# Scaffolding Students' Information Literacy Skills with an Online Credibility Evaluation Learning Tool

**by**

**Christopher Alan Leeder**

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**Dissertation Committee:**

Professor Karen Markey (Chair)

Professor Xun Ge, University of Oklahoma

Associate Professor Christopher Quintana

Associate Professor Soo Young Rieh

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## Table of Contents

**List of Tables**

**List of Figures**

**List of Appendices**

## Abstract

This research explored how to effectively teach today's students Information Literacy (IL) and credibility evaluation skills in the online information environment. In light of students' reliance on the Internet, their general lack of IL skills, limited critical evaluation practices, and the lack of consistent institutional IL training, new pedagogical methods are needed to teach effective online IL skills. Specifically, there is a need for IL training that is customized to the online information environment and relevant to the research habits of today's students. To address this problem, an online learning tool incorporating scaffolding and metacognitive support was prototyped and built. The tool decomposes credibility evaluation into a structured set of stages, giving students repeated practice in each stage while providing scaffolded support for learning and metacognitive reflection, and integrating the instruction into the online information environment.

An experimental study was conducted to test the tool's effectiveness, with a total of 84 students randomly assigned to three experimental conditions to allow for statistically valid analysis of the results. The findings show that use of the online credibility evaluation tool significantly increased subjects' understanding of credibility criteria. The results did not show a significant difference between groups in the application of evidence-based source characteristics as the basis for their credibility evaluations, or in metacognitive awareness of the evaluation process, although descriptive trends suggest some improvement in the treatment group. Along with these three research questions, the study also examined the types of sources that students used in their research, showing that they relied on blogs and other hybrid online genres that do not conform to the traditional genres often covered by IL instruction. The study also solicited self-reports of student learning, with students reporting that they learned that online credibility evaluation is more complex than they thought, involving asking systematic questions and using critical thinking.

Overall, this research demonstrates that IL instruction needs to address the specific challenges of online credibility evaluation, and that scaffolding and metacognitive support in the form of an online learning tool can effectively integrate IL instruction into the online information environment where students actually do their research.

# Chapter 1. Introduction

## 1.1. Background

Information literacy (IL) has been called a survival skill in the Information Age (ALA, 1989; Eisenberg, 2010) and "a prerequisite for participation in society and the work force" (US 21st Century Workforce Commission, 2000). It has also been described as *the* critical literacy of the 21st century and the foundation of learning in our contemporary environment of continuous technological change (Bruce, 2004). IL has been defined by the American Library Association as: "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" (ALA, 1989), which has become the widely accepted definition in academic libraries. Research shows that IL instruction has a positive impact on student skills, performance and academic achievement (Gross & Latham, 2007; Ren, 2000; Selegean, Thomas & Richman, 1983; Smalley, 2004; Van Scoyoc, 2003; Wang, 2006). Students will need these critical skills in their lives outside of academia, as they are key to preparing students for life-long learning (ALA, 1989; Daugherty & Russo, 2011).

IL skills have increasingly been recognized as critical to success in today's economy and society, with several professional organizations including IL skills into their official standards. The Partnership for 21st Century Skills' "Framework for 21st Century Learning" describes the "skills, knowledge and expertise students should master to succeed in work and life in the 21st century" (Partnership for 21st Century Skills, 2011), among which are includes information literacy and critical thinking. Another professional organization, the International Society for Technology in Education (ISTE), developed the National Educational Technology Standards (NETS), described as "the standards for learning, teaching, and leading in the digital age" (ISTE, 2012), which include "Research and Information Fluency" and "Critical Thinking, Problem Solving, and Decision Making." A report from the Georgetown University Center on Education

and the Workforce states that competencies such as critical thinking, active learning, and complex problem-solving are required for success in STEM (Science, Technology, Engineering, Mathematics) occupations, which are critical to our nation's continued economic competitiveness (Carnevale, Smith, & Melton, 2011).

IL is closely aligned with critical thinking (Akyol & Garrison, 2011), with critical thinking sometimes taken as a central aspect of IL (Lorenzo & Dziuban, 2006). The two terms – "critical thinking" used primarily in education, "information literacy" used primarily in library instruction – may in fact merely be disciplinary terminology for the same set of skills (Allen, 2008). Reece states that "information literacy is a form of critical thinking applied to the realm of information" (2005, p. 488) and Doyle suggests "while critical thinking skills provide the theoretical basis for the process, information literacy provides the skills for practical, real world application" (1994, p. 4). In this context, IL can be understood as an embodiment of critical thinking in the context of information seeking activities.

Information literacy can also be seen as inherently metacognitive in that it encourages individuals to become aware of their search and evaluation skills and apply them to specific information needs (Booth, 2011). Metacognition involves "planning cognitive tasks, monitoring one's progress to meet goals, taking appropriate steps to solve problems, and reflecting on past performance for future improvement" (Quintana et al., 2005, p. 2360). Metacognitive abilities are categorized as knowledge of cognition and regulation of cognition (Schraw & Dennison, 1994). The *Information Literacy Competency Standards for Higher Education* aim to support students in building a "metacognitive approach to learning" through gaining control over their interactions with information and through making explicit the criteria for gathering, analyzing, and using information (ACRL, 2000, p. 6). The Middle States Commission on Higher Education in their *Guidelines for Information Literacy in the Curriculum* echo the ACRL, stating that "one of the highest and best uses of information literacy is as a metacognitive device for students to better manage the learning process" (MSCHE, 2003). Any training in IL skills should not only equip students with guidelines to help them assess the credibility of websites, but should also encourage them to reflect on the process of evaluation (Madden et al., 2011).

Learning software applications can systematically support metacognition through the use of instructional scaffolding. Azevedo (2005) defined scaffolding in computer-based learning environments as "instructional support in the form of guides, strategies, and tools that are used

during learning to support a level of understanding that would be impossible to attain if the students learned on their own" (p. 199). (Azevedo also describes human tutors as providing scaffolding, however the research focuses on what he calls "embedded procedural scaffolds.") These instructional scaffolds can help students to work through a difficult task and attain a higher level of proximal development that would be beyond their unassisted efforts (Ge & Land, 2004). With the assistance of scaffolds, learners can bridge the gaps between their current abilities and intended learning goals that would be unachievable through their unassisted effort alone (Rosenshine & Meister, 1992). The use of metacognitive support in the form of scaffolding can help students to develop strategies to be more critical in their evaluation of the credibility of web sources (Iding et al. 2008). Since students do not spontaneously engage in metacognitive thinking unless they are specifically encouraged to do so, it is important to include metacognitive support in learning environments (Lin, 2001).

## 1.2. Problem statement

Evaluating the credibility of online information sources may be difficult for today's students due to the volume and diversity of sources, and the lack of conventional quality control mechanisms and indicators of authority from traditional print-based formats (Rieh, 2002; Gasser et al., 2012; Metzger et al., 2010). Historically, markers of credibility in the print-based paradigm were maintained by professional gatekeepers such as editors and reviewers (Rieh & Danielson, 2007). However, the fast-changing information environment of the Internet is transforming familiar genres, combining them and creating new genres which resist easy classification (Markey et al., 2014). When print-document genres are adapted to the Internet, they can appear to be shuffled, disassembled and reassembled in new and sometimes confusing ways (Crowston et al., 2010). Information sources on the web often lack the filters and markers of institutional credibility and authority which promote reliability in traditional print sources (Burbules, 2001; Mackey & Jacobsen, 2011). Overall, web pages typically offer few reliable cues to credibility that students can use in their evaluations (Iding et al., 2008).

While IL instruction programs attempt to instill evaluation skills, research shows that college students rarely evaluate the quality of information sources that they find online (Becker, 2003; Brand-Gruwel et al., 2005; Julien & Barker, 2009; Kolowich, 2011; Metzger, 2007;

Parker-Gibson, 2005; Walraven et al., 2009). This is a particularly urgent problem since for many of today's students the Internet is the starting point when searching for information (Becker, 2003; Costello et al., 2004; Curtis, 2000; Swanson 2005). Studies consistently show that college students overwhelming rely on Google to the exclusion of many other academic search tools (Hargittai et al., 2010; Head & Eisenberg, 2011; Kim & Sin, 2011; Kolowich, 2011; OCLC, 2002; Van Soyoc & Cason, 2006). Overall, students are unsophisticated information seekers in academic contexts (Julien & Barker, 2009; Thomas, 2004).

While stakeholders in higher education and in professional societies agree that IL is necessary to students' success in their education and afterward in their work and personal lives, there are significant challenges to the implementation of universal IL instruction programs. One obstacle is the "faculty problem": the perception of librarians that faculty are either apathetic or outright obstructive towards efforts to collaborate on IL instruction (McCarthy 1985). Faculty may assume that IL instruction happens in introductory courses, and may feel that it is not their responsibility to teach it themselves (Saunders 2012). Librarians and faculty may have very different expectations of the content and desired emphasis of IL instruction (Cunningham, Carr, & Brasley, 2011). The onus is on librarians to initiate and sustain discussions with faculty about IL instruction and to proactively build collaborative relationships (Saunders 2012). However, even when librarians successfully work with faculty to bring IL instruction into the classroom, the reality is that there is very little time available in the faculty member's curricula to include IL content (van Meegen & Limpen, 2010). Another obstacle is the inconsistent accreditation standards across the United States (Owusu-Ansah 2004; Gross & Latham, 2007). Only a small percentage of higher education institutions with first-year experience programs include a required information literacy component (Boff & Johnson 2002). These difficult conditions mean that broad integration of IL into undergraduate education remains an aspiration rather than a fully realized ideal (McGuiness 2006).

Traditional IL training methods (one-shot sessions, tutorials, worksheets) are often simplistic, not customized to the online information environment, and rely on a traditional classroom-based pedagogical model, and thus may not connect effectively with today's students (Costello et al., 2004; Manuel, 2002; Gibson, 2008; Leach & Sugarman, 2005). These brief training sessions may be the only explicit and focused exposure to IL that most students receive, and the limited time and contact with students make it difficult for librarians to keep students

interested and engaged (Smale 2011). This lack of opportunity to engage and motivate students means that students get bored quickly when IL lessons do not trigger them to pay attention (Doshi 2006). When learning new skills, today's students often prefer active involvement in the learning process, and a networked, participatory learning environment (Davidson & Goldberg, 2009; Halse & Mallinson, 2009; Thomas & Brown, 2011). Overall, one-shot instruction sessions cannot provide students with the engagement and sustained practice required to learn, apply and master IL competencies (Mokhtar et al. 2008, Mery et al. 2012).

Although metacognition is an important part of learning, most IL instructional models position reflection at the very end of the process or simply take it for granted (Markless, 2009). This approach is not likely to enable the development of the metacognitive strategies necessary to perform problem-solving with information, particularly when students are working independently online (Markless, 2009). Studies show that students often lack the ability or awareness to monitor and regulate their cognitive processes while engaged in problem-solving (Artz & Armour-Thomas, 1992), which likely relates to the lack of metacognitive skills (Ge & Land, 2004). Novice learners usually have weak metacognitive skills, which impede their ability to engage in complex practices like online inquiry (Quintana et al., 2005). These students are unlikely to be successful in completing complex web-based tasks, such as online credibility evaluation (Kauffman et al., 2008).

