skills.³⁰

This study demonstrates the value of applying ACJ to visual literacy instruction. It includes proven validity and reliability; the ability to have judges from different locations, programs, and fields; and a tool that enables students to learn through the process of evaluation. The instruction and research team believed that both library instruction and an assessment tool that is visual by nature and incorporates learning as part of the process would elicit evidence that the students gained visual literacy skills in both practice and articulation.

Adaptive comparative judgment software presents a pair of works to a judge, who chooses which is “better” and, if prompted by the software, can also provide comments explaining why.

... significant benefits included students learning from each other and the ability to practice evaluation skills.



Methods

Participants

All participants were enrolled full-time at a research-intensive university in the Midwest. The study was conducted in a portfolio class as part of a newly offered bachelor's degree program in Transdisciplinary Studies in Engineering Technology. The students were required to participate in the research as part of their assignment. Ten students took part, five females and five males. The course was vertically integrated, enrolling students across all grade levels. Three participants were freshmen, three were sophomore-level students, three were juniors, and one was a senior.

The small single sample size limits the generalizability of the study. However, this case study provided valuable material from which the instruction and research team can develop future work. Additionally, the length of the study was limited to one semester and lacked a longitudinal perspective. Due to its limitations, this study was exploratory in nature.

Study Design

The 16-week course was delivered in spring 2019. The five-session learning module covering visual literacy and ACJ was just one part of the course; Table 1 provides a summary (see Table 1).

Session 1: Developing a Career Vision Board

The first training session, co-taught by the library liaison and course instructor, opened with questions regarding what resources students currently used to plan their career futures. Subsequently, students were asked their thoughts on the differences between IL and visual literacy. The seven ACRL Visual Literacy Competency Standards for Higher Education guided the discussion:

1. Determine the nature and extent of the visual materials needed.
2. Find and access needed images and visual media effectively and efficiently.
3. Interpret and analyze the meanings of images and visual media.
4. Evaluate images and their sources.
5. Use images and visual media effectively.
6. Design and create meaningful images and visual media.
7. Understand many of the ethical, legal, social, and economic issues surrounding the creation and use of images and visual media, and access and use visual materials ethically.³¹

Homework assignment 1 required the students to assemble a career vision board following the ACRL Visual Literacy Standards. An example of a career vision board was given with an explanation as to how it did or did not meet the ACRL standards. To assist students in learning about career paths, a career portal was provided through the university library. It included listings of available jobs and internships and field-specific data, among other career-related resources. To support students using visuals to convey information, they received a tour of [Creative Commons](#) (CC), a nonprofit organiza-



Table 1.

Session	Lecture topic	Homework assignment
1 (week 3)	Developing a career vision board	Vision board version 1
2 (week 5)	Assessing vision boards	Vision board version 2
3 (week 6)	Developing a visual résumé	Visual résumé version 1
4 (week 9)	Assessing visual résumés	Visual résumé version 2
5 (week 11)	Assessing updated vision boards and visual résumés	Vision board version 3 and visual résumé version 3

tion devoted to expanding the range of creative works available for others to use and share legally, followed by a discussion of copyright. Students obtained an overview of Canva (www.canva.com), a design tool freely available online, which was the required platform for creating the career vision board. For the remainder of class, students had time to engage with the resources and work on the assignment. The instructional team interacted with the students, asking questions to prompt thinking about career possibilities, where they could find information, and ways to visually express their desired paths. The class ended with a guided discussion on potential challenges students foresaw in visually expressing information, compared to writing it.

As members of a transdisciplinary program, the students have gained a variety of skills through their studies that could take them on different career paths. The intention behind creating a career vision board was to help the students use visual tools to express possibilities that interested them. They needed to use their IL skills to locate resources that would help them investigate possibilities and their visual literacy skills to express those alternatives. The career vision board required students to incorporate headings found on the Occupational Outlook website, including pay, job outlook, and state and area data.³²

The intention behind creating a career vision board was to help the students use visual tools to express possibilities that interested them.

