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Assessing Synthesis of Information from Sources

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Abstract

Synthesis of information from sources is an important component of information literacy, and one that is perhaps less straightforward to teach and to assess than other information literacy skills. At the author's institution, synthesis was identified as an area in which students were not demonstrating proficiency at the desired level. This led to an iterative, multi-year process of working with faculty from across disciplines to develop, employ, and revise a rubric that measures synthesis and its component parts. The author found that using a multidimensional rubric such as the one developed is a viable method for assessing students' ability to synthesize information from sources in a way that can lead to improvements in teaching and learning. Additional instructional materials were developed to support the synthesis of information from sources.

Introduction

When we teach information literacy, much of our attention is focused on students' ability to find information, evaluate it, and cite it. How students incorporate that information into their papers is equally important, as this step allows students to achieve their communicative purpose. Synthesis is only one way of effectively using information, but it is an important one in that it represents a high-level cognitive process in which the writer is not just restating information, but rather seeing how different pieces of information connect to each other and making inferences based on those connections. This allows the writer to create new understandings, and it can be viewed as one way in which students can move from being information consumers to being information producers. ACRL's Framework lists "synthesize ideas gathered from multiple sources" as a knowledge practice under the "Research as Inquiry" frame (ACRL, 2015, p. 18).

Many instructors expect students to synthesize information from sources, showing the reader the connections between various sources and how that information relates to the student's thesis or purpose. However, instructors do not always clearly communicate that expectation to students, or they may not feel confident teaching students how to synthesize. Anecdotally, I have heard from many faculty members that they never received explicit instruction on how to synthesize, resulting in uncertainty about how to teach it. This is an area in which librarians can be of assistance—we can help teach students how to synthesize information from sources. Because teaching and assessment go hand in hand, if we are teaching synthesis, we need to be able to assess it as well.

This paper will describe the efforts at my institution, California State University, Monterey Bay (CSUMB), to assess synthesis, to develop tools to more accurately assess synthesis, and to close the loop by making improvements to the teaching and learning of synthesis. This has been a multi-year process that included the efforts of 12 faculty members from seven departments. I will describe that process and share the tools that we created for assessing synthesis in student work, as well as instructional materials for closing the loop by making improvements to teaching and learning in this area.

At CSUMB, assessment takes place at a program level, within the library and within degree-granting programs, but also at a campus level, where we have groups of faculty, sometimes including librarians, collaboratively assess our undergraduate learning outcomes, which include information literacy. Our 2017 campus-wide assessment was when we initially identified synthesis as an area for improvement. I was helping to lead a team of faculty from across campus in assessing students' capstone papers from different programs using a rubric that was heavily based on AAC&U's Information Literacy VALUE Rubric (AACU, 2013). One of the rubric dimensions is "use information effectively to accomplish a specific purpose." The difference between milestones two and three in this dimension is that milestone three includes synthesis of information and milestone two does not. Our assessment results showed that most of our students, in their capstone papers that they submit before graduating, were not making it to milestone three because they were not synthesizing.

As a result, a librarian colleague and I worked with one program, the Social and Behavioral Sciences major, over the course of the following year and did a single instruction session in their capstone classes on how to synthesize. Applying the same rubric to capstone papers from those classes showed us that our instruction made a difference: we were able to move the bar—albeit only slightly—toward greater competence in this area (Dahlen & Leuzinger, 2020). While this was a promising result, the process helped us recognize that we were trying to measure a complex competency—synthesis—with a very general tool. The VALUE rubric measures synthesis in terms of presence or absence, and we wanted to look at it more granularly, hoping that separating out the component parts would allow us to see where students were having the greatest difficulties and allow us to teach synthesis more effectively.

Literature Review

Synthesis is a difficult skill for students to master. Many studies have documented students' struggles to synthesize information from sources, either through direct assessment of student work (Dahlen & Leuzinger, 2020; Eastman et al., 2018; Lundstrom et al., 2015; Rosenblatt, 2010) or through faculty observations (Bury, 2016). Synthesis is also a skill that is highly valued, both by faculty (Bury, 2016) and by employers of recent college graduates (Head et al., 2013), making it worthy of our instructional attention.