Learning software applications can systematically support metacognition through the use of instructional scaffolding. Wood, Bruner and Ross (1976) defined scaffolding as a "process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (p. 90). Essentially, scaffolds change the task in some way so that learners can accomplish what would otherwise be out of their reach (Reiser, 2004). With the assistance of scaffolds, learners can bridge the gaps between their current abilities and intended learning goals that would be unachievable through their unassisted effort alone (Rosenshine & Meister, 1992). During this process, scaffolds enable learners to reflect in action (Hung, 2001), providing "opportunities for students to deepen their understanding by externalizing and comparing their knowledge and beliefs with those of their peers" (Sharma & Hannafin, p.43). Social software tools are "increasingly being recognized as essential scaffolds and learning tools" (McLoughlin & Lee, 2008, p. 649) because their affordances support participatory

knowledge creation through networking, socialization, communication and engagement with communities of learning (McLoughlin & Lee, 2008).

In light of students' reliance on the Internet, their general lack of IL skills, limited critical evaluation practices, and the lack of consistent institutional IL training, new pedagogical models are needed to teach effective online IL skills. Specifically, there is a need for IL training that is customized to the online information environment and relevant to the research habits of today's students. If students are to effectively evaluate the credibility of online information sources, they must learn the specific criteria on which to judge the credibility of these sources, and the evidence necessary to support their evaluations (Metzger, 2007; Harris, 2008; Iding et al., 2009). They must also learn to base their judgments on evidence-based source characteristics rather than relying on subjective judgments based on intuition or projection (Markey, Leeder & Rieh, 2014). Guidance in learning these skills should be provided through structured scaffolding and metacognitive prompts that support students in reflecting on their learning. Developing students' metacognitive skills regarding credibility evaluation, and understanding IL as a structured process requiring practice, planning and reflection, will help students become critically aware users of online information, and will prepare them for lifelong learning.

Although there is a significant amount of literature on case studies of IL instruction, there is little empirical research on its effectiveness beyond surveys, pre/post-tests and outcomes evaluation (Barclay, 1993; Coupe, 1993; Rockman, 2002; Orme, 2004). Scaffolding and metacognition have been studied in other fields, e.g. education and psychology (Kauffman, 2004; Iding, 2008; Pifarre & Cobos, 2010), educational media (Bannert, Hildebrand & Mengelkamp, 2009), pharmacy (Ge, Planas & Er, 2010; Ge, 2013), science (Qunitana, et al., 2004; Azevedo, 2005; Quintana, Zhang & Krajick, 2005; Raes, 2012; Tanner, 2012), and specific domains such as reading comprehension and writing skills (Lin, 2011). However, there has been little research on the application of scaffolding and metacognitive support to teaching students IL and credibility evaluation skills (Gorrell et al., 2009; Bannert & Mengelkamp, 2013), and in online learning environments (Akyol & Garrison, 2011). These gaps in the literature are addressed by the research through conducting an experimental study on the learning impact of an IC tool that incorporates scaffolding and metacognitive support.

## 1.3. Purpose and research questions

The purpose of the research is to investigate the effects of scaffolding and metacognitive support on student learning of online credibility evaluation skills. The study tested whether a custom-built online credibility evaluation learning tool that incorporates scaffolding and metacognitive supports increased students' understanding of the expert criteria that constitute credibility evaluations, their application of evidence-based source characteristics in making credibility evaluations, and the metacognitive awareness of the online information evaluation process. These outcomes are defined as follows:

- "Understanding" was defined as the ability to 1) accurately define the criteria and 2) articulate their importance.
- The expert credibility criteria that students learned are the concepts of authority, relevance, reliability, currency, and purpose (based on a scaffolded model of "who, what, where, when and why") and their definitions.
- The evidence-based source characteristics students learned to examine are evidence used for credibility evaluations such as author credentials, main ideas, references/links, site domain, contact information, date, and About and purpose statements.
- The metacognitive strategies students learned are increased use of planning, monitoring, and reflecting on their evaluation practices.

The research design uses an experimental study to address these research questions:

> **RQ1:** Do students who use the online credibility evaluation learning tool demonstrate greater understanding of expert credibility criteria in the process of evaluating online sources compared to groups of students who use a tutorial and an online form, or those who use only an online form?
>
> **RQ2:** Do students who use the online credibility evaluation learning tool demonstrate greater application of evidence-based source characteristics as the basis for their credibility evaluations compared to groups of students who use a tutorial and an online form, or those who use only an online form?
>
> **RQ3:** Do students who use the online credibility evaluation learning tool demonstrate greater metacognitive awareness compared to groups of students who use a tutorial and an online form, or those who use only an online form?

## 1.4. Theoretical models

The design of the online credibility evaluation learning tool titled "InCredibility" (IC) was inspired by learning theory and its application to online learning tools. Constructivist learning theory, which sees learning as a social process in which students play an active role in building knowledge (Woodard, 2003; Gibson, 2008), and Vygotsky's Zone of Proximal Development model of bridging students' current knowledge toward more advanced practice (Vygotsky, 1978; Azevedo, 2005; Zhang & Quintana, 2012), both informed the pedagogical model of the prototype learning tool.

Constructivism provides a theoretical framework for scaffolding and for providing metacognitive support, and guides the design and development of the prototype IC tool. Through instructional supports that structure an otherwise haphazard sequence of actions, and visual representations that structure what had previously been just a series of uncoordinated events, the scaffolds embedded in the prototype learning tool enhance the development of the student's metacognitive and self-regulation processes (Azevedo, 2005; Quintana et al., 2005; Stahl, 2006). Metacognitively-aware learners have been shown to be more strategic and perform better than unaware learners, through planning, sequencing, and monitoring their learning in a way that directly improves performance (Schraw & Dennison, 1994). Effective searching of the web is a complex process of reasoning and decision making (Todd, 2000), and strong self-regulation ability and metacognitive awareness are necessary in order to be successful in web-based learning (Raes et al., 2012).

The design of the tool follows Quintana et al.'s Scaffolding Design Framework of supporting sensemaking, process management, and reflection and articulation (2004). Learning is scaffolded by the structured decomposition of tasks into discrete units, and the segmentation of the learning goal into stages. Since novice learners usually have weak metacognitive skills, which are important for engaging in complex practices like online credibility evaluation, the prototype learning tool provides needed practice and reinforcement of these important skills (Quintana et al., 2005). In addition, the situated, just in time, web-based nature of the tool facilitates active involvement in the learning process by Millennial students who value collaboration and peer-based learning (Manuel, 2002; Head & Eisenberg, 2010).

The design of the tool is also informed by theories of library-related information seeking behavior (ISB). One of the most influential models in IL theory is Kuhlthau's Information Search Process (ISP), which broke new ground by exploring the cognitive and affective aspects of the information search process, rather than merely the mechanistic steps of information retrieval (Kuhlthau, 1991). The cognitive processes involved in Kuhlthau's ISP (critical thinking, decision making, problem solving) relate closely to the fundamental skills of IL (Thomas, 2004). Drawing on constructivist pedagogical and cognitive learning theory, Kulthau crafted a model that identified "zones of intervention" based on Vygotsky's Zone of Proximal Development which focus on providing effective assistance and coaching when it is most needed by students. The ISP model created a new vocabulary and role for school librarians (Behrens, 1994). Since it is empirically tested, the ISP model was an important milestone in research on students' information-seeking behavior and has served as the basis for much library instruction (Thomas, 2004).

Three other important theoretical models influenced the design of tool. The first is "library anxiety" (Mellon, 1986), a sense of powerlessness which students may feel when they begin an information search that requires using the library, involving feeling lost, fearful of library staff, and unable to navigate the library. The IC tool addresses these anxiety barriers by situating library instruction in the online context where students normally do their research, rather than relying on placing them physically in the library, or bringing a librarian physically to the classroom. The second theoretical model is the Principle of Least Effort (PLE) (Zipf, 1949; Rosenberg, 1974; Mann, 1993) and the related term "satisificing" (Simon, 1956; Agosto, 2002; Thomas, 2004; Gibson, 2008; Warwick et al., 2009) both of which suggest that students often accept the first satisfactory alternative over the best possible alternative when searching for information. The tool's design structures the information-searching process through a series of measured steps, each involving self-review and reflection on the part of students, as well as providing them a process map of the overall task and progress monitors of completion and gives them repeated opportunities to practice new skills. The third theoretical model is Competency Theory, which suggests that students who lack information literacy skills do not realize it and therefore are unlikely to seek out instruction (Gross & Latham, 2007). The three stages of the tool give students repeated, structured practice in evaluating their own work (Investigate) as well as the evaluating the quality of other students' evaluations (Question) and making comparative

evaluation judgments (Solve). Through this structured skills practice, students learn to evaluate their own skill level more realistically and compare their own skills to others based on shared performance.

Together, the IL models of Kuhlthau's Information Search Process, Library Anxiety, the Principle of Least Effort, Satisficing, and Competency Theory provide context and background to efforts to teach effective IL skills to college students. These theories help researchers understand how students approach – and avoid – evaluating online information, and illustrate the importance of designing learning tools that can ameliorate the challenges students feel while still providing effective skills training.

Credibility evaluation criteria are a crucial component of the tool's theoretical design. The literature on online credibility evaluation provides extensive insight into the actual practices students use, but without providing suggested methods to improve students' evaluation skills. Incorporating a research-based understanding of actual student credibility evaluation behavior into the design of a learning tool situated in the online information environment was one of the fundamental motivations for this research project. Former school media librarian Kathy Schrock's criteria model called "5Ws" (Who, What, Where, Why, and When) employs non-expert language that is appropriate to the intended audience of the learning tool: incoming college students, and potentially high school and community college students. In the learning tool's later stages, the 5Ws are mapped to more sophisticated credibility criteria language (authority, relevance, reliability, currency, and purpose), providing scaffolding to bridge the gap between students' unsophisticated understanding of online information evaluation and the more sophisticated models of evaluation criteria used by experts. While the 5Ws model of website evaluation is widely used in IL education, especially in high schools, it has not been empirically tested (Schrock, 2013) so this study represents the first research into the effectiveness of the 5Ws model for teaching website evaluation criteria.

## 1.5. Methods

The research involves an experimental study of college undergraduates using a two treatment group and a control group to compare the performance of subjects under three learning

conditions. The Treatment 1 group completed the IC tutorial and used the IC tool to conduct credibility evaluations; Treatment 2 completed the IC tutorial but did not use the IC tool, instead using an online form to conduct credibility evaluations; and the Control Group will only use the online form to conduct credibility evaluations, without using either the IC tutorial or the IC tool. Comparison between the Treatment 1 group and Control Group measured the imapct on learning outcomes of using the IC tutorial and IC tool. Comparison between the Treatment 2 and Control Group measured the impact of the using the IC tutorial only. Thus, the independent variable is exposure to the structured sequence of scaffolded instruction and guided practice that constitutes the design of the IC tool. The dependent variable is the students' demonstrated use of specific evidence to evaluate credibility criteria, and metacognitive awareness of the steps of the evaluation process.