Session 2: Assessing Career Vision Boards

For the second training session, students used the ACJ online tool CompareAssess, now called RM Compare, for the first time, to evaluate career vision boards submitted by all class participants. RM Compare allows students to view each other's work and provide detailed feedback based on the ACRL standards and in-class discussion. Each judge (or whoever is evaluating) sees a pair of items from which to choose the "best." The judge is prompted to provide feedback on both items. When the judgment is completed, a new pair of items, which may or may not include an item previously viewed, is displayed,



and the judge repeats the process. Figure 1 illustrates what the screen looks like for a judge. This iterative process results in a ranking of all items compared and feedback from a variety of judges for each item. Because of concerns that student peer feedback might fall short in insight or reliability, six instructors (two portfolio co-instructors, two graduate teaching assistants, and two instructors not affiliated with the course) also provided assessment feedback. At the end of the session, students received the private and anonymous feedback in both a qualitative and quantitative form. The qualitative information was a summary of the detailed feedback, and the quantitative information was a ranking (1 = worst, 10 = best) according to the two different groups of assessors (peers and instructors).

Choose which is “best”.

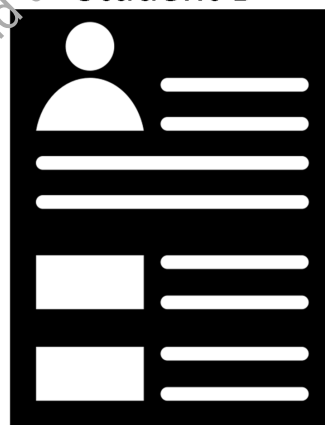


Student A



Created by priyanka
from Noun Project

Student B



Created by Davo Sime
from Noun Project

Feedback

Feedback

Figure 1. A visual representation of the adaptive comparative judgment (ACJ) screen seen by judges, with a pair of items from which each judge must choose the “best.”



For homework assignment 2, the students had to summarize lessons learned from the ACJ session and create a second version of their career vision board. The new version had to incorporate a minimum of three changes based on information from the ACJ session.

Session 3: Developing a Visual Résumé

The third session, co-taught by the library liaison and course instructor, opened with a review of visual literacy. Then students were asked what they thought visual communication was and how it differs from visual literacy, followed by an introduction to visual communication (noting its relationship to number 6 of the ACRL Visual Literacy Standards: "Design and create meaningful images and visual media"). Next, students participated in a short presentation on basic design tips for résumés, based on an acronym developed by the library liaison: SHARCC (space, hierarchy, alignment, repetition, color, and contrast). For every word in the acronym, a "bad" and a "good" example of that design word was represented in a visual résumé. For example, for space, the "bad" résumé was packed with print, colors, and graphs. A discussion followed in which the class discussed how hard it was to find what was important in the résumé and how overwhelming it was to look at. A "good" résumé was then shown with less information and better spacing that highlighted the images and print on the page. Discussion for both examples followed, in which students explained why they did or did not like the design choices by the résumé creators.

The students received links to both Creative Commons and the [Noun Project](#), a website that offers millions of symbols created and uploaded by graphic designers around the world, if they needed resources for images or icons. For the remainder of class, students had time to work on the assignment. The instructional team walked around to help students think about ways to visually express the specific skills they gained in their program. The class ended with students sharing what they learned and discussing potential challenges they foresaw in visually relaying information that they had not encountered with written information.

For homework assignment 3, the students had to create an initial version of their own visual résumé, using Canva. The intention behind the visual résumé was for students to identify gaps and connections in comparison to goals presented in the career vision board.

Session 4: Assessing Visual Résumés

During the fourth class, students used CompareAssess to evaluate visual résumés submitted by all class participants. Comments were again provided by the six instructors, and students again were given qualitative and quantitative feedback. For homework assignment 4, the students had to summarize lessons learned from the ACJ session and create a second version of their visual résumé integrating a minimum of three changes based on the session.

Session 5: Assessing Updated Vision Boards and Résumés

During the fifth session, students used CompareAssess to evaluate the updated career vision boards and visual résumés. As previously, students and instructors compared artifacts and provided feedback for improvement. Four human resources professionals from industry who were actively engaged on the university industry advisory boards also provided comments through CompareAssess.



