Mapping Educational Standards to the Big6

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Abstract. Information literacy is arguably the *essential* 21st century skill set for all students, and as such, it is important that students have a solid grounding in information problem-solving, the application of information literacy skills. A wide variety of authorities have called for these skills to be incorporated into educational standards both in the United States and in Europe. This paper compares the American Association of School Librarians (AASL) information literacy standards to the Big6 model of information problem-solving to determine the extent that these standards engage with *all* aspects of the information problem-solving process—especially the stage of Evaluation. Findings indicate that Evaluation and Task Definition seem to be under-emphasized in the AASL standards and missing entirely from the CCSS and should be addressed in research, policy, and practice.

Keywords: Educational standards, information literacy, information problem-solving, American Association of School Librarians, Big6, learning.

1 Introduction

The importance of information literacy is well agreed upon [1-2]. It is a cliché to point out that the amount of information available to individuals has exploded. But that does not make it any less true. However, this explosion has not necessarily made the ability to find any particular piece of information easier. Much of the freely obtained information on the World Wide Web is of limited value, especially to school-aged students engaged in research. Information literacy is seen as one answer for dealing with both the quantity and the quality of that information. Thus information literacy and related skills must be explicit in education policy documents.

A variety of educational policy documents exist that include standards intended to directly or indirectly address information literacy. Our investigation focused on the standards from the American Association of School Librarians (AASL) because it is the most extensive set of information literacy standards developed for Kindergarten to Grade 12 (K-12), and the Common Core State Standards (CCSS) [3], a national effort in the United States to identify key educational standards in core subjects.

These standards were categorized and analyzed in order to determine the extent that the standards cover the full range of information problem-solving skills. For categorization, we used the Eisenberg-Berkowitz Big6 model [4], the most widely-used K-12 information problem-solving model and approach. This paper reports on

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findings related to the AASL standards and the six Big6 stages, and also make comparisons between the AASL standards and standards from the CCSS, the Association of College and Research Libraries (ACRL) [5-6], and the Society of College, National, and University Libraries (SCONUL) Seven Pillars of Information Literacy [2] for insights on connections and possible further in-depth comparisons.

The AASL standards are the most detailed and extensive information literacy standards for K-12 students. The most recent version is "Standards for the 21st-Century Learner In Action" [1]. Although these standards are intended for school librarians, the AASL clearly assumes that the entire teaching staff will collaborate to help students learn these information skills.

This study sought to determine how the full scope information literacy skills are explicitly represented in the AASL standards and the CCSS. The first goal was to map the stages of the information problem-solving process, using the Big6 model, to the AASL standards; the second goal was to analyze the standards in terms of particular stages of information problem-solving. We previously reported on the CCSS and the Big6 stage of Task Definition [7]. This paper focuses on the AASL standards and the Big6 stage of Evaluation.

1.1 Describing Information Literacy Behavior and Problem-Solving

The American Library Association Presidential Committee on Information Literacy defined information Literacy from an individual perspective: "To be information literate, a person must be able to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information"[8]. Decades of research on information literacy have contributed to better understandings of how people successfully access, evaluate, use, and share information to answer questions, complete tasks, and solve problems [9]. This study opted to use a skills based definition of information literacy because it is primarily concerned with elementary and secondary education and helping students gain essential information literacy skills. Therefore, for this study, information literacy is defined as the skills and stages of the information problem-solving process; that is, those who are successful at each stage of the information problem-solving process are information literate.

Cognitive Psychology defines problem-solving as having four basic elements: a goal, obstacles preventing one from achieving the goal, strategies for overcoming the obstacles, and an evaluation of the process [10]. This definition of problem-solving can be mapped to the information problem-solving model. Equating the goal to the recognition that information is needed, the obstacles are the need to locate, evaluate, and use information, the strategies are the acts of locating, evaluating and using information, and the final phase, evaluation, remains the same as in the Cognitive Psychology model, describing the evaluation of the process and the product.