Both quantitative and qualitative data were collected during this study. Qualitative data included student responses entered to credibility evaluation prompts, comments on other students' sources, and students' responses to the credibility criteria and metacognition post-tests. Quantitative logfile data on the use of the tool, including time spent on tasks, use of prompts, and overall level of participation (e.g., did they exceed quotas) were automatically recorded. Logfile data is a relatively unobtrusive method for gathering data and provides fine-grained, detailed, time-referenced markers of student actions and allows the researcher to examine patterns among student learning strategies (Perry & Winne, 2006).

After completing their treatment/control group activities, all subjects completed two post-tests: a test of credibility criteria and a metacognition test. Both instruments were pilot tested prior to the start of the experiment, and were modified as needed based on results from cognitive interviews with pilot test subjects. The custom credibility criteria post-test developed for this study asks 10 specific questions about the criteria for evaluating the credibility of online information, based on the expert terminology and definitions introduced in the Question stage (as opposed to the novice-level terminology of the tutorial). The open-ended questions ask students to demonstrate their knowledge of both the criteria themselves and the strategies for evaluating the criteria. The custom metacognition test developed for this study asks 12 questions customized specifically to the process of evaluating the credibility of online information. Response options were on a 4-point Likert scale (strongly disagree, disagree, agree, strongly

agree). Both post-test were conducted as online surveys, with questions assigned randomly to reduce order effects.

The study's research questions were answered based on analyses of both qualitative and quantitative data, which provided a multi-dimensional understanding of student behavior and strengthened findings and conclusions regarding the impact of the online participatory learning tool. Open-ended responses were analyzed through coding for the presence of credibility criteria and evidence-based source characteristics. Metacognitive prompt responses were coded for the presence of planning, monitoring, and reflection on students' learning. Results of the credibility criteria and metacognition post-tests were scored numerically. Table 1 below lists the data analysis methods that were used to answer each research question:

**Table 1. Data analysis methods**

| Research question | Data source | Analysis method |
|---|---|---|
| RQ1 | Credibility criteria post-test | Coding and statistical |
| RQ2 | Reflective prompts | Content analysis |
| RQ3 | Metacognition post-test results | Scoring and statistical |

After all data are analyzed, inter-group statistical tests were conducted to compare results between the Treatment groups and Control Group and look for evidence of statistically significant differences. Scores on the credibility criteria and metacognition post-tests were analyzed using one-way analysis of variance (ANOVA) with treatment condition as the independent variable and scores as dependent variables to analyze patterns of performance. Statistical analysis was conducted using the SPSS statistical software package.

## 1.6. Overview of this dissertation

This dissertation consists of six chapters: a literature review, a description of the prototype design of the IC tool, the experimental research design, the findings, and discussion chapters. The literature review (Chapter 2) covers three disparate areas of research that together form the theoretical basis of the IC tool: Information Literacy, online credibility evaluation, and Computer-supported Collaborative Learning. Chapter 3 covers the design and development of

the prototype version of the IC tool, the results of initial pilot testing, and the plan for finalizing the tool. Chapter 4 describes the three research questions, the experimental design for experimentally testing the impacts of the tool on student learning, the tests to be used, and the data collection and assessment plan. Chapter 5 describes the findings of the experiment, including an analysis of the sources found by students during the experiment, the results of the three research questions, and additional findings regarding student skills. Chapter 6 summarizes the findings, discusses the implications of the findings for the design of the IC tool, the study design, and for online IL instruction. The final chapter closes with a discussion of the contributions of the study and suggestions for future research.

# Chapter 2. Literature Review

This literature review covers three fields of research which informed the design of the IC tool: Information Literacy (IL), online credibility evaluation, the concepts of metacognition and scaffolding from the field of Computer-supported Collaborative Learning (CSCL). Because the research addresses student IL skills and methods to teach evaluation skills, this literature review (2.1) examines theoretical models in the library literature that apply to IL skills, research into student IL skills, the benefits and challenges of IL instruction, and instructional methods currently used to teach IL. Because the research addresses what evidence students use to judge credibility of online information, this literature review (2.2) examines research into student credibility evaluation practices, terminology of credibility criteria, and models of the evaluation process. Because the research addresses techniques to best support students in learning credibility evaluation skills, this literature review (2.3) examines CSCL learning theories, in particular metacognition and scaffolding. The last sections summarizes the impacts of the literature on the design of the tool.

## 2.1. Information Literacy

The research addresses student IL skills and methods to teach evaluation skills. This section reviews the history and definitions of IL, theoretical models of IL, research into student evaluation skills, the benefits and challenges of IL instruction, the benefits and challenges of IL instruction, and instructional methods currently used to teach IL.

### 2.1.1. History of IL

The history of the concept of IL begins with the traditional models of "library instruction," "library skills," "user education," and "bibliographic instruction," or the practice of educating the library user to locate and use library resources (Arp, 1990; Shapiro & Hughes,

1996; Thomas, 2004). Academic and school librarians were responsible for developing the original agenda and principles behind information literacy (Lorenzo & Dziuban, 2006). These practices focused on educating library users about access to books and physical print resources, as well as orientation to the structural aspects of libraries such as facilities, classification and organization (Behrens, 1994). The term "information literacy" gained acceptance during the 1980's (Sundin, 2008) and in the 1990's a new focus emerged on enhancing student skills (Markless & Streatfield, 2007). This shift in focus has been characterized as a move from the use of particular information artifacts towards shaping user behavior (Sundin, 2008), from the practice of teaching tool-based skills toward teaching competencies (Špiranec & Zorica, 2010), and from the traditional definition of librarian as collector and curator of resources to identification as information specialist and teacher (Thomas, 2004). In 1998, Langford commented on the debates over the definition of IL:

> Is it a concept or a process? Is it an embodiment of essential skills that have only had name changes over the decades? Or is it a new literacy that has been transformed from existing literacies to complement the emerging technologies for which the Information Age students must be skilled? (p.2).

While there has been much discussion of these questions, even today a general consensus has not been reached on the answers. Gibson (2008) describes the IL model as a "reform movement" with broad educational goals. He identifies the information literacy model as "a coherent, planned, program-level set of research skills and learning outcomes" and "a programmatic, curriculum-integrated, and pervasive and sustained placement of information and research skills throughout the curriculum" (p. 12). This definition emphasizes the context of IL training as integrated into the broader educational mission rather than as a collection of isolated skills. In contrast, Gibson characterizes bibliographic instruction as an instructional movement focused on teaching students about the tools, resources and strategies for using a specific library's information resources in the context of a particular assignment given by faculty.

The concept of IL has evolved over the past 30 years, developing through different phases each with its own definitions and implementations. In general, however, two definitions issued by professional organizations of libraries have set the generally-accepted standard. In 1989, the American Library Association (ALA) released its Presidential Committee on

Information Literacy report stating “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" (ALA, 1989). This report characterized IL as a “means of personal empowerment” and a “survival skill.” In 2000, the Association of College and Research Libraries (ACRL), a division of the ALA, issued their own definition of IL in their *Information Literacy Competency Standards for Higher Education*. Referring back to the original ALA definition, the ACRL definition added that IL is “a set of abilities requiring individuals to "recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" “ (ACRL, 2000). These standards described IL as an “area of competence” and “an intellectual framework.” This statement marked an important shift of focus from defining a type of a person to identifying a set of abilities. As described by Kuhlthau (1999):

> Information literacy incorporates both library skills and information skills, but adds the critical component of understanding the process of learning in information-rich environments. Information literacy extends library skills beyond the use of discrete skills and strategies to the ability to use complex information from a variety of sources to develop meaning or solve problems (p. 11).

Breivik and Jones (1993) stated that information literate students:

> …become sophisticated users of these resources and technologies as they: (1) gather needed information from all sources; (2) test the validity of information as it remains constant and as it changes from discipline to discipline; (3) place information into various contexts that ultimately will yield its pertinent meaning; and (4) remain skeptical about information and discriminate fact from truth (p. 26).

IL is closely aligned with critical thinking (Akyol & Garrison, 2011), with critical thinking sometimes taken as a central aspect of IL (Lorenzo & Dziuban, 2006). As defined by the Foundation for Critical Thinking:

> Critical thinking is the intellectually disciplined process of actively and skillfully conceptualizing, applying, analyzing, synthesizing, and/or evaluating information gathered from, or generated by, observation,

> experience, reflection, reasoning, or communication, as a guide to belief and action (Scriven & Paul, 1987).

Allen (2008) states that:

> Critical thinking involves the conceptualization, analysis, synthesis, evaluation, and ultimate application of information that the learner has experienced combined with previous knowledge. (p. 21)

These definitions clearly share similarities with definitions of information literacy. In fact, the two terms – "critical thinking" used primarily in education, "information literacy" used primarily in library instruction – may in fact merely be disciplinary terminology for the same set of skills (Allen, 2008). Reece states that "information literacy is a form of critical thinking applied to the realm of information" (2005, p. 488) and Doyle suggests that "while critical thinking skills provide the theoretical basis for the process, information literacy provides the skills for practical, real world application" (1994, p. 4). In this context, IL can be understood as an embodiment of critical thinking in the context of information seeking activities.

Some have argued for an even broader interpretation of the IL mission. Tuominen et al. (2005) describe IL as a sociotechnical practice with much broader implications outside education. Shapiro and Hughes argue that IL should not be conceptualized and taught as just a collection of technical skills that teach people to be "effective information consumers" but should also enable people to "think critically about the entire information enterprise and information society"(1996, n.p.). They argue that IL should in fact be seen as a new liberal art which embraces a broad perspective of social, cultural and even philosophical context. This call is echoed by Breivik and Jones who argue that IL should be incorporated into undergraduate education as a part of a revived liberal education philosophy, aimed at helping students "to better illuminate their understandings" and develop the "full range of abilities that will be absolutely necessary for future professional flexibility and successful citizenship" (Breivik & Jones, 1993, p. 29).

Digital media and social computing have uncoupled credibility and authority, shifting the burden of evaluation onto the individual information seekers (Metzger et al., 2010). Today's young people are leaving behind – or have already left - the traditional world of print, flocking to all forms of digital media and developing new forms of online communication and new modes of

interaction with information (Todd, 2008). Traditional techniques of credibility evaluation (granting credibility to representatives believed to provide reliable information or granting it based on credentials) only works when there are a limited number of sources and when there are high barriers for access to public dissemination of information (Metzger et al., 2010).The Internet has become a site of information exploration, creation and exchange, a "virtual place for knowledge production rather than a collection of stable documents" (Sundin & Francke, 2009, n.p.). Traditional library-based research models, based on information scarcity and expert authority, have been problematized.