For homework assignment 5, the students had to summarize lessons learned from the ACJ session and create a third version of both the career vision board and visual résumé. They were tasked with integrating a minimum of three changes based on the information obtained from the ACJ sessions.

Data Collection

The data collection for the purposes of this paper had two parts. First, homework assignments were gathered from two students to gain insight into the level of visual literacy skills they put into practice. Secondly, the written ACJ session feedback from two different students was collected to assess how well they could articulate the visual literacy skills of others.

Measuring Visual Literacy from Vision Boards and Résumés

The data collected included the first and revised versions of both the career vision boards and visual résumés from two students (students A and B) to determine if the required three changes based on ACJ feedback had been made to the revised version. The work of those two students was chosen because they attended all sessions, participated in all ACJ session feedback, and completed all assignments. These artifacts enabled the investigators to measure how well the students could put visual literacy into practice.



Figure 2. An example of a career vision board used in class.



Figure 3. A sample of a visual résumé from Creative Commons used in class.



Images of the students' work do not appear in this paper because they included information unique to them. Instead, Figure 2 shows the example one instructor gave in class to illustrate how information can be conveyed visually, and Figure 3 displays a visual résumé from Creative Commons.

Written ACJ Feedback to Measure Visual Literacy Articulation

The written ACJ feedback given by two students (students 1 and 2) about the work of two other students (C and D) was collected to assess visual literacy articulation using a rubric the research team created. The team used feedback from students 1 and 2 because they consistently commented on the two students' work, and it was difficult to find more than two students who did so. The students were instructed to keep the ACRL standards and SHARCC framework in mind while creating their work and were also told to use them as a reference when doing their ACJ evaluations. The ACRL standards and SHARCC framework guided the rubric created after the ACJ evaluations (meaning the students never saw them), against which two members of the research team compared the students' written ACJ evaluations.

Data Analysis

The career vision board and visual résumés from students A and B were used to measure visual literacy skills in practice. The research team compared the students' first assignment with their final revised assignment to determine whether they incorporated ACJ feedback by making at least the required three changes. Applying feedback from the ACJ evaluation demonstrated that students could interpret the comments and put into practice the visual literacy skills taught in class.

Rubric to Measure Visual Literacy Articulation

Table 2 shows the completed rubric used to assess visual literacy articulation in student 1 and 2's ACJ evaluations of student C and D's work. If students made specific use or reference to words used in the ACRL standards or SHARCC, a checkmark went next to the standard or framework with which the comment most closely aligned. Two members of the research team worked separately and then compared their outcomes to reach consensus. The number of boxes checked in the rubric determined whether there had been an increase in visual literacy articulation.

Results

Visual Literacy Skills in Career Vision Boards and Visual Résumés

The career vision boards and visual résumés from students A and B showed an overall increase in visual literacy skills because, with the exception of student A's résumé, each included at least three required changes. The revisions incorporated ACJ feedback, which reflected ACRL standards and the SHARCC framework. These changes in student A's vision board and student B's vision board and visual résumé demonstrated increased visual literacy skills in practice.



Student A's Career Vision Board

For the first version, student A's use of images appeared random; there were no citations for the images or job information presented. The board had many colors and delivered information randomly throughout the page. For the revised version, student A used a personal photo and a simple color scheme, cited job information, and conveyed a hierarchy of information through font size, space, and placement. The research team identified from the ACJ feedback the ACRL standards that student A had incorporated in the revisions: (1) meaningful use of images, (2) a determination of the nature and extent of images needed, and (3) an understanding of the ethical issues surrounding the use of images. From the SHARCC framework, student A incorporated (1) developing a hierarchy of information, (2) intentional use of color, and (3) employing space to highlight information.

Student A's Visual Résumé

Student A applied the ACRL standards and SHARCC framework throughout the first version of the résumé, leaving little room for improvement, so few changes were necessary. Student A may have gained skills from the vision board training and ACJ evaluation experience that carried over to the visual résumé assignment. The revised résumé incorporated ACJ feedback that suggested using a personal photo, providing more specific biographical information, and omitting a home address, since giving one was considered an outdated practice.