Assessment of students' ability to synthesize information from sources has not received as much attention in the library science literature as other aspects of information literacy, leaving librarians and others with a desire to assess this area with little guidance. The AAC&U's Information Literacy VALUE Rubric has been used by some to measure synthesis (Dahlen & Leuzinger, 2020; Eastman et al., 2018), though, as noted above, only one of its dimensions addresses synthesis and only cursorily. Others have created synthesis rubrics (Rosenblatt, 2010) or adapted them from other sources (Darowski et al., 2016), but again, these rubrics have only one dimension addressing synthesis. A notable exception is the work of Lundstrom et al. (2015), who created a synthesis rubric with five dimensions that addresses in greater detail the various skills that make up or contribute to synthesis. This same rubric was also used for further assessment of synthesis at the same institution (Eastman et al., 2018). Eastman et al. (2018) note that this multidimensional rubric provided them a more nuanced understanding of where students struggle with synthesis; in contrast, Darowski et al. (2016) describe their one-dimensional rubric as compressing multiple skills together in a way that did not allow them to detect specific areas for improvement.

Assessments of student synthesis can give us a baseline measurement for how proficient students are in this area and allow us to see the impact of our instruction. Rubrics have been successfully used to this end; gains in rubric scores have followed various instructional interventions on synthesis (Dahlen & Leuzinger, 2020; Darowski et al., 2016; Eastman et al., 2018; Lundstrom et al. 2015). Indirect measures have also been used, either separately or in conjunction with rubric scores, to document student improvement in synthesis following instruction (Darowski et al., 2016; Lacy & Hamlett, 2021). While indirect measures can be a useful complement, applying rubrics to authentic student work is the primary method used to assess synthesis.

While librarians can play an important role in teaching synthesis, we cannot do it alone. Even those who have documented post-instruction improvements note that synthesis is not a skill that can be developed through a single class session or tutorial, but rather requires greater instructional investment (Dahlen & Leuzinger, 2020; Darowski et al., 2016; Lundstrom et al. 2015). Many faculty are interested in incorporating more information literacy into their instruction, but do not always feel confident in doing so (Bury, 2016). One successful model is described by Lacy and Hamlett (2021), who worked with faculty to incorporate more information literacy skills into their syllabi, and provided a two-hour training on teaching these skills. Another means of deepening faculty engagement with information literacy is involving them in rubric-based assessment (Dahlen & Leuzinger, 2020). If sustained practice is required for students to synthesize proficiently, faculty buy-in is critical in making this happen.

Methods

To meet our campus' need to assess the synthesis of information from sources in a granular way, we developed a rubric through an iterative process of creating, testing, and revising. Our initial group consisted of nine faculty members from three departments, and we created a synthesis rubric in spring 2020 by adapting Lundstrom et al.'s (2015) rubric. Their rubric was designed to assess student work from a second-year English composition class, and we needed a rubric broad enough to evaluate assignments from different courses, class levels, and disciplines. While we initially retained the five dimensions of that rubric, we made extensive modifications to the descriptions of each level to reflect these goals.

We used the first draft of our synthesis rubric in summer 2020 to assess student papers from 300-level classes in a single program, the Social and Behavioral Sciences major, which was using this assessment for its own program review process. Student papers were collected from five sections of three 300-level courses taught in fall 2019 or Spring 2020. Ten papers from each section were scored, with the exception of one section of SBS 300 that had two relevant assignments; ten papers from each assignment in this section were included. A total of 60 papers were scored using the synthesis rubric. Eight faculty members, who had normed to the rubric, participated in the scoring, with each student artifact read by two scorers. Scores that were split by two or more points, or those split between a two and a three (the threshold for proficiency), were resolved through discussion. Faculty met to debrief and reflect multiple times throughout the assessment days. Based on the experience of applying the rubric, in fall 2020 our faculty group revised the rubric, adding an additional dimension and modifying level descriptions to reduce ambiguity.