The rapid evolution of information technology and the information environment has impacted the nature of IL skills. Historically, markers of information credibility in the print-based paradigm were maintained by professional gatekeepers such as editors and reviewers (Rieh & Danielson, 2007). Physical formats were often reliable proxies for authority, as publishers limited the amount of sources produced and readers had little interaction with authors. The guidelines for traditional credibility evaluation promoted by bibliographic instruction were primarily based on the material format of documents (Sundin & Francke, 2009). However, the Internet has caused an "erosion of information contexts" where all search results have almost identical look and feel (Tuominen, 2007, p. 2). One of the chief differences between the web and traditional sources of information is that it lacks the filters, the markers of institutional credibility and authority, which promote reliability in many print sources (Burbules, 2001, Mackey & Jacobsen, 2011). Web pages typically offer few reliable cues to credibility (Iding et al., 2008). For instance, newsfeeds and RSS aggregators strip webpages of cognitive authority clues and present all information uniformly (Tuominen, 2007). This the lack of conventional quality control mechanisms and indicators of authority can make it difficult for students to make credibility judgments about online information (Rieh, 2002). The stability and permanence of a book as an information artifact, which helped users make credibility, does not apply in today's online environment (Tuominen, 2007).

Since the basic model of library skills and bibliographic instruction pre-dates the Internet, the traditional IL instruction model must be adapted to the current digital environment of pervasive information and social media (Mackey & Jacobsen, 2011). Much of traditional IL tended to be focused on library resources and technical searching skills, relying on laborious sequential steps (Markless, 2009). Marcum (2002) argues that traditional IL practice is too

grounded in text and overly concerned with basic skills to address the current information environment. Holman argues that librarians have traditionally relied on information retrieval systems with complex interfaces and less intuitive search strategies based on mental models of print-based research (Holman, 2011). Librarians have wanted to push students towards advanced searching, but students are not interested because they are already satisfied with their search results (Godwin & Parker, 2008). Even though they may not actually possess strong search skills, students are still not likely to want or appreciate IL instruction that simply teaches advanced search techniques (Holman, 2011). Instead, IL instruction should help students refine their searches rather than trying to make them into "advanced" searchers (Godwin, 2008). Echoing this point, Tuominen (2007) argues:

> "The most important goal of IL education should be to increase users' conceptual understanding of their information environment. In this sense, the tricks of information retrieval like truncation or Boolean logics are not so significant. Who even uses Boolean searches anymore?" (p. 8)

Holman suggests that rather than teaching students more effective search syntax, IL instructors should focus on developing critical thinking and evaluative skills (Holman, 2011). Farkas argues that:

> “students will need to evaluate information in more nuanced ways than they are currently taught at most colleges and universities. Information literacy needs to be increasingly focused on teaching evaluative skills to students, skills that go well beyond determining whether or not something is peer-reviewed (p. 90)

Orme echoes this caution:

> “Instructional librarians might wish to consider whether they wish to train students to focus on *doing* things correctly or whether they might wish to train students more generally to navigate an information landscape and *recognize* what is correct when they encounter it.” (p. 213, italics in original)

Given the changes in today’s information environment, a new pedagogical approach to IL instruction is needed. The abundance of information sources available online, and their lack of traditional markers of authority, present new challenges to both information seekers and IL instructors.

### 2.1.2. Definitions and standards

The first documented use of the term "information literacy" was by Paul Zurkowksi, president of the Information Industry Association (IIA), in a proposal to the National Commission on Libraries and Information Sciences (NCLIS) that stated: "People trained in the application of information resources to their work can be called information literates" (Zurkowski, 1974). The report discussed the needs of workers in emerging information technology environments and raised policy questions regarding the relationship between libraries and the private sector (Behrens, 1994). The report suggested that NCLIS establish the goal of achieving national information literacy in the following decade. In a later report, Eugene Garfield, founder of the Institute for Scientific Information (ISI) which was a partner in creating the IIA, presented a broader version of Zurkowski's definition:

> "The IIA defines an 'information literate' as a person who knows the techniques and skills for using information tools in molding solutions to problems" (Garfield, 1979, p. 210).

This report characterized the content of such training as "methods of information handling" (p. 210), indicating the professional, work-related orientation of this document. Note that this definition defines the characteristics of a person rather than a set of skills, as does the later ALA definition.

The 1983 report by the National Commission on Excellence in Education, titled *A Nation at Risk,* decried the contemporary state of American education, but ignored the role of libraries in education (Behrens, 1994). This oversight in part prompted the American Library Association (ALA) to create their own charter document. In 1989, the ALA Presidential Committee on Information Literacy produced a report detailing the concept of information literacy, stating that "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" (ALA, 1989). This authoritative definition became a springboard for our current understanding of the concept (Eisenberg et al., 2004). The report identified specific skills required for students to be considered information literate, and also expanded the concept to lifelong learning. The recommendations of the Presidential Committee final report led to the creation of the National

Forum on Information Literacy later that year. This forum, which continues to meet regularly, promotes the adoption of IL across all professions (Eisenberg et al., 2004).

In 2000, the Association of College and Research Libraries (ACRL), a division of the ALA, issued their *Information Literacy Competency Standards for Higher Education*, providing "a framework for assessing the information literate individual" (ACRL, 2000). Referring back to the original ALA definition, the ACRL definition added that IL is "a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information." The ACRL document has become a common starting point for librarians in higher education who are designing IL instruction (Bobish, 2010; Allen, 2008). It is the most widely adopted definition in use by universities and academic libraries (Fitzpatrick & Meulmans, 2011).

In the field of primary school librarianship, the American Association of School Librarians (AASL), a division of ALA which focuses on K-12 librarians, and the Association for Educational Communications and Technology (AECT), created a set of standards focused on teaching IL skills to primary school students. *Information Power: Building Partnerships for Learning* (AASL & AECT, 1998) redefined the role of the library media specialist as an instructor actively engaged in education efforts (Eisenberg et al., 2004). The AASL/AECT standards included "Information Literacy Standards for Student Learning" which state that an information literate student "accesses information efficiently and effectively" (Standard 1), "evaluates information critically and competently" (Standard 2), and "uses information accurately and creatively" (Standard 3). These criteria clearly echo the original ALA definition. In 2009, AASL issued a new *Standards for the 21st-Century Learner* which extends the criteria to a broader educational framework focused on skills, dispositions, responsibilities, and self-evaluation strategies. The IL elements are now described as "applying critical-thinking skills (analysis, synthesis, evaluation, organization) to information and knowledge in order to construct new understandings, draw conclusions, and create new knowledge" (AASL, 2009).

Another national standards initiative relevant to IL skills is the Common Core State Standards Initiative, led by the National Governors Association Center for Best Practice and the Council of Chief State School Officers (NGACPB, 2010). The educational standards described in Common Core have achieved a widespread acceptance as a national baseline for student achievement and have been implemented by 45 states and 3 territories (see

http://www.corestandards.org/in-the-states). The *Common Core Standards for English Language Arts and Literacy in History/Social Studies, Science, and Technical Subjects* contains "Writing Standards" with a sub-section "Research to Build and Present Knowledge" which includes "assess the credibility and accuracy of each source" (Grade 6-8), "assess the usefulness of each source in answering the research question" (Grade 9-10), and "assess the strengths and limitations of each source in terms of the specific task, purpose, and audience" (Grade 9-10) (NGACPB, 2010). The Grade 11-12 Writing Standards also include "gather relevant information from authoritative print and digital sources, using advanced searches effectively" and "integrate information into the text" (NGACPB, 2010). Overall, these different standards incorporate substantially similar definitions of IL skills. The consistency of these standards and their linking to accreditation for schools and universities helped normalize IL as part of the broader educational mission.

Other professional and commercial organizations have developed similar standards. The Association of American Colleges and Universities identifies IL as one of the essential learning outcomes for all students in the 21st century (NLCLEAP 2007). The Partnership for 21st Century Skills, a national organization that "advocates for 21st century readiness for every student," has issued its *Framework for 21st Century Learning* which describes the "skills, knowledge and expertise students should master to succeed in work and life in the 21st century" (Partnership for 21st Century Skills, 2011). These standards include "Learning and Innovation Skills" (creativity and innovation, critical thinking and problem solving, communication and collaboration) and "Information, Media and Technology Skills" (Information Literacy, Media Literacy, ICT Literacy). The organization has also published a crosswalk between their standards and the Common Core standards.

Another professional organization, the International Society for Technology in Education (ISTE), a professional association for educators using technology in PK–12 classrooms, has developed their *National Educational Technology Standards* (NETS). Described as "the standards for learning, teaching, and leading in the digital age" (ISTE, 2012). NETS includes sub-sections on "Research and Information Fluency" (apply digital tools to gather, evaluate, and use information) and "Critical Thinking, Problem Solving, and Decision Making" (use critical thinking to plan and conduct research) The multiplicity of these standards and the specificity of their multiple criteria, while potentially confusing for instructors to implement, also testifies to

the increasing normalization and integration of IL concepts into mainstream education and society.

### 2.1.3. Theoretical models

Many researchers have investigated what factors most influence students during the library research process. One of the most influential models in IL theory is Kuhlthau's Information Search Process (ISP), which broke new ground by exploring the cognitive and affective aspects of the information search process, rather than merely the mechanistic steps of information retrieval (Kuhlthau, 1991). The cognitive processes involved in Kuhlthau's ISP (critical thinking, decision making, problem solving) relate closely to the fundamental skills of IL (Thomas, 2004). Based on a longitudinal series of studies, initially focusing on high school students researching term paper topics, Kuhlthau documented students' thoughts, feelings, and cognitive processes as they proceeded through the research process. The students' emotional states of confusion or confidence changed based on their stage in the process. Students often experienced uncertainty and anxieties at the initial stages of the ISP. Drawing on constructivist pedagogical and cognitive learning theory, she crafted a model that identified "zones of intervention" based on Vygotsky's Zone of Proximal Development which focus on providing effective assistance and coaching when it is most needed by students. Since it is empirically-tested, the ISP model was an important milestone in research on students' information-seeking behavior and has served as the basis for much library instruction (Thomas, 2004). The ISP model created a new vocabulary and role for school librarians (Behrens, 1994). Throughout a long career, Kuhlthau has continued to contribute major theoretical works to IL research and practice, including the model of inquiry-based information seeking or Guided Inquiry, which integrates the librarian into a teaching team and seeks to create an environment that motivates students to learn through constructing their own meaning and developing deep understanding (Kuhlthau et al., 2007).