Student B's Career Vision Board

For the first version, student B's career vision board was overcrowded with images and text. The images matched the text information, but text and images overlapped, and there was no hierarchy of information. The revised version used fewer images, cited them correctly, and employed space, font size, and color to highlight information. Student B incorporated ACRL standards through ACJ feedback in the revision of the board in that (1) the nature and extent of images were determined, (2) the use of images was more effective, and (3) ethical use of information was applied. From the SHARCC framework, student B incorporated (1) creating a hierarchy of information with use of color and fonts, (2) providing visual reading direction to the viewer by incorporating repetition, and (3) highlighting information with the use of contrast—that is, employing light and dark colors to recede or foreground information.

Student B's Visual Résumé

Like student A, student B's first version of the visual résumé applied both the ACRL standards and SHARCC framework and so needed few improvements. However, student B did incorporate three revisions reflecting both ACRL standards and the SHARCC framework. The student added icons to highlight texts, borders to contrast sections, and color to highlight important informational boxes and contact information. These revisions based on ACJ feedback reflected the ACRL standards of (1) determining the nature and extent of visual materials needed, (2) interpreting and analyzing the meanings of



images, and (3) evaluating images and their sources. From the SHARCC framework, student B incorporated (1) color to both recede and highlight information, (2) repetition to make the information easy to digest, and (3) contrast to highlight certain information.

Articulation of Visual Literacy Skills by Student Reviewers

The authors analyzed the feedback that two students (1 and 2) gave on the assignments completed by two other students (C and D). Two members of the research team worked separately in applying the rubric to the ACJ feedback of those students, then compared notes to come to a consensus on whether an ACRL standard or the SHARCC framework was addressed in the comments. Table 2 illustrates the rubric used. Table 3 gives the feedback students 1 and 2 gave student C in their ACJ evaluations. Table 4 gives the feedback students 1 and 2 gave student D in their ACJ evaluations.

Student 1 and 2's evaluations showed only minimal language that articulated the visual literacy skills taught in the training sessions. This indicated a need to spend more time on the meanings of the standards and framework vocabulary. It also indicated that the students required more discussion and practice on how to give constructive feedback with specific word use. These student evaluators demonstrated the divide between aesthetic critiquing and appraising how information is effectively delivered through design. Student 1 typified many of the student responses in referring to a "good" use of images or space but failing to explain why a choice was "good" or "bad." Student 2's use of language was unique in that it specified what information was not conveyed and gave consistently specific feedback. The comments, however, could be hard to translate into visuals. If Student 2 had developed more skill in visual literacy articulation, then a more meaningful exchange of advice and learning could happen. The rubric highlighted the differences between information and design. If there had been more developed instruction in the use of visual literacy language, the student comments could have conveyed more sophisticated and impactful visual information.

Discussion

The purpose of this study was to respond to the following research question: How does co-created curriculum using academic library resources with an ACJ tool impact student visual literacy learning outcomes? The research and instruction team sought

an opportunity for students to further their visual literacy skills through an assessment process that supported the visual nature of the material they studied.

Between library instruction, collaboration with program-specific faculty, the adaptive comparative judgment sessions, students' practice, and the resource navigation to do so, students' visual literacy skills improved notably. As discussed in the "Results" section, students A and B both started with career vision boards that left room for improvement. By the time both students

Between library instruction, collaboration with program-specific faculty, the adaptive comparative judgment sessions, students' practice, and the resource navigation to do so, students' visual literacy skills improved notably.

Table 2.