While there are a variety of models of the information problem-solving process, this paper uses the most widely used model in K-12 education, Eisenberg & Berkowitz' Big6 information literacy process [4]. The Big6 approach [4], outlines and describes the process of successfully solving an information problem. The Big6 identifies the first stage as (1) task definition, in which the problem-solver defines the

task or problem to be solved, and then identifies the information needed to solve the problem. From there, the problem solver engages in (2) information seeking strategies; (3) location and access of information; (4) use of information; (5) synthesis; and (6) evaluation of the process and product. The process is not linear or prescriptive, and stages may be repeated throughout the process.

The Big6 was developed from practice and has been employed as a conceptual framework in several studies of information problem-solving [11]. Brand-Gruwel et al. [12] studied expert and novice higher education students in an effort to decompose the Big6 information literacy approach into cognitive components, and to determine the key components in the information problem-solving process. They conclude that the Big6 information literacy approach was an accurate description of stages in information problem-solving, and useful in the decomposition of cognitive components into related categories. Murray [13] has previously done extensive work aligning various standards and curricula to the Big6 model.

1.2 Evaluation: The Ultimate Stage in Information Problem-Solving

Prior research on information literacy investigates a range of factors, situations, settings, and stages of the information problem-solving process. However, scant attention is paid to the end stage of the entire process – Evaluation. This is a key stage in which students decide whether or not the problem has been successfully solved and how successful they were in information problem-solving as a whole as well as in accomplishing each individual stage of the process. This differs from the concept of evaluation of information. "Evaluating information" is part of *every* stage of the information problem-solving process: determining the nature and scope of information as part of task definition, assessing various sources in information seeking strategies and also in location and access, considering accuracy, credibility, usefulness, and relevance in use of information, choosing and presenting information in synthesis, and evaluating information as part of assessing both product and process.

The nature of the problem can also affect success in information problem-solving. Mayer and Wittrock [14] have identified two categories of problems. Problems can be well-defined or ill-defined. Well-defined problems have the parameters clearly stated. Ill-defined problems lack a clear goal statement and the allowable operators are not clearly defined. They note that well-defined problems are what schools tend to give children, while ill-defined problems more closely resemble the real world. This suggests a reason why evaluation appears poorly represented in the standards statements. If schools are giving students well-defined problems with known answers, the evaluation of the product is left to the teacher, as the keeper of the known answer.

1.3 Research Questions

The AASL standards offer educational policy guidelines for information and library instruction in schools in the United States. The CCSS also represents education policy guidelines as it sets learning expectations for students in elementary and secondary schools, i.e., grades Kindergarten-12. The goal of the research described in this paper

was to gather and analyze evidence on information literacy standards as reflected in these policy statements. This study first sought to identify explicit references in the AASL standards to the skills or stages of the information problem-solving process, as described by the Big6 information literacy process. We then sought to identify explicit standard statements related to the stage of Evaluation.

The following research questions guided the study:

1. Which stages of the information problem-solving process, as described by the Big6 Skills, are reflected in the AASL standard statements?
2. How are skills specific to the culminating stage of Evaluation in the information problem-solving process reflected in the AASL standard statements?
3. How do these results compare to other sets of standards specifically, the CCSS?

2 Methodology

2.1 Research Design

The AASL standard statements at grades 2, 5, and 8 were matched to their Big6 equivalent by a team of information literacy experts. Using a team of experts allowed for greater assurance that a particular standard statement was appropriately placed at a Big6 stage than if just one or two individuals had sorted the standards. Five experts in information literacy were coders. Four of the five are experienced school librarians, while the fifth is classroom teacher with National Board certification. Four team members are also doctoral students at the University of Washington the fifth is a state Director of Library and Media for the Superintendent of Learning.

The AASL standard statements are made up of standards, strands and benchmarks. The benchmarks are at grades 2, 5, 8, 10, and 12. Coders reviewed all the AASL benchmarks (313) for Grades 2, 5, and 8, and categorize them according to stages of the Big6 information literacy process. The four AASL Standards are (1) inquire, think critically, and gain knowledge; (2) draw conclusions, make informed decisions, apply knowledge to new situations, and create new knowledge; (3) share knowledge and participate ethically and productively as members of our democratic society; and (4) pursue personal and aesthetic growth [1].