Of the more theoretical models and theories of information seeking behavior (ISB), some that apply specifically to students and their library research habits include Library Anxiety, the Principle of Least Effort, Satisficing, and Competency Theory. The concept of "library anxiety" was originally described by Mellon (1986) as a sense of powerlessness when beginning an

information search that required using the library. In her research, students reported feeling lost, fearful of library staff, and unable to navigate the library. Onwuegbuzie, Jiao & Bostick (2004) elaborated a structural equation model of the situational antecedents to library anxiety. As students transition from the high school library to the academic research library, they may be affected by unfamiliarity with new surroundings and general anxiety about success. Students also report the associated emotions of perceived inadequacy, embarrassment and intimidation in the library environment (Van Scoyoc, 2003). Measurement scales have been developed to test the impact of library anxiety on students' behavior and performance. In the age of easily-accessible online information, students who experience these emotions and feelings have even less incentive to visit the library and may avoid doing so.

The Principle of Least Effort (PLE), originating in the work of George Zipf, suggests that most people will chose easily available sources of information, even when they are clearly of lesser quality than other, harder to find sources (Zipf, 1949; Rosenberg, 1974; Mann, 1993). The literature on PLE shows that most researchers, even experienced scholars, rely on information access systems that are perceived as easy to use (Mann, 1993). Related to PLE is the concept of "satisficing," a term coined by Herbert Simon (1956), which suggests that information seekers rarely conform to the idealized model of effective, motivated searchers who will follow all the steps of an ISB model, but instead accept the first satisfactory alternative a higher-quality alternative. Students often reduce the cognitive of reviewing information through shortcuts such as relying on familiar sites, search engine descriptions, skimming, and ending searches as soon as an acceptable result is found (Thomas, 2004). Students conduct "cost-benefit analyses" of how much time and attention to expend on searching and research (Gibson, 2008). The concepts of PLE and satisificing correlate with findings that emphasize efficiency and ease of finding results as primary motivations for much student research behavior, rather than the scholarly goals that faculty and librarians might hope for. In a longitudinal study of undergraduate information seeking behavior, Warwick et al. (2009) found that students completed information seeking tasks with the minimum amount of effort judged necessary. Using "strategic satisificing," the subjects "estimated what the minimum literature requirements were and chose specific goals that they could fulfill easily and quickly with their existing skills" (p. 2412). These students avoided the library, relied on familiar strategies to find satisfactory information with a minimum of effort, and were unwilling to move beyond their current skill level. New skills were only adopted when

immediately required by an assigned task, and students "deployed considerable ingenuity in finding ways to avoid or limit complexity" (Warwick et al., 2009, p. 2414). This avoidant behavior stands in stark contrast to the idealized model of ISB in which the motivated seeker follows a directed process of information seeking to the best result.

Competency Theory suggests that students who lack information literacy skills do not realize it and therefore are unlikely to seek out instruction (Gross & Latham, 2007). In a study investigating the relation between standardized Information Literacy Test scores and Library Anxiety Scale scores of college undergraduates, the researchers found that low-skilled students are unlikely to self-identify as lacking skills in either a classroom or library context, and at the same time are unable to accurately assess the skill levels of others (Gross & Latham, 2007). Self-teaching or learning from friends were the most frequently reported methods reported by these students for learning research skills. The authors noted that "students who are unaware of a deficit in their IL skills are unlikely to seek skill remediation on their own or to engage with instruction when forced to take it" (p. 334). Students with low level skills hold inflated views of their own competence in information seeking, do not know their own weaknesses, and often overestimate their abilities to find and evaluate online information (Manuel, 2002). Today's college students may perceive their own fluency with technology to be so thorough that they fail to see value in learning IL skills (Brown, Murphy & Nanny, 2003). While these "digital natives" can often multitask, learn systems without consulting manuals, and surf the web confidently, they also frequently lack the critical thinking and metacognitive skills necessary for college research (Lippincott, 2005).

Together, the IL models of Kuhlthau's Information Search Process, Library Anxiety, the Principle of Least Effort, Satisficing, and Competency Theory provide context and background to efforts to teach effective IL skills to college students. These theories help us understand how students approach – and avoid – evaluating online information, and illustrate the importance of designing learning tools that can ameliorate the challenges students feel while still providing effective skills training.

### 2.1.4. Student information literacy skills

Researchers consistently find that college students are not learning how to think critically about the information they find (Kolowich, 2011). In fact, there is evidence that many students are information illiterate when they enter college (Gross & Latham, 2007).The critical evaluation skills of high school students were studied by Julien and Barker (2009), who found that "understanding of critical evaluation criteria such as authority, accuracy, objectivity, currency, and coverage was not evident" (p. 15). Studies show that most undergraduates are confused by what college-level research entails, do not understand what quality research resources are or how to locate them on the Internet, are unable to narrow down topics to make them manageable, and are overwhelmed by the plethora of available resources (Head, 2007). Incoming college students frequently don't have an understanding of what is required for an academic research paper in terms of authority, content, relevance, or other ways of evaluating information (Parker-Gibson, 2005). While searching for information, students do not effectively evaluate the sources they found, and predominantly viewed the trustworthiness of information in terms of the site or resource rather than by evaluation of the content. Parker-Gibson states that "Overall, students gave less emphasis to the process of finding information than to the end product of the search" (2009, p. 15). This general lack of IL skills in today's students presents a critical problem for IL instructors.

Jackson (2008) suggests that the critical thinking skills described in the IL standards may rely on higher levels of cognitive development that are only reached by senior students. Undergraduates may still be at earlier levels of cognitive development, either dualistic or multiplistic, whereas true critical thinking requires reaching the relativistic stage of development where students are aware they that are active makers of meaning (Jackson, 2008). If students still believe that authorities hold absolute truth and/or take a surface approach to learning, they have may not be able to engage in higher-level evaluative skills. Also, Jackson notes that stress, anxiety and confusion can prompt students to regress to earlier stages when confronted with a problem (for example, library anxiety or the stress of a difficult assignment). Level of domain expertise is another important factor of student information seeking competence. Domain novices tend not to employ the search strategies of experts (author searching, citation searching,

footnote chasing, journal runs, and known-item searching) but instead tend to rely on non-expert strategies such as subject and keyword searching (Drabenstott, 2003). Drabenstott suggests that "librarians and instructors have an important role to play to transition students from non-domain to expert-domain strategies" (p. 85) and advocates for scaffolding domain novices from their usual strategies into the strategies characteristic of experts.

Students' lack of IL skills can in part be attributed to the primacy of the Internet in college students' lives, and their unsophisticated use of online search tools. Rieger et al. (2004) states that a growing number of students do not understand the difference between information that is offered by library resources and by internet search engines The web is the first choice of information source for most students (Herring, 2011). College students overwhelming rely on Google to the exclusion of many other academic search tools (Hargittai et al., 2010; Head & Eisenberg, 2011; Kim & Sin, 2011; Kolowich, 2011; OCLC, 2002; Van Soyoc & Cason, 2006). Most college students instinctively start their research by using public Internet sources (Curtis 2000; Mizrachi 2010). Costello et al. (2004) note that students with an "information-age mindset" rely almost exclusively on the web for all their information needs. When conceptualizing online searching, "students see Google as being 'the' Internet, and they use these two terms interchangeably, seeing them to be one and the same thing" (Julien & Barker, 2009, p. 14). This often means that users make very little use of advanced search facilities which are available (Spink, Wolfram, Jansen & Saracevic, 2001). Instead, students use tools that require little skill, and "appear satisfied with a very simple or basic form of searching" and assume that "search engines 'understand' their queries" (Rowlands et al., 2008, p. 297). In addition, students tend to demonstrate inflated views of their own IL skills, especially students with lower level skills whose lack of skill hinders their ability to accurately assess their own performance or to recognize expertise in others (Gross & Latham 2007). This demonstrates the increasing importance of IL skills in the contemporary online information environment. Thomas (2004) argues that many of the problems that students encounter while researching online electronic reflect their lack of basic literacy skills:

> "…unless youngsters are taught and also expected to appraise critically the resources they find on the Internet and pursue research questions rather than fact-finding tasks, the potential for inspiring the development of

> higher-order thinking skills represented by the activity of Internet-based searching will remain largely unrealized" (Thomas, 2004, p. 136)

Given that the web is such an important part of many students' lives, it is unfortunate that little time in school is dedicated to teaching students how not only to be web users, but web learners (Herring, 2011). While web users may have a superficial, technical understanding of the web, their use involves little or no reflection. Web learners develop effective search strategies, critically evaluate what they find, select relevant information, use information ethically and effectively, and learn from reflection on their use (Herring, 2011). Web learners are information literate users of the web. Madden et al. (2011) argue that any training in information literacy skills should aim to equip students with guidelines to help them assess the credibility of websites, while encouraging them to reflect on the nature of their search task and to apply the guidelines accordingly.

Overall, students have trouble evaluating information and do not have a critical attitude towards information on the web (Brand-Gruwel et al, 2005). When they do evaluate online information, they often utilize criteria that are entirely different from those promoted in IL training (Hargattai et al., 2010). Given the consistency of these findings, Julien and Barker (2009) noted that "despite clear evidence that sophisticated information literacy skills are beneficial to academic success, students are generally unsophisticated information seekers in academic contexts" (p. 12). The academic requirements for credible, relevant sources to support college research papers remain a mystery to many college students, presenting both a challenge and an opportunity for IL instructors.

### 2.1.5. Benefits of IL training

Research shows that IL instruction has a positive impact on student skills, performance and academic achievement. College students who participate in information literacy classes report significantly less library anxiety (Van Scoyoc, 2003) and that high achieving students are more likely to report experiencing formal information literacy instruction (Smalley, 2004; Gross & Latham, 2007). Wang (2006) found statistically significant differences in grades between college students who took a library credit course and students who did not, and those who had taken the instruction in library skills received higher grades on their papers and in their courses.

Selegean, Thomas & Richman (1983) also found a statistically significant improvement in the academic performance of those students who had completed the library instruction course over those students who had not. Ren (2000) found that receiving library instruction significantly increased college students' self-efficacy in electronic information searching.

Daugherty & Russo (2011) showed that students who received IL training continued to use the materials and skills taught in the course throughout their college careers for both course work and personal research, suggesting that a library IL course establishes a foundation for life-long learning. Wong, Chan & Chu (2006) found that students who took an IL course felt that they retained the skills they were taught and also felt confident in doing library research. Stamatoplos & Mackoy (1998) showed that students who received IL training felt increased overall satisfaction with the library. School library studies have also shown IL's positive effect on student attitudes and achievement. Goodin (1991) showed that IL instruction makes a significant impact on students' attitudes and performance and helps prepare high school students for college; Lance et al. (2000) showed that school library programs increased student reading scores; and Todd et al. (1992) demonstrated positive impacts on students' learning processes and outcomes. These studies demonstrate that IL training is beneficial to academic success, and indicate that wider access to IL skills would offer opportunities for success to even more students.

Overall, there is little empirical research into the impact of IL instruction on student learning. This research makes a contribution to the field by conducting a well-designed experimental study that provided measurable outcomes based on between-group comparisons (see Chapter 4 for discussion of the research design.)