	Visual career board					Visual résumé				Revisions			
		C	D			C	D			C	D		
Students' work being judged (C and D)													
Student judges (1 and 2) being assessed for visual literacy articulation		1	2	1	2	1	2	1	2	1	2	1	2
Association of College and Research Libraries Visual Literacy Competency Standards for Higher Education													
Determine the nature and extent of the visual materials needed.		✓		✓									✓
Find and access needed images and visual media effectively and efficiently.													
Interpret and analyze the meanings of images and visual media.													
Evaluate images and their sources.													
Use images and visual media effectively.		✓		✓									
Design and create meaningful images and visual media.													
Understand many of the ethical, legal, social, and economic issues surrounding the creation and use of images and visual media, and access and use visual materials ethically.													
SHARCC* framework													
Use of space						✓		✓				✓	
Use of hierarchy													✓
Use of alignment									✓				✓
Use of repetition													✓
Use of color											✓		✓
Use of contrast													✓

*SHARCC is an acronym that stands for space, hierarchy, alignment, repetition, color, and contrast, and is based on design tips for résumés developed by the library liaison.



Table 3.

	Student 1	Student 2
Session 1: Career vision board	Nice use of simplicity in relaying information.	Very creative but didn't follow the guidelines with the headings. You don't explain what industrial designers and engineers do, how to become one, job outlook, or similar occupations. You did flesh out your career goals and target salary, but this is not put into perspective of what the median salary is.
Session 2: Visual résumé	Good use of hierarchy and design to portray activities, possibly include a picture.	A little too much text. Don't understand the icons on the left side. Like the dots showing level of expertise. Use more pink to change up color.
Session 3: Revisions of career vision board and visual résumé	1. Good connection between experience and knowledge, and combining the two. 2. Good use of hierarchy, and organization of information, great use of color.	Be more specific about how your experience in college helps you manage people. Focus on how your coursework, particularly on how design courses help you find problems and implement improvements. It is unclear if you [do both] jobs concurrently, or are considering both paths. Nice use of icons, but the side icons on the left do not necessarily correlate with the information on the right. Use of more pink would be nice.

got to their visual résumés, their initial drafts applied both the ACRL standards and SHARCE framework throughout. Students A and B not only found resources to convey information visually but also followed copyright guidelines to do so. Library resources offer support in a way that is unique to that type of gathering and using of information.

Future papers from this work will offer a more detailed analysis of how ACJ impacted student learning. For the purposes of this project, integrating ACJ into library instruction proved beneficial because it brought a new tool to the table with which students actively engaged. Adaptive comparative judgment served as a powerful teaching tool and also an effective analysis instrument. Although this study was small and exploratory, there is potential with ACJ software, such as RM Compare, to collect much larger and more varied data than this project explored. ACJ also gave an opportunity for the librarian to see how program faculty view both IL and visual literacy. Further, it provided the instruction team with a better understanding of how students' articulation of visual



Table 4.

	Student 1	Student 2
Session 1: Career vision board	Not enough content. Not clear what you are applying for.	<i>Did not participate.</i>
Session 2: Visual résumé	Great use of background to visually show what the information tells, although the color of the text can be hard to read so might want to find a solution to that.	Text not readable at the end. Some pictures were cropped out.
Session 3: Revisions of career vision board and visual résumé	1. Great use of color and hierarchy, might want to work on spacing and alignment of the topics. 2. Good use of space and organization, might want to improve the timeline of some of the categories.	Not a clear connection between experience and future career. Be more explicit about teaching experience and ability to work with data. Talk more about your leadership.

literacy concepts fell short and could use increased support going forward. Being visual by nature, and focusing on process over grades, ACJ supported student learning while informing library instruction with the potential for greater understanding. When librarians have limited time in the classroom, an assessment instrument that doubles as a teaching tool adds to their impact. The authors' framework (SHARCC), instruction material, and repeated, iterative support through the assignments and an assessment tool can be applied across many different programs of study. The tools and instruction are transferrable, and the partnerships between librarians and program-specific faculty would benefit from continued growth.

When librarians have limited time in the classroom, an assessment instrument that doubles as a teaching tool adds to their impact.

Recommendations

The research team failed to consider that students might have more developed spatial skills than verbal ones, due to the emphasis on putting theory into practice and the experiential approach of their program. Alternatively or additionally, the visual environment in which all students live today may offer fewer opportunities for written exchanges



than in the past. The researchers noted that increased guided practice articulating visual literacy concepts could benefit students' learning and work. The visual literacy instruction focused primarily on developing skills for practice, not articulation. Examples should have been given with the ACRL standards to foster more dialogue; this increased discussion might have supported an increase in articulation of visual literacy skills. Going

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forward, the team recommends more instruction time for students to learn to articulate their visual literacy skills, so that when they perform their ACJ evaluations, they are prepared to give valuable feedback.