The second version of the rubric was used in summer 2021 to assess student papers from 300-level Graduation Writing Assessment Requirement (GWAR) classes in eight different majors, including humanities, social sciences, and natural sciences. Our team this time included six faculty members from four departments, with some continuing from the previous year and others joining the group. After norming to the rubric, faculty scored eight papers from each class, for a total sample of 64 student artifacts. Each student artifact was read by two faculty. Scores that were split by two or more points, or those split between a two and a three (the threshold for proficiency), were resolved through discussion. Faculty debriefed and engaged in questionnaires to prompt reflection multiple times throughout the assessment days. Based on the experience of applying the rubric to this broader collection of student papers, the rubric was revised further to be more inclusive of different types of assignments.

When using the rubric, we assigned a score of 0 when the work did not yet meet the "beginner" level. We did not permit half scores, but rather chose the level that

corresponded with the preponderance of evidence. A score of n/a was assigned when the paper did not provide enough evidence to assign a score.

Results

The Rubric

Our final rubric, and the one that has been adopted by our campus, has six dimensions whose order represents the way that we (the rubric’s creators) see these component skills building upon each other (Figure 1). The first three dimensions are precursors to synthesis, things that need to be in place if we expect synthesis to occur. The first dimension, “source variety,” recognizes that synthesis is not possible without a variety of sources that is appropriate to the assignment. The rubric does not prescribe numbers or types of sources as this will vary by assignment. We discovered through our process that if a student’s topic is too broad, and as a result their sources are not closely related to each other, it becomes very difficult to find the connections between them. This led to the second dimension, “scope of conversation represented by sources.” The third dimension, “translating information from sources,” evaluates how students represent information from sources in their papers. If there is an overreliance on direct quotes, for example, which is a common issue, synthesis becomes more challenging, as it is difficult to put sources in conversation with each other when merely copying and pasting direct quotes.

Figure 1. CSUMB synthesis rubric.

	4 – Advanced	3 – Proficient	2 – Developing	1 – Beginner
	Expectations for some students at or near graduation.	Expectations for all students at or near graduation.	Expectations for students advancing towards proficiency.	Expectations for students initiating development towards proficiency.
<i>Source variety</i>	Uses multiple relevant sources which address an appropriate variety of perspectives, approaches, and/or methods.	Uses a variety of sources that cover some of the differing perspectives, approaches and/or methods.	Uses sources representing an inappropriately limited variety of perspectives, approaches, and/or methods.	Uses sources that are redundant or singular in their perspectives, approaches, and/or methods; contrasting perspectives may

	4 – Advanced	3 – Proficient	2 – Developing	1 – Beginner
	and/or methods.	related to the topic.		have been excluded.
<i>Scope of conversation represented by sources</i>	Sources comprehensively represent the appropriately focused conversation around the issue, thesis, goal, or argument.	Sources represent the conversation around the issue, goal, or argument, but do so too generally or too narrowly.	Sources represent an incomplete conversation relevant to the issue, goal, or argument.	Sources are not sufficiently relevant to represent the conversation on the issue, goal, or argument; topic may be defined too broadly.
<i>Translates information from sources</i>	Information from sources is accurately represented. Follows disciplinary conventions for direct quotes, paraphrasing, and summarizing.	Information from sources is mostly accurately represented. Uses information from sources primarily through paraphrasing; summarizes main ideas. Uses appropriate quotations if relevant to the discipline.	Uses information from sources with some summary; information from sources may be incompletely represented. There may be an overreliance on direct quotes not appropriate to the discipline or an overreliance on summary and paraphrase not appropriate to the discipline.	Information from sources provided primarily inappropriately or inaccurately. Information may be provided haphazardly and/or serve no clear purpose.