### 2.1.6. Challenges to teaching IL

While stakeholders in higher education and in professional societies agree that IL is necessary to students' success in their education and afterward in their work and personal lives, there are multiple obstacles and challenges to implementation of universal IL instruction programs. One obstacle is the "faculty problem": the perception of librarians that faculty are either apathetic or outright obstructive towards efforts to collaborate on IL instruction (McCarthy 1985). This may arise from several factors. Faculty may not view librarians as educational

partners but may regard them as support staff and providers of support services (Owusu-Ansah 2004; Manuel, Beck and Molloy 2005; McGuiness 2006). Faculty may feel that librarians are not qualified to be teachers (Saunders 2012). They may also be unwilling to cede valuable in-class time to librarians (Hardesty 1995; Breivik & Jones 1993; Owusu-Ansah 2004; Hrycaj and Russo 2007). The language of standards and outcomes used by librarians may not connect with faculty, who may view IL as an administrative or bureaucratic imposition (Bell 2011). Faculty and librarians may have very different expectations of the content and desired emphasis of IL instruction (Cunnignham, Carr, & Brasley, 2011). Given these challenges, the onus is on librarians to initiate and sustain discussions with faculty about IL instruction and to proactively build collaborative relationships (Saunders 2012).

Another obstacle may be faculty perceptions of IL training itself. While faculty appear to value IL competencies, they do not necessarily agree on how students should be taught these skills (Saunders 2012). Some instructors seem to expect that students will acquire the necessary competencies on their own by doing research projects, through working with other students, or simply through exposure to resources (McGuinness 2006). Faculty tend to focus only on their own disciplinary content and assume that IL skills will be addressed in other circumstances (Hardesty 1995). They may assume that IL instruction happens in introductory courses, and may feel that it is not their responsibility to teach it themselves (Saunders 2012). Over all, faculty tend to rely on coursework and assignments as the primary vehicle for students to learn IL skills, and do not actively integrate it into their curriculum in a systematic way (McGuinness 2006, Saunders 2012). Even when librarians successfully work with faculty to bring IL instruction into the classroom, the reality is that there is very little time available in the faculty member's curricula to include IL content (van Meegen & Limpen, 2010).

Harris identifies three structural challenges to teaching credibility evaluation in public schools: the variation among curricula and school requirements between states, and even among counties; the proliferation of high-stakes testing; and the culture of filtering and blocking online information to protect children, with the unintended result of limiting opportunities to teach authentic credibility (Harris, 2008). Some schools may also focus on teaching information and communication technology (ICT) skills strictly as tool literacies, in which the technology itself is the object of instruction, a practice which has its root in the traditional business school

curriculum where students are taught the computer applications which they will need to succeed in the workforce (Harris, 2088). An additional obstacle is that IL instruction tends to be located on the periphery of the curriculum in many academic institutions, and getting buy-in from administrators for programs can be a struggle (Branston, 2006). Since IL is applicable in all disciplines, it doesn't belong specifically to any one discipline but belongs to all of them (Weiner 2010). IL may be perceived as something that is library-oriented and not part of the general curriculum (Langford, 1998).

Despite the advocacy of librarians for comprehensive, campus-wide, for-credit IL courses, accreditation standards across the United States are inconsistent in their inclusion of IL requirements (Owusu-Ansah 2004). K-12 schools are inconsistent in requiring IL training for their students (Gross & Latham, 2007). In most high schools, schools, there seems to be an assumption that students will learn IL skills, but there is little empirical evidence that this is true (Herring, 2011). Only a small percentage of higher education institutions with first-year experience programs include a required information literacy component (Boff & Johnson 2002). The inclusion of IL in curricula relies on the advocacy of individual librarians (Weiner 2012). However, librarians lack political leverage within the academic community, making it difficult for librarians to create change (McGuiness 2006). These difficult conditions mean that broad integration of IL into undergraduate education remains an aspiration rather than a fully realized ideal (McGuiness 2006). This lack of consistent, uniform program implementation into the curriculum creates a tension between the official standards and competencies models developed by library leaders, library associations, and national committees, and the practical experience of librarians who deliver the instruction.

IL instruction is often conducted in a "one-shot" format, which requires that only the most basic topics can be covered in one in-class session. However, these one-shot instruction sessions are often "reactive, limited, place-bound, and constrained in terms of wider impact" (Gibson, 2008, p. 12) whereas IL aims to have a broader impact on student success and lifelong learning (Bruce, 2004). One-shot instruction sessions cannot provide students with the sustained practice required to learn, apply and master IL competencies (Mokhtar et al. 2008, Mery et al. 2012). These brief training sessions may be the only explicit and focused exposure to IL that most students receive, and the limited time and contact with students make it difficult for librarians to keep

students interested and engaged (Smale 2011). Since research tools and IL concepts are not intrinsically interesting to most students, catching the attention of highly technologically and visually oriented students is a challenge for librarians (van Meegen & Limpen, 2010). This lack of opportunity to engage and motivate students means that students get bored quickly when IL lessons do not trigger them to pay attention (Doshi 2006). Studies show that students rank required, for-credit classes as their least preferred means of getting library instruction, compared with individual instruction conducted at the point of need while students are actively seeking information (Davidson, 2001). Manuel (2002) argues that the lecture format is an especially ineffective instructional technique for Gen Y students because these students prefer more active learning environments. Costello et al. (2004) state that delivery of library instruction through the traditional lecture method is ineffective and does not engage today's students:

> The literature clearly indicates that the traditional library instruction session organized around a print handout, a lecture, and a demonstration of library resources fails to adequately meet the needs of the current generation of students. Instruction librarians must embrace new technologies to assist them in their teaching mission (p. 453).

This criticism relates back to Gibson's characterization of traditional BI one-shot sessions as "reactive, limited, place-bound, and constrained in terms of wider impact" (2008, p. 12). Information literacy needs to be reinforced over a longer period of time with appropriate scaffolding and guidance (Chu, et al., 2011).

Other formats for teaching IL skills may be more appealing to students. In a study comparing different methods of IL instruction, students specifically mentioned that they preferred an online format since it allowed them to actually use the skills that they were learning about (Anderson & May, 2010). Building IL skills training into the online environment that today's students are accustomed can potentially make IL more relevant to them by giving them practice in evaluating real world sources that they might find in their own information searching process. As information technology continues to reshape contemporary education, new forms of IL instruction continue to emerge, including online, interactive tools and use of social media. Teaching philosophy and pedagogy in librarianship has moved from the early concept of the traditional "sage on the stage" model to the contemporary model of "guide on the side" (Doyle, 1994), embracing cognitive, constructivist and inquiry-based models of learning (Stripling,

2010). Librarians have shifted their educational goals from teaching students how to locate materials for particular assignments using specific library tools to teaching students how to deal with information in any format located anywhere (Thompson, 2002). Overall, there has been a substantial shift in the status of librarians away from traditional roles as transmitters of knowledge towards "the innovative role of facilitator of independent learning" (Lorenzo & Dziuban, 2006, p. 11).

The expanded role of librarians has developed from simply teaching retrieval skills to incorporating "a more total research environment in the course of finding and using information/knowledge" (Owusu-Ansah, 2004, p. 5). Librarians now focus less on selecting and presenting appropriate tools and resources for students' use, instead focusing on to helping students develop their own decision-making skills based on context-specific needs (Schrum & Berenfeld, 1997). A primary motivation of these changes was (and continues to be) the rapidly evolving technological infrastructure of the information environment, and the resultant changing requirements for effective information seeking and use skills (Behrens, 1994). Despite these transformations, however, the fundamental mission of IL education has remained the same: to help people learn to help themselves by becoming more effective, critical-thinking information users (Grassian, 2004).

### 2.1.7. Implications for the research

As the field of IL instruction has evolved over time from its origin in bibliographic and user education to the a broader conceptualization of a set of skills and competencies, approaches to teaching IL have changed as well. The contemporary mission and philosophy of IL instruction envisions developing crucial 21st century skills in all learners. However, the content of much IL instruction remains rooted in the print-based paradigm of source evaluation. The reliance on traditional physical formats and cues is evident in many online IL tutorials, i.e., distinguishing between popular magazines and scholarly journals by comparing physical formats. In today's online information environment, explicit markers of authority relied upon in print materials often do not exist or may be difficult to identify without sustained practice. Today's students may not even recognize traditional physical formats such as magazines and scholarly journals, since individual articles are typically available online as disaggregated items not clearly associated

with a physical source, and students must learn to make their own judgment of source credibility based on synthesizing a variety of evidence-based source characteristics. Due to these factors, IL instruction may seem irrelevant to today's students, who are comfortable with web searching and assume that search engines insure credibility. IL instruction needs to embrace online information sources and integrate learning skills into the authentic context in which students actually do the majority of their research: on the Internet.

Given research that demonstrates the lack of student IL skills, as well as the benefits of IL training in preparing students for future success, a new pedagogical approach to IL instruction is needed. This research aims to test an approach to integrating IL instruction into the online searching environment, customized to online evidence-based source characteristics, and incorporating interactivity and participation. This research addresses several of the challenges identified in the literature review: it address the faculty problem and the deficiencies of the one-shot IL instruction mode by integrating IL instruction into coursework and real-life classroom assignments. It addresses Library Anxiety by removing IL instruction from the context of the library and into the immediate context of online searching where students feel comfortable. It addresses the Principle of Least Effort and Satisficing by giving students repeated practice in a structured process of IL evaluation. It addresses Competency Theory by giving students practice in evaluating both their own evidence-based judgments as well as comparing their work to that of their peers.

Overall, this research explores a new model of online IL instruction that is grounded firmly in the canonical definition of IL as "a set of abilities requiring individuals to recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" while exploring new techniques for teaching and learning these important 21st century skills.

## 2.2. Credibility evaluation

The research addresses what evidence students use to judge credibility of online information. This section reviews research into student credibility evaluation practices, terminology of credibility criteria, and models of the evaluation process. The study of how people make credibility judgments about information sources is broad and highly

interdisciplinary, extending across several disciplines and areas of inquiry (Flanagin & Metzger, 2008). Credibility has been studied across a number of fields from communications to information science, to psychology, and using different approaches, goals and conflicting views (Rieh & Danielson, 2007). With multiple methodological approaches and theoretical models, the field of research is complex and multifaceted (Wathen & Burkell, 2002). Generally, credibility is considered to be part of the larger study of relevance evaluation, which is classified as an element of human information behavior (Lazar, 2007; Rieh & Danielson 2007). Information science researchers investigate the phenomena of credibility along multiple trajectories (Wathen & Burkell, 2002). Rieh and Danielson (2007) reviewed credibility studies across multiple disciplines and developed a comprehensive framework of credibility, organized around five topics: 1) the construct of credibility as a chief element of information quality; 2) orientation toward the targets of credibility evaluation; 3) credibility evaluation processes; 4) situational aspects of credibility evaluation; and 5) the evaluator's background and domain knowledge. They argue that while credibility has traditionally been conceived of as limited to a criterion of relevance judgments, it is important enough to be researched on its own.