Visual information has continued to develop and become increasingly relevant in the classroom, workplace, and society. When the 2011 ACRL stan-

dards were presented to the class, little dialogue resulted. Students were prompted to use the ACRL standards in their critiques but rarely mentioned them. As ACRL reviews and updates the Visual Literacy Competency Standards for Higher Education, the instruction and research team recommends simplifying the standards, and potentially offering a dynamic tool that puts them into context based on work happening in the classroom. For example, Standard 2 asks that the visually literate person "Find and access needed images and visual media effectively and efficiently." This statement might have more meaning if presented visually in the cycle of information gathering and production a researcher goes through to produce work. Additionally, terms and concepts could be simplified to meet the class expectations. For example, a guideline such as "Effectively and ethically locate meaningful images" could be mapped to the visual information gathering that goes into creating a PowerPoint presentation. If a visual was interactive, allowing students to see different avenues for visuals to be applied in academic work, discussion could focus on how the researcher "effectively and ethically locates meaningful images" in context. With this example, language with which students evaluate their peers might be more accessible and improve their visual literacy articulation. It can be argued that putting the standards into context is part of the instructor's work, but typically, library instruction time is limited. A dynamic tool students could interact with on their own would support instruction.

Conclusion

Contributions

This paper makes several contributions. First, it provides an example of how library faculty can collaborate with program-specific instructional and research faculty to increase student learning outcomes related to visual literacy. Second, it provides an example of how experiential learning can be integrated with library instruction into any classroom. It shows the value of teaching real-world applications in context; students were motivated by the assignment outcomes benefiting their career paths. It shows the value of combining library instruction with ACJ software for both student and instructor learning. Finally, it demonstrates the importance of giving students opportunities to practice visual lit-



eracy articulation. These contributions provide justification for increased collaborations between library and instructional faculty to teach visual literacy.

Limitations

This study had a few limitations. It involved a group of 10 undergraduate students, and so the small single sample size limits the generalizability of the study. Second, the length of the study was limited to one semester and lacked a longitudinal perspective. Lastly, the study was qualitative and could unintentionally reflect the bias of the researchers. The size and length provided a case study to explore ideas and work closely with students and collaborating faculty. Rather than being a definitive study, the paper serves as a starting point for future work across disciplines.

Future Research

Future research would benefit from a mixed methods approach, integrating quantitative, explanatory analysis to explain the phenomena in more depth. A larger sample size over a longer time would be desirable.

Specific to engineering programs, students present a variety of visual materials, including posters of their work, presentations, data visualizations, and in some cases, virtual and augmented reality artifacts. Future research would benefit from this tool set being introduced early in the students' academic career and repeated throughout different courses where students are expected to both study and create visual materials.

Although this project took place in an engineering technology classroom, the instruction collaboration, materials, and assessment tool have application across academic programs. Within the liberal arts, as digital humanities grows, so does visual information. Equipping students with tools to create and articulate visual information that has impact is increasingly important. Research that compared the instruction and assessment presented in both a STEM and liberal arts class could measure impact across different disciplines.

Across disciplines, visual literacy skills combined with peer review ability will prepare students to enter the work force, where they will often collaborate with others. Having skills in both articulation and practice of visual literacy could give them a competitive advantage. Research comparing visual literacy articulation and practice of students with those of industry professionals may further inform visual literacy instruction.

Librarians are especially equipped to work across programs of study to teach students a core set of visual literacy skills. As visual information continues to grow, students are expected to critically take in and process the materials as well as create them. There is little evidence in the library literature of rigorous visual literacy instruction to support these expectations. This study explored a tool set for librarians to meet the student need for visual literacy in practice and articulation. The findings indicate

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that collaboration between subject experts and an assessment tool with which students engaged both effectively taught and informed practice for future library visual literacy instruction and research.