This study uses the term “standard statement” to describe a discrete statement of what a student should be able to do or know. This is equivalent to the AASL term “benchmark” and the CCSS use of the phrase “grade-specific standard.”

2.2 Data Collection

The five coders independently reviewed 313 AASL standard statements grouped into 4 surveys. Coders sorted each of the standard statements into a stage or sub-stage of the Big6 information literacy process; coders were given the choice to identify the standard statement as “not related” to the Big6. Moreover, coders were able to evaluate standard statements as “Unable to tell” for statements that were ambiguous or poorly worded and not clearly aligned with any stage or sub-stage.

After each coder completed all surveys the researcher compiled the data using a 60% level of consensus to determine where each standard statement fit into a Big6 stage. The 60% level of consensus was chosen in order to maximize the number of standard statements included in the research project. The researcher made a decision to err on the side of including more standard statements rather than to use a higher consensus percentage resulting in fewer standard statements.

At the 60% level of consensus, 85% of the 313 AASL standard statements (266) were categorized into either a Big6 stage or into the Not Able to Tell/Not Big6 category. Coders agreed on a Big6 stage designation for 202 standard statements (65% of all 313). (see Table 1).

3 Results

The final tally of AASL standard statements categorized into Big6 stages is shown in Table 1. The number of standards in each Big6 category is shown using frequencies and percentages with the goal of detecting patterns. A Chi Squared test could indicate if there were a significant difference between the reported frequencies and an evenly distributed model of the Big6 stages. However, currently there is no reason to expect an even distribution, or any pattern, in the stages of an information problem-solving model in a set of standard statements. The intent here is to determine what is present in the AASL in terms of the information literacy skill or stage as represented by the Big6 information literacy process model. This information may then be used to spark a conversation about what is an appropriate or even ideal distribution of the stages of an information problem-solving model in a set of standards.

Table 1. Content analysis results

Big6 Stage	AASL Standard 1	AASL Standard 2	AASL Standard 3	AASL Standard 4	Totals
1	12	2	0	0	14
2	6	0	1	13	20
3	15	1	0	5	21
4	14	8	8	14	44
5	11	32	27	17	87
6	0	8	8	0	16
Big6 Total	58	51	44	49	202
Percent	19%	16%	14%	16%	65%
Not Big6	9	3	24	29	65
No Consensus	7	8	8	23	46
Totals	74	62	76	101	313

Table 1 shows that all six stages of the Big6 were reflected in the standard statements in the four AASL standards. The total of AASL standards matched to Big6 stages was 202. The range is approximately evenly spread across the four standards ranging from 14% to 19% of the total standard statements.

Table 2 displays results of the coding by Big6 stage. The AASL standards statements have an emphasis on stage 5, (Synthesis), and stage 4, (Use of Information). Of the 202 of 313 standard statements that were placed into a Big6 stage, 87 (43%) were at Big6 Stage 5, another 44 (22%) were at Stage 4. These two stages make up 65% of the all the standard statements. The remaining four stages of the Big6, Stage 1 (Task Definition), Stage 2 (Information Seeking Strategies), Stage 3 (Location and Access), and Stage 6 (Evaluation) were each detected in 10% or fewer of the standard statements. These four stages of the Big6 made up just over one third (35%) of the AASL standard statements. Task definition, the most important phase of problem solving [6], [15] and Evaluation, the final stage of problem-solving, are the two least represented. Each was detected in less than 10% of the standard statements.

Table 2. Summary of Big6 frequencies in AASL Standards

Big 6 Stage	Freq	Percent
1	14	7%
2	20	10%
3	21	10%
4	44	22%
5	87	43%
6	16	8%
Total	202	100%

4 Discussion

The standards statements of the AASL provide clear evidence of incorporating all the stages of the information problems solving method as represented by the Big6. Big6 Stage 5 (Synthesis) was the most frequently identified Big6 stage, showing up 87 times. Synthesis is where students organize and present the information they have found, in the process creating their own unique answer to the information problem. Use of Information, Big6 Stage 4, was the second most frequently identified Big6 stage with 22% of the total standard statements. In this stage, students engage with information through reading, hearing, viewing, and or touching. These steps are done as part of extracting relevant information for solving their information problem. Students consider questions concerning the information they expect to find in the source and which information in the source is useful. Synthesis and Use of Information, representing 65% of the standards go beyond rote memorization—they require applying knowledge and creating new products.