There are no universal rules to judge credibility (Hilligoss & Rieh, 2007; Swanson, 2005) and no definitive definition of the term itself (Flanagin & Metzger, 2008). Evaluation of information is often subjective, relative, and situational rather than objective, absolute, and universal (Harris, 2008). However, it is generally accepted among researchers that the primary component of credibility is "believability," which is itself made up of "trustworthiness" and "expertise" (Hilligoss & Rieh, 2007; Flanagin & Metzger, 2008). Many studies have focused on the issue of trust relating to websites (Madden et al., 2011). Trustworthiness can be defined as information that is "reliable, unbiased, and fair" (Hilligoss & Rieh, 2007, p. 1469), while expertise can be described as "the perceived knowledge, skill, and experience of the source" (Fogg et al, 2003). These two primary components of credibility both relate to characteristics of authors and originate in print-based media. Rieh and Danielson (2007) point out that historically the credibility of information has been maintained by gatekeepers such as editors, reviewers, publishers, and librarians. However, in the online environment, such professional knowledge workers are no longer the acknowledged gatekeepers, and making credibility evaluations of digital media calls for different practices of evaluation than those developed throughout the history of traditional print-based media.

### 2.2.1. Theoretical models

Models describing the process of credibility evaluation help us understand how information seekers make decisions about the quality of information sources that they find during searches. Fogg et al. four types of online information credibility judgments: 1) presumed (based on prior assumptions), 2) reputed (based on endorsement by other sources), 3) surface (based on visual and structural cues), and 4) earned (based on experience with the information source) (2003). Flanagin and Metzger (2008) describe two types of credibility evaluations: 1) conferred (by another source's reputation), and 2) tabulated (measured by numerical peer ratings) (2008). Rieh (2002) studied the factors influencing users' judgments of information quality and cognitive authority on the web, and describes a process-oriented model of credibility evaluation in which users make active judgments about information quality and authority based on their own knowledge and experience. Two types of judgment are involved: predictive (based on prior knowledge and expectation), and evaluative (based on opinions formed while encountering the information). These judgments are iterative, repeated by information seekers until the evaluative judgments meet the expectations of predictive judgments (Rieh & Hilligoss, 2008).

Researchers argue that most information seekers' credibility judgments are based on heuristics, cognitive rules of thumb employed to quickly make evaluations. Defined as "situation-dependent dimensions and criteria for evaluation" (Rich & Danielson, 2007, p. 344-345) and "evolved generalizations stored in one's knowledge base" (Sundar, 2008, p. 78), heuristics allow searchers to save the time and energy of an in-depth analysis of quality for every information source they find. Quick judgments are made based on past patterns of experience, which allow the user to conserve cognitive energy in the face of a large number of possible information sources (Sundar, 2008). The use of heuristic cognitive processing is more practical and efficient than the use of a detailed checklist approach to credibility evaluation, and is a common means of coping with information overload (Metzger et al. 2010).

### 2.2.2. Credibility criteria

Researchers often focus on studying how specific features of websites effect users' credibility judgments and what criteria they apply when making these judgments (Fogg et al.,

2003; Hargattai et al., 2010). Since the criteria for judging the trustworthiness of information are subjective and open to interpretation, there are multiple and sometimes conflicting typologies of the specific criteria which make up credibility judgments. Based on a review of "digital literacy" literature, Metzger identified five fundamental criteria for evaluations of online information credibility: accuracy, authority, objectivity, currency, and coverage (Metzger, 2007). These terms were defined by Metzger as: lack of errors and verifiability (accuracy); identifiability of authorship and the author's credentials (authority); presence of bias, opinion, or conflict of interest (objectivity); whether the information is up to date (currency); and the comprehensiveness or depth of the information provided on the site (coverage) (Metzger, 2007).

Rieh (2002) developed a credibility evaluation model, based on the work of Taylor (1986) and Wilson (1983), which focuses on two factors: information quality and cognitive authority. Wilson's concept of cognitive authority relates to second-hand knowledge about whether sources are considered to be worthy of belief. Rieh found that these decisions were related to whether a source is judged to be trustworthy, credible, reliable, scholarly, official, and authoritative (Rieh, 2002). Given the difficulty of establishing authority of much online information, the criteria for this factor are less relevant to the present study than the criteria for information quality, which is based on Taylor' "value-added" model. Taylor focused on users' judgments about the value of information, which Rieh found to be related to whether a source is judged to be good, accurate, current, useful, and important (Rieh, 2002). A comparison of different sets of criteria is shown in Table 2 below. The only terms shared by all the examples are accuracy and currency.

**Table 2. Comparison of evaluative criteria**

| Taylor (1986)<br>Value-added model | Rieh (2002)<br>Information Quality model | Metzger (2007)<br>Digital literacy literature |
|---|---|---|
| Accuracy | Accuracy | Accuracy |
| Currency | Currency | Currency |
| Comprehensiveness | | |
| Reliability | | |
| Validity | | |
| | Goodness | |
| | Importance | |
| | Usefulness | |
| | | Authority |

| | | |
|---|---|---|
| | | Coverage/Scope |
| | | Objectivity |

For comparison, a recent directory of IL games (McDevitt, 2011) includes several cases studies that include the criteria used in different games (see Table 2). For the games that listed their specific criteria, a comparison is shown in Table 3. Again, the only terms shared by all the examples are accuracy and currency. Two terms were shared by three cases: authorship/authority and objectivity. Audience was shared by two cases.

**Table 3. Criteria used in specific IL games**

| IL Game #1 | IL Game #2 | IL Game #3 | IL Game #4 |
|---|---|---|---|
| Accuracy | Accuracy | Accuracy | Accuracy |
| Currency | Currency | Currency | Currency |
| Authorship | Authority | Authority | |
| | Objectivity | Objectivity | Objectivity |
| Audience | Audience | | |
| Purpose | | | |
| | | Coverage | |
| | | | Expertise |
| | | | Relevance |

These sets of criteria show some overlap but also a great deal of variation in the specific concepts that are considered to be part of credibility evaluation. While some terms may be generally related (comprehensiveness and coverage, expertise and authority, objectivity and purpose) there is still a great deal of variability between the specific sets of criteria used in different cases.

Some instructional approaches enlist criteria guidelines to give students a basic checklist of features to investigate when evaluating sources. However, there are arguments against this type of checklist approach. Checklists can be reductive, forcing students into making simplistic "yes" or "no" responses when complete information may be unavailable or difficult to find, especially since authorship can often be difficult to determine online (Harris, 2008). Making such a binary choice may be difficult for inexperienced students who may have more qualified responses. Overall, a checklist approach may encourage a mechanistic process to decision making that does not encourage critical thinking (Meola, 2004), and can result in superficial or even false analyses (Harris, 2008). In addition, it may be unrealistic to expect students to

painstakingly apply all five criteria, i.e., accuracy, authority, objectivity, currency, and coverage, in their daily research habits. The basic checklist approach can be defended, however, since students generally lack the requisite experiences and practice to make informed evaluations of online information on their own (Doyle & Hammond, 2006). Breaking credibility down into specific components may help the student learn the steps involved in making an informed evaluation.

Checklists are a popular model for teaching the evaluation of websites in libraries (Myhre 2012). An early example of a specifically web-based checklist was developed by Jim Kapoun (1998), consisting of five evaluation criteria: accuracy, authority, objectivity, currency, and coverage (Appendix 1). Each criteria includes a set of questions that the student answers to help determine if the website meets a particular criterion. Many academic libraries use some variation of Kapuon's original criteria in their online instruction materials (Myhre, 2012). A more recent version of this checklist that is widely used is the CRAAP (Currency, Relevance, Authority, Accuracy, Purpose) test created by a librarian at California State University, Chico (Blakeslee, 2004). The CRAAP test was not specifically designed for web evaluation, although it contains two additional questions marked as "for Web" (Appendix 2). On this checklist, Kapuon's criteria of objectivity and coverage have been replaced with relevance and purpose. See Table 4 for a comparison of the criteria and their questions prompts.

**Table 4. Comparison of two early checklists**

| Criteria | Kapoun (1998) | Blakeslee (2004) |
|---|---|---|
| Accuracy | • Who wrote the page and can you contact him or her?<br>• What is the purpose of the document and why was it produced?<br>• Is this person qualified to write this document? | • Where does the information come from?<br>• Is the information supported by evidence?<br>• Has the information been reviewed or refereed?<br>• Can you verify any of the information in another source or from personal knowledge?<br>• Does the language or tone seem unbiased and free of emotion?<br>• Are there spelling, grammar or typographical errors? |
| Authority | • Who published the document and is it separate from the "Webmaster?"<br>• Check the domain of the document, what institution publishes this document?<br>• Does the publisher list his or her qualifications | • Who is the author/publisher/source/sponsor?<br>• What are the author's credentials or organizational affiliations?<br>• Is the author qualified to write on the topic?<br>• Is there contact information, such as a publisher or email address?<br>• Does the URL reveal anything about the |

| | | |
|---|---|---|
| | | author or source? examples: .com .edu .gov .org .net (for Web) |
| Objectivity | • What goals/objectives does this page meet?<br>• How detailed is the information?<br>• What opinions (if any) are expressed by the author? | |
| Currency | • When was it produced?<br>• When was it updated?<br>• How up-to-date are the links (if any)? | • When was the information published or posted?<br>• Has the information been revised or updated?<br>• Does your topic require current information, or will older sources work as well?<br>• Are the links functional? (for Web) |
| Coverage | • Are the links (if any) evaluated and do they complement the documents' themes?<br>• Is it all images or a balance of text and images?<br>• Is the information presented cited correctly? | |
| Relevance | | • Does the information relate to your topic or answer your question?<br>• Who is the intended audience?<br>• Is the information at an appropriate level (i.e. not too elementary or advanced for your needs)?<br>• Have you looked at a variety of sources before determining this is one you will use?<br>• Would you be comfortable citing this source in your research paper? |
| Purpose | | • What is the purpose of the information? Is it to inform, teach, sell, entertain or persuade?<br>• Do the authors/sponsors make their intentions or purpose clear?<br>• Is the information fact, opinion or propaganda?<br>• Does the point of view appear objective and impartial?<br>• Are there political, ideological, cultural, religious, institutional or personal biases? |

These questions make explicit the procedure that experts use when evaluating the credibility of websites, and organize the procedure that students will follow in their own credibility evaluation process. They have been developed by content-domain experts, in this case instructional

librarians and educators, to provide expert modeling by showing students the questions they should use to guide their thinking during problem solving (Ge & Land, 2004).

Myhre (2012) conducted a small study (N=14) of the use of a version of the CRAAP test modified to specifically address online sources, and found that participants' scores improved from pre-test to post-test, as did their ability to explain why a website met the criteria. However, qualitative responses suggests that students needed help articulating how they reached their conclusions to these questions (Myhre 2012). This reinforces a weakness of the checklist approach and underscores the importance of embedding a criteria checklist into a process of learning credibility evaluation practices.