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Notes

1. Benjamin R. Harris, "Blurring Borders, Visualizing Connections Aligning Information and Visual Literacy Learning Outcomes," *Reference Services Review* 38, 4 (2010): 529, <https://doi.org/10.1108/00907321011090700>.
2. Maria D. Avgerinou and Rune Pettersson, "Toward a Cohesive Theory of Visual Literacy," *Journal of Visual Literacy* 30, 2 (2011): 4, <https://doi.org/10.1080/23796529.2011.11674687>.
3. Tracey Bowen, "Assessing Visual Literacy: A Case Study of Developing a Rubric for Identifying and Applying Criteria to Undergraduate Student Learning," *Teaching in Higher Education* 22, 6 (2017): 706, <https://doi.org/10.1080/13562517.2017.1289507>.
4. Ibid.
5. United States Department of Labor, Bureau of Labor Statistics (BLS), "Civil Engineering Technicians," *Occupational Outlook Handbook* (Washington, DC: BLS, 2018), <https://www.bls.gov/ooh/architecture-and-engineering/civil-engineering-technicians.htm>.
6. Joanna Kędra, "What Does It Mean to Be Visually Literate? Examination of Visual Literacy Definitions in a Context of Higher Education," *Journal of Visual Literacy* 37, 2 (2018): 73, <https://doi.org/10.1080/1051144X.2018.1492234>.
7. Jennifer M. Brill, Dohun Kim, and Robert Maribe Branch, "Visual Literacy Defined—The Results of a Delphi Study: Can IVLA [International Visual Literacy Association] (Operationally) Define Visual Literacy?" *Journal of Visual Literacy* 27, 1 (2007): 47, <https://doi.org/10.1080/23796529.2007.11674645>.
8. Avgerinou and Pettersson, "Toward a Cohesive Theory of Visual Literacy"; Maria Avgerinou and John Ericson, "A Review of the Concept of Visual Literacy," *British Journal of Educational Technology* 28, 4 (2002): 280–91, <https://doi.org/10.1111/1467-8535.00035>; Kędra, "What Does It Mean to Be Visually Literate?"
9. Avgerinou and Ericson, "A Review of the Concept of Visual Literacy."
10. Kędra, "What Does It Mean to Be Visually Literate?"
11. Denise Hattwig, Kaila Bussert, Ann Medaille, and Joanna Burgess, "Visual Literacy Standards in Higher Education: New Opportunities for Libraries and Student Learning," *portal: Libraries and the Academy* 13, 1 (2013): 61–89, <https://doi.org/10.1353/pla.2013.0008>; Kędra, "What Does It Mean to Be Visually Literate?"
12. Hattwig, Bussert, Medaille, and Burgess, "Visual Literacy Standards in Higher Education."
13. David Green, *Using Digital Images in Teaching and Learning: Perspectives from Liberal Arts Institutions* (Academic Commons, 2006), <https://academiccommons.org/using-digital-images-in-teaching-and-learning-perspectives-from-liberal-arts-institutions/>.
14. Youngok Choi, "Effects of Contextual Factors on Image Searching on the Web," *Journal of the American Society for Information Science and Technology* 61, 10 (2010): 2011–28, <https://doi.org/10.1002/asi.21386>.