Big6 Stages 2 and 3 were also present in the CCSS, though to a lesser degree. These stages represent the "search" part of the information problem-solving process: Information Seeking Strategies dealing with identifying possible sources of information and Location & Access, locating those sources, and accessing information within sources to engage with and extract relevant information.

The stages of Task Definition and Evaluation, are present in the AASL standard statements but in a very limited manner. Task Definition was identified 14 times (7%)

and Evaluation 16 times (8%). One explanation for these results could be the types of problems assigned in schools. Problems assigned in schools tend to be well-structured problems [14]. Well-structured problems have clear parameters and often have known answers. School is a formal learning environment, and as such the problems presented to students tend to be well-structured problems with a known solution.

Schoolwork that requires information problem-solving is typically assigned by a teacher and it is the students' responsibility to find the known answer/solution. Task Definition, thus, is often not viewed as belonging to the student. In well-structured problems students are not require to define the parameters of the task.

The same is true of the Evaluation stage of information problem-solving. Well-structured problems in the formal learning environment of school have a known answer, and students are frequently not asked to make judgments about either the product of their work or the process that led to a product. Students view evaluation as teachers' work.

However, informal learning environments outside of school have ill-structured problems that often have competing answers of relatively equal value. Learning to solve these ill-structured problems that are typical of everyday-life should be a goal. Being able to define what information is needed, identifying the tasks to be done, evaluating if the problem has been successfully completed, and judging to what extent the problem-solving process functioned well or poorly, are important parts of information problem-solving, yet explicit standards for doing these steps are present to only a limited degree in the AASL standards.

Our results suggest a content analysis of the standard statements may provide information concerning the degree of differentiation between grade levels. Examples of Task Definition AASL standard statements came from the indicator, "Develop and refine a range of questions to frame the search for new understanding." The benchmark at second grade is "Ask I wonder questions about the topic, question, or problem." At fifth grade the benchmark is, "With guidance formulate questions about the topic." The eighth grade benchmark is, "Write questions independently based on key ideas or areas of focus." The benchmarks indicate a degree of increasing difficulty in the task asked, though it seems possible that both second and eighth grade tasks could be completed by the same range of questions.

Examples of AASL standard statements from the Synthesis stage, came from the indicator, "Use prior and background knowledge as context for new learning." The benchmark for second grade is, "Share what is known about a topic, problem, or question." At fifth grade the benchmark is, "Articulate what is known about a topic, problem, or question." And at eighth grade the benchmark is, "State and support what is known about a topic, problem, or question, and make connections to prior knowledge." The wording differs, but conceptually these statements are quite similar. The eighth grade standard is slightly differentiated by the phrase "and make connections to prior knowledge." It appears the AASL standard statements may lack a consistent degree of grade level differentiation. Content analysis focusing on grade level differentiation could provide valuable information about the degree to which the AASL standards implement advanced work as students advance in grades.

4.1 Comparing Other Sets of Standards to the Big6 Common Core State Standards

The CCSS Initiative in the United States is an education policy initiative seeking to establish a single set of standards for kindergarten through 12th grade [3]. The CCSS standard statements were also reviewed in depth [7]. The 377 CCSS statements at grades 2, 5, and 8 were found to have clear evidence of both Big6 Stage 4 and Stage 5. The CCSS were heavily concentrated in Big6 Stage 5, Synthesis, (86 standard statements) with a lesser emphasis on Big6 Stage 4, Use of Information (33 standard statements). Particularly noteworthy was the absence of any standards related to Task Definition or Evaluation in the CCSS. This finding points out a major deficiency in the CCSS, as these are two crucial information problem-solving skills. Defining the task and evaluation are two of the four steps in problem-solving identified from the field of Cognitive Psychology, but as they are not addressed by the CCSS, the CCSS may not be fully meeting the goal of preparing students for college or careers.