	4 – Advanced	3 – Proficient	2 – Developing	1 – Beginner
<i>Organizes information from sources effectively</i>	Sources are ordered with an explicit logic that reveals insightful patterns, differences, or similarities related to the author’s purpose or focus.	Sources are ordered logically in a way that reveals patterns, differences, or similarities mostly related to the author’s purpose or focus.	Sources are ordered with limited success in revealing important patterns, differences, or similarities. There may not be a consistent relationship illustrated between sources and the author’s purpose or focus.	Ordering of sources does not reveal patterns, differences, or similarities or does not relate to the author’s purpose or focus.
<i>Identifies conversations from different sources</i>	Similarities, differences, relationships, and patterns are almost always identified so the reader can see how the sources are related and how they support the author’s purpose or focus.	Similarities, differences, relationships, and patterns are sometimes, but not consistently, identified so the reader can see how some of the sources are related.	Similarities, differences, relationships and patterns among sources are identified mostly by their proximity in the text, requiring the reader to make assumptions about how the sources are related.	The reader has difficulty seeing how the sources are related to each other.

	4 – Advanced	3 – Proficient	2 – Developing	1 – Beginner
<i>Brings together sources to make inferences</i>	Explicitly connects information from various sources to make inferences appropriate to the assignment, such as identifying a gap in the cited literature, suggesting areas for future research, proposing a solution to a problem, or reaching a conclusion.	Connects information from various sources to make inferences appropriate to the assignment, such as characterizing the conversation in the cited literature, suggesting areas for future research, proposing a solution to a problem, or reaching a conclusion.	Generally describes the collection of sources.	Represents the sources as isolated bits of information or misrepresents the relationships among sources.

The final three dimensions of the rubric start to address what we think of as the core of synthesis. “Organizing information from sources effectively” is one way of revealing the connections between them. “Identifying conversations from different sources” evaluates whether students are explicitly showing the reader the relationships between the sources and their relationship to the author’s own ideas. Finally, the last dimension assesses whether students have used the information to make inferences. Depending on the assignment, an inference might be reaching a conclusion, proposing a solution to a problem, identifying a gap in the literature, or suggesting directions for future research. Moving from the top of the rubric to the bottom, the dimensions become increasingly challenging.

We did not measure inter-rater reliability, as we were fairly confident that our process of having the two scorers for each paper frequently discuss and reach a consensus about any split scores would have the effect of keeping our scoring practices aligned. This is a limitation, though arguably inter-rater reliability reflects the effectiveness of a norming process as much as the design of a rubric. To shed some light on the validity of

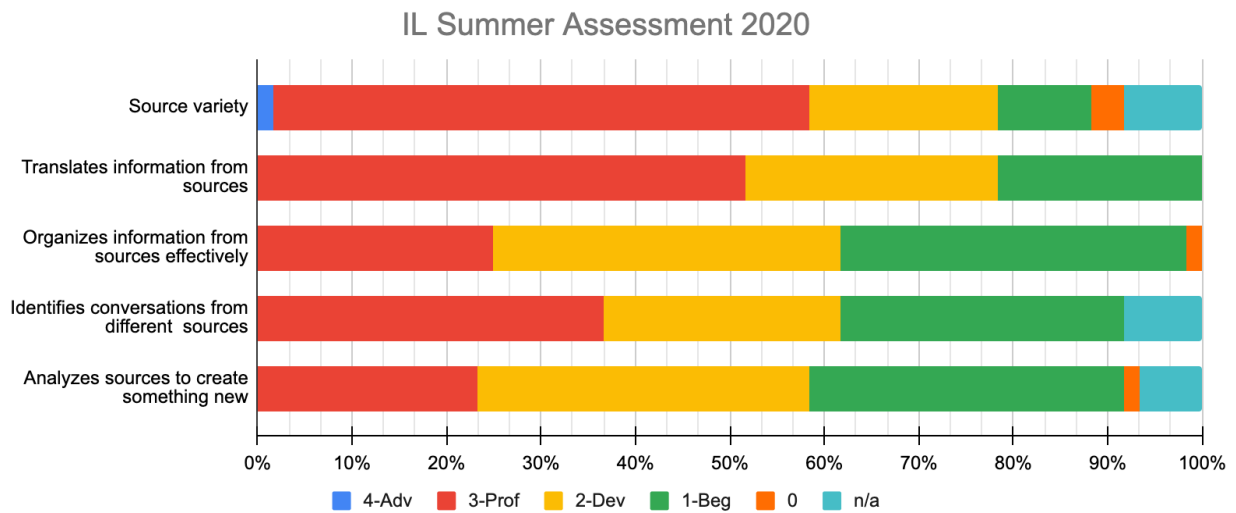
the rubric, we explored whether the scores from each of the rubric dimensions were correlated with another measure of synthesis. This other measure came from our 2022 assessment in which a group of six faculty from six departments coded information cited in student papers to different categories. One of the categories was whether the student had synthesized by connecting the cited information to information from another source. 204 citations from 14 papers were coded. These 14 papers came from the same sample we used for our 2021 rubric assessment, so we were able to calculate the correlation coefficients between the rubric dimensions and the percentages of citations where synthesis was present in each paper. The percentage of citations with synthesis had a strong and statistically significant ($\alpha=0.05$) relationship with two of the rubric dimensions: “translates information from sources” ($r=0.54$) and “draws inferences about scholarly conversation” ($r=0.57$). We interpret this as a possible indication of the rubric’s validity, though an imperfect one. We would have expected to also see a correlation with the “identifies conversations from different sources” dimension.