15. Alison J. Head and Michael B. Eisenberg, "Truth Be Told: How College Students Evaluate and Use Information in the Digital Age," *SSRN Electronic Journal*, October 20, 2010, 16, <https://doi.org/10.2139/ssrn.2281485>.
16. Hattwig, Bussert, Medaille, and Burgess, "Visual Literacy Standards in Higher Education."
17. Association of College and Research Libraries (ACRL), "ACRL Visual Literacy Competency Standards for Higher Education," 2011, <http://www.ala.org/acrl/standards/visualliteracy>.
18. L. L. Thurstone, "A Law of Comparative Judgement," *Psychological Review* 34, 4 (1927): 266, <https://psycnet.apa.org/doiLanding?doi=10.1037%2Fh0070288>.
19. Ian Jones and Matthew Inglis, "The Problem of Assessing Problem Solving: Can Comparative Judgement Help?" *Educational Studies in Mathematics* 89, 3 (2015): 341, <https://doi.org/10.1007/s10649-015-9607-1>; Thurstone, "A Law of Comparative Judgement."
20. Alastair Pollitt, "The Method of Adaptive Comparative Judgement," *Assessment in Education: Principles, Policy & Practice* 19, 3 (2012): 297, <https://doi.org/10.1080/0969594X.2012.665354>.
21. Pollitt, "The Method of Adaptive Comparative Judgement"; Alastair Pollitt and Neil Murray, "What Raters Really Pay Attention To," Research Centre for English and Applied Linguistics, University of Cambridge, 1993, <https://www.researchgate.net/publication/313202066>.
22. Pollitt, "The Method of Adaptive Comparative Judgement."
23. "Harvard I-Lab [innovation lab] | Data Visualization for Non-Programmers," YouTube, 2015, <https://www.youtube.com/watch?v=-xS7QJhVbcM>.
24. Richard Kimbell, Tony Wheeler, Kay Stables, Tristram Shepard, Alistair Pollitt, Dan Davies, and Gillian Whitehouse, *E-Scape Portfolio Assessment Phase 3 Report* (London: Goldsmiths University of London, Technology Education Research Unit, 2009), https://www.teachertoolkit.co.uk/wp-content/uploads/2014/08/e-scape_phase3_report.pdf; Pollitt, "The Method of Adaptive Comparative Judgement."
25. Kimbell, Wheeler, Stables, Shepard, Pollitt, Davies, and Whitehouse, *E-Scape Portfolio Assessment Phase 3 Report*, 91; Pollitt, "The Method of Adaptive Comparative Judgement," 288.
26. Pina Tarricone and C. Paul Newhouse, "An Investigation of the Reliability of Using Comparative Judgment to Score Creative Products," *Educational Assessment* 22, 4 (2017): 220–30, <https://doi.org/10.1080/10627197.2017.1381553>.
27. Scott R. Bartholomew, Liwei Zhang, Esteban Garcia Bravo, and Greg J. Strimel, "A Tool for Formative Assessment and Learning in a Graphics Design Course: Adaptive Comparative Judgement," *Design Journal* 22, 1 (2019): 73–95, <https://doi.org/10.1080/14606925.2018.1560876>.
28. Jones and Inglis, "The Problem of Assessing Problem Solving," 9.
29. Scott R. Bartholomew, Louis S. Nadelson, Wade H. Goodridge, and Edward M. Reeve, "Adaptive Comparative Judgment as a Tool for Assessing Open-Ended Design Problems and Model Eliciting Activities," *Educational Assessment* 23, 2 (2018): 85–101, <https://doi.org/10.1080/10627197.2018.1444986>; Bartholomew, Zhang, Garcia Bravo, and Strimel, "A Tool for Formative Assessment and Learning in a Graphics Design Course"; Jones and Inglis, "The Problem of Assessing Problem Solving"; Pollitt, "The Method of Adaptive Comparative Judgement"; Tarricone and Newhouse, "An Investigation of the Reliability of Using Comparative Judgment to Score Creative Products"; McMahon and Jones, "A Comparative Judgement Approach to Teacher Assessment." engagement, and experience with the design process in an open-ended problem assigned in a technology and engineering education course. Our results indicate that the adaptive comparative judgment tool effectively facilitated the grading of the students' products and improved the judges' understanding of the processes the students used to arrive at their solutions. We found the reliability and validity of the tool to be acceptable and the outcomes of our study suggest that there is justification for the use of the adaptive comparative judgment method to assess student learning outcomes at multiple levels of Science, Technology, Engineering, and Math (STEM



30. Batholomew, Zhang, Garcia Bravo, and Strimel, "A Tool for Formative Assessment and Learning in a Graphics Design Course."
31. ACRL, "ACRL Visual Literacy Competency Standards for Higher Education."
32. United States Department of Labor, Bureau of Labor Statistics (BLS), "Civil Engineering Technicians," *Occupational Outlook Handbook*.

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