Seven Pillars of Information Literacy. SCONUL produced an information literacy framework, the Seven Pillars of Information Literacy in 1999 and revised it in 2011 [2]. The revision seeks to update the Seven Pillars of Information Literacy to remain current with the changing world of information technology. One of the changes includes more clearly including the concept of Evaluation in both the meanings noted above.

The Seven Pillars of Information Literacy offers a model for information literacy around the needs of higher education from which other models of information literacy may be developed using different lenses. Wales has mapped the Seven Pillars to two key educational frameworks, the Skills Curriculum in Wales (3-19) and the Credit and Qualifications Framework for Wales (CQFW) (14+ years) to demonstrate to teachers and learners the degree that information literacy skills are incorporated in the frameworks [16]. Unlike the CCSS of the United States, both Evaluation and Task Definition are well-represented in the Wales model. Evaluation in both of its meanings, the evaluation of information and the evaluation of the process, are present in these standards. The Wales adaptation of the Seven Pillars model appears to be well suited to preparing students with the information literacy skills they will need in the 21st century.

ACRL Standards. The ACRL standards, like SCONUL's Seven Pillars of Information Literacy are aimed at higher education. Also, like the Seven Pillars, the ACRL standards are undergoing revision. A new definition of information literacy is being offered. The new framework emphasizes the "highly relational, context-specific nature of information literacy, and the varied circumstances in which individuals and groups activate this competencies and describe them to researchers" [6]. Other changes from the Information Literacy Standards of Higher Education (ILCSHE) adopted in 2000 [17], include the shift from standards to a framework in order to make the guidelines more flexible and adaptable for different disciplines and different institutions and an emphasis on self-awareness or metacognition. This emphasis on metacognition directly relates to the importance of evaluating both the product (the outcome of the information problem solving process) and process of information problem solving.

5 Conclusion

5.1 Limitations

This research focused on AASL in grade levels 2, 5, and 8. AASL standard statements are also benchmarked at both the 10^{th} and 12^{th} grades. The research did not attempt to look at AASL standards in the high school years. It could be that areas of the Big6 information literacy process that are limited in grades 2, 5, and 8, such as Task Definition and Evaluation, are present to a greater extent in standard statements for grades 10 and 12. It should also be noted that this research focused on a skills approach and thus did not address certain areas of the AASL framework, such as dispositions and responsibilities that go beyond the skills approach.

5.2 Implications

The findings indicate that the AASL standards may be insufficient to fully prepare students for college and career readiness. Both of the important information problem-solving stages of identifying the task and evaluation of process and product have modest representation in the AASL standards. One recommendation is for the AASL to consider developing additional standards in these underrepresented stages.

The AASL does address the full scope of the information problem-solving process unlike the CCSS, where two stages of the information problem-solving process seem to be missing entirely. This is an important and serious finding, and we recommend further analysis and research to confirm the finding as well as reconsideration by those responsible for the CCSS.

New frameworks in higher education for information literacy from the ACRL and SCONUL, have added emphasis on metacognition and thus on Evaluation, making both potential models for improvements to the AASL standards and CCSS.

5.3 Future Research

As noted, an important follow-up on this study is to look further at the CCSS in terms of presence (or lack) of standards related to task or problem definition and evaluation. Corollary work should be done to determine the importance of these areas in learning and teaching and the nature and scope of what should be included.

We also recognize the need to examine grade levels other than 2, 5, and 8 in the AASL standards. This would clarify whether or not the grade levels studied are exceptions or whether they are representative of the AASL standards as a whole. SCONUL and ACRL have released or are in the process of updating their guidelines for information literacy. Both organizations are issuing frameworks rather than lists of standards. This presents another opportunity to map frameworks to information problem-solving and to compare to existing standards in grades K-12, especially those of the AASL and the CCSS. Task definition and evaluation are key stages in information problem-solving and need emphasis in the AASL standards and both are missing from the CCSS. The findings raise concerns that should be addressed in research, policy, and practice.

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