Assessment results

While the results of our assessments with this rubric are not the primary focus of this paper, they are provided here to help illustrate the value of a multidimensional rubric in informing instruction.

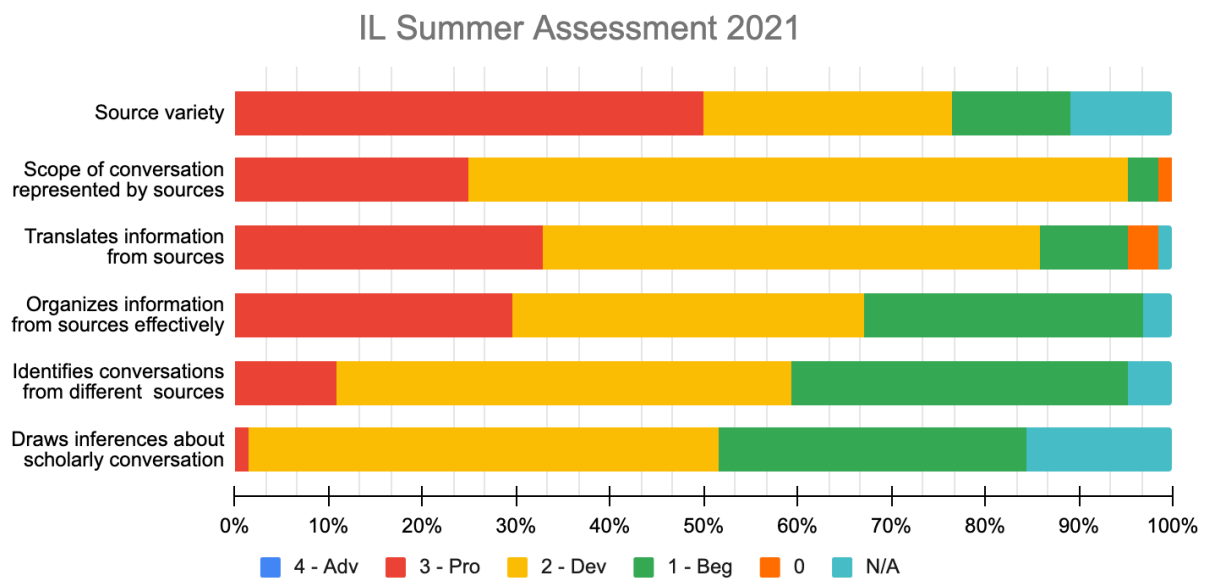
For our 2020 assessment, we used an initial version of the rubric that only had five dimensions to assess a sample of student papers from 300-level courses in the Social and Behavioral Sciences major. Our campus had previously decided that level three (out of four) is considered proficient for students at or near graduation. The proportion of students who achieved a score of three or higher ranges from 58% (source variety) to 23% (analyzes sources to create something new) (Figure 2). A general, though inexact, trend is visible: as the rubric dimensions become progressively more challenging, the number of students achieving proficiency decreases.

Figure 2. 2020 assessment results from 300-level SBS classes.



For our 2021 assessment, we applied the rubric to 300-level writing courses across disciplines and saw a similar pattern (Figure 3). Proficiency levels were generally lower than the previous assessment, though it is not an entirely fair comparison as the rubric was revised in the interim, including the addition of the “scope of conversation represented by sources” dimension. The percentage of students achieving proficiency ranged from 50% (source variety) to 1.6% (draws inferences about scholarly conversation).

Figure 3. 2021 Assessment results from GVAR classes across disciplines.



Discussion

Having a detailed rubric has proved useful for several reasons. First, it has helped us identify with more precision where students are experiencing difficulties, similar to what has been described by Eastman et al. (2018) and Lundstrom et al. (2015). Second, the multidimensional rubric will allow us to more accurately measure the impact of any instructional modifications we might make in the future. Finally, even when not being used for assessment, the rubric provides a road map for teaching synthesis, which we can use to help us break down this complex skill into its component parts.

The process of rubric creation, application, and revision has prompted some changes on our campus. Before our initial assessment in 2017, when we first identified synthesis as a low-scoring area for students, librarians at CSUMB were not teaching it as part of our library instruction. That has changed, though not uniformly; each librarian works with different departments, and our ability to incorporate synthesis into our instruction varies depending on the amount of class time and the openness of instructors. Importantly, though, the impact of librarians teaching students about synthesis is minimal if their instructors are not asking them to synthesize in their assignments. A single librarian-led instruction session is not sufficient to teach students this high-level skill (Darowski et al., 2016; Lundstrom et al., 2015). For this reason, I have engaged in outreach to instructors, which has included informing them about the existence of the [rubric](#), and also about an [assignment guide](#) that we created to help instructors more explicitly ask for synthesis in their assignment prompts. Additionally, I created a [zine](#) on teaching synthesis for faculty and a [video](#) for students on how to use a synthesis table for a literature review.

At CSUMB, I have the advantage of having worked with faculty from across disciplines on these campus-wide assessment projects, and many of them now make concerted efforts to teach their students synthesis, or at least give them opportunities to practice it in their assignments. I have also been able to reach faculty by offering to help them with the assessments they do for their program reviews. Most universities conduct program reviews, assessment processes that their degree-granting programs go through to evaluate their effectiveness at educating their students. On my campus, program review is most closely focused on assessing the learning outcomes of the major, but programs are also expected to address the undergraduate learning outcomes, which are the ones that all students, regardless of major, are expected to achieve. Some programs have been open to assessing information literacy (or synthesis specifically) when I have offered to make that task easier for them by facilitating the assessment process.

Conclusion

Synthesis as an important component of information literacy and one that can be assessed by applying a rubric to student papers. We found that using a rubric such as

the one we developed is a viable method for assessing students' ability to synthesize information from sources in a way that can lead to improvements in teaching and learning. The rubric we developed is available to be used or adapted to meet the needs of other institutions, and our assessment methods may be a useful model for those considering similar endeavors.

Our assessment results indicated that there is much room for improvement in the teaching and learning of synthesis at our institution. Additionally, we found that many assignments that require students to use information from multiple sources do not explicitly call for synthesis, making this an opportunity for outreach to instructors.

Rubrics are not merely assessment tools, but also roadmaps for instructors and students seeking to better understand synthesis and its component parts. Our rubric, assignment guide, and instructional video can all be employed as teaching tools to assist librarians and other faculty in their efforts to improve students' ability to synthesize information from sources. Librarians have an important role to play in increasing student competence in this area.

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