Former school media librarian Kathy Schrock developed a simplified version of these criteria that is widely used in IL education, especially in high schools. Instead of using the expert terminology of the previous checklists, Schrock's list uses five easy questions (Who, What, Where, Why, and When) to structure the evaluation process (Appendix 3). This language may be more accessible for high schools students with little exposure to IL training, and the mnemonic format of 5Ws may help these students adopt the criteria. An example of adoption of this model by an academic library is the University of Michigan Library's handout used in IL classes (Appendix 4). Schrock's 5Ws model is discussed in section 3.2.2.

### 2.2.3. Student credibility evaluation practices

For many students, the web has become the starting point when searching for information (Becker, 2003; Costello et al., 2004; Curtis, 2000; Swanson 2005). However, given the volume and diversity of online information sources, traditional credibility evaluation strategies may be difficult for students to apply (Metzger et al., 2010). In this environment of information abundance, students often look for other standards of quality. To many young people, search engines themselves are the new de facto gatekeepers (Metzger et al., 2010). Many students seem to credit search engine relevancy rankings with a kind of omniscience (Harris, 2008). Students assume that search results are recommendations of credibility and rely on search engine brands as endorsement of quality (Hargittai et al., 2010). This type of name-brand recognition has

become a new component of credibility judgments. Students often rely on the top items in a list of search results as recommendations of the best sources and barely go beyond the first few results pages (Lankes, 2008; Hargittai et al., 2010; Spink, Wolfram, Jansen & Saracevic, 2001), even when the abstracts of the search results were less relevant than other results (Pan et al., 2007).

Overall, students verify information they find online significantly less than do older adults (Metzger et al., 2003). Motivated mainly by time constraints, students may compromise information credibility for the sake of speed and convenience, and demonstrate willingness to satisfice (Warwick et al., 2009; Connaway et al., 2011). Students prefer starting a new search session rather than conducting the more difficult and time-consuming tasks of verification, and might change their question or search strategy in order to avoid having to evaluate the results (Warwick et al., 2009). Thus, while many students depend on the Internet to provide information, they rarely take the necessary steps to verify the traditional criteria of credibility for the information that they find (Metzger et al., 2003). Young people generally have simplistic and unsophisticated mental maps of what the Internet is, often not understanding its networked structure, and seeing Google itself as the entire Internet and not understanding how search engines function (Large, 2005; Pan et al., 2007, Rowlands et al., 2008; Julien & Barker, 2009). Since undergraduate students are much less likely to possess the skills to apply sophisticated evaluation strategies, understanding how they actually evaluate online information is important (Leckie, 1996; Warwick et al., 2009).

Studies have investigated the reality of how students perform online credibility evaluations, and what criteria they actually employ. Results consistently show that young people are unlikely to exert much effort in making credibility judgments (Metzger, 2007). Speed and convenience are highly valued by students, who tend to be pragmatic and opportunistic when searching for sources, and not overly concerned about quality (Flanagin & Metzger, 2008; Connaway, et al. 2011). Strategies requiring more effort and initiative are less frequently employed, with verification of author credentials the least used, presumably because it requires the most effort to locate this information on many sites, particularly sites with no identified author or corporate authorship (Metzger et al., 2003). However, students do frequently utilize currency as an evaluation criterion since dates are relatively concrete and easy to locate in online information sources (Metzger et al., 2003). Substantive content-specific criteria such as accuracy

and objectivity may occasionally be verified, but infrequently, in part because they are more time-consuming, and possibly because they require greater disciplinary knowledge than students may possess.

In general, students spend little time or effort evaluating search results, information and sources (Walraven et al., 2009) and do not employ any systematic strategies for judging website legitimacy (Mizrachi, 2010). Instead, they are more likely to simplify website evaluation tasks and make judgments based primarily on site design and surface features rather than content (Harris, 2008). Novelty, "coolness" of the interface, and professional site design can be crucial elements of credibility decisions (Sundar, 2008). Even basic presentational factors such as color can influence students in their credibility evaluations (Agosto, 2002). Technological affordances may also impact how content is experienced and evaluated, with students showing a predisposition toward sites that are novel and interactive (Sundar, 2008).

The field of credibility research has produced much data that describes how users determine credibility, but there has been much less research into teaching effective credibility evaluation (Harris, 2008). Traditional credibility evaluation models assume that students will be thorough and meticulous in their evaluation behavior, and follow a checklist completely and diligently. Instead, college students often use a “risk-averse strategy” for information-seeking and base their decisions on efficiency and predictability (Head & Eisenberg, 2010, p. 3). Although instructors and librarians may be loath to admit it, students are often not motivated by learning but are more concerned with the pragmatic motivations of passing the course, finishing the paper, and getting a good grade (Head & Eisenberg, 2010). Rather than viewing evaluation as a process of reflection and judgment, students may see it instead as merely a procedural step to be cursorily completed (Julien & Barker, 2009). Thus, a change in behavior is required, which is more likely to be addressed through sustained practice of skills rather than a one-shot session. Mizrachi (2010) argues that:

> “librarians and educators must continue to stress the importance of critical thinking and the development of evaluation strategies for determining the reliability of sources found on the worldwide web.” (p. 574).

Information professionals and librarians can play an interventionist role in facilitating students' judgments about credibility, developing critical thinking skills, and helping students make informed judgments about others' knowledge claims (Rieh & Danielson, 2007).

### 2.2.4. Collaborative online evaluation

The Internet has introduced a new paradigm of information credibility, radically different than the traditional print-derived model, instead embracing a model of "multiple distributed authorities based on information abundance and networks of peers" (Metzger et al., 2010, p. 415). Millennial students have grown up surrounded by interactive digital technology and are accustomed to information sharing and remixing. Young people today are actively involved in a culture of distributed social networks which shape the production and distribution of knowledge (Ito et al., 2008). In contemporary learning environments, evaluating information found online often involves collaborative support from others and is "far from being a solitary task" (Head & Eisenberg, 2010, p. 14). Young people often use social and group-based means to evaluate credibility (Metzger et al., 2010). These new modes of collaborative knowledge creation and participatory evaluation are reshaping contemporary practices of credibility evaluation (Lankes, 2008). Farkas notes that "bringing students together to discuss ideas and solve problems collaboratively helps them to co-create an understanding of information literacy that is greater than what any of them could have developed alone" (Farkas , 2012, p. 92).

Research consistently shows that students' information seeking and credibility judgments are becoming inherently social, and relative to social context, as students often consult friends and classmates when making evaluations (Metzger et al., 2003; Rieh & Hilligoss, 2008; Head & Eisenberg, 2010). When today's students search for information, they are less likely to use a systematic information seeking process than relying on interest groups, peer web pages, or social bookmarking (Markless, 2009). Traditional credibility models assumed that individuals work in isolation to form credibility evaluations, but current research shows that users often rely on others when making judgments (Metzger et al., 2010). Credibility evaluations are more likely to be determined by synthesizing multiple sources of judgment, than by employing the print-based concepts of authority and hierarchy (Lankes, 2008). The strategies that students employ when searching for information and the criteria which they use in deciding what information to use is

“deeply influenced by others with whom they feel socially close and with whom they share common ground” (Rieh & Hilligoss, 2008, p. 65). Since they respect one another’s authority online, students are often more motivated to learn from their peers than from adults (Ito et al., 2008).

The sociotechnical model conceptualizes information seeking and credibility judgments as activities mediated by tools and shaped in a social setting (Tuominen et al., 2005; Sundin & Francke, 2009). In this theoretical framework, information seeking and evaluation are considered to be embedded in social practices (Sundin, 2005). Rather than embodying abstract, hierarchical standards of authority, credibility criteria are seen as negotiated, situated in context and learned from communities (Tuominen et al., 2005; Sundin & Francke, 2009). In these situated practices, students learn to recognize what is considered to be reliable knowledge and what is regarded as an uncertain source in the educational context (Sundin & Francke, 2009). This approach to understanding credibility as situated in the online context and conducted collaboratively means that the online tools and social media that students actually use in their daily lives, and utilize practices they are already familiar. Since many students already use Web 2.0 technologies, incorporating these tools into IL instruction can help engage them with the library (Click & Petit, 2010).

Utilizing familiar technology may make credibility training more relevant to Millenials (Flanagin & Metzger, 2008). For today’s students, group engagement in the information evaluation process informs decision making and is “crucial to credibility construction and assessment” (Flanagin & Metzger, 2008, p. 10). This approach focuses on educating youth to assess credibility in participatory ways (Lankes, 2008) and incorporates social evaluation through collective intelligence (Metzger et al., 2010). Harris states that "Some of the best practices in credibility evaluation instruction are those that occur over time, in the context of application, and, in the best cases, provide collaborative and apprenticeship-like experiences" (2008, p. 167). Digital media and networked online learning provide opportunities to build collaborative credibility evaluation tools that support students as they search for and critically evaluate information (Harris, 2008).

In today’s online information environment, credibility is often not determined by the individual, but “within a community engaged in a larger conversation" (Lankes 2008, 114). Collaborative filtering and peer-review systems such as recommender or reputation systems

allow users to pool their intellectual and experiential resources, transforming credibility evaluation into a collaborative rather than an individual effort (Metzger, 2007). Not only the criteria for evaluation but also the processes by which credibility evaluation is taught need to reflect the realities of online information seeking. For example, practices of collaborative inquiry can encourage students to participate in online verification strategies to assess author credentials (Metzger et al., 2003) or to share and compare sources through organized, collaborative online searches (Todd, 2000). To reinforce the real-world value of these practices, collaborative learning opportunities should be employed in the context of real classroom assignments (Harris, 2008) and embrace the Internet as "a means of creating communities and fostering collaboration" (Rieh & Danielson, 2007, p. 350). However, these approaches require "a cultural shift and a certain openness to experimentation and social exploration that is generally not characteristic of educational institutions" (Ito et al., 2008, p. 35).

Gross and Latham argue that "more research is also needed to develop innovative strategies for providing new kinds of information literacy education…. Students with low-level skills may benefit from working collaboratively to create knowledge" (2007, 350). There are many opportunities for credibility education to incorporate the use of new information technology and social media that can help users assess the credibility of online information. Educators can better reach students and promote effective credibility evaluation skills by taking advantage of "the way young people think and work" (Harris, 2008, p. 172). However, the social factors involved in learning are rarely explored in IL teaching and learning (Walton & Hepworth, 2011). Much research on youth credibility evaluation does not address the "newer behaviors emerging in digital environments" (Rieh & Hilligoss, 2008, p. 50). This gap in the literature is addressed by the research.

One example of an experimental study that investigated the impact of online peer interaction on learning IL skills is Walton and Hepworth's (2011) study of students ability to critically evaluate source material. Students in the treatment condition evaluated sample web pages then summarized their own evaluation criteria in postings to a discussion forum in the Blackboard Learning Management System (LMS). Other students responded to these comments in discussion threads. Control groups in the study did not use the discussion forum. Results showed that the experimental group used better quality sources, demonstrated better understanding of a wider range of evaluation criteria, and applied IL evaluation criteria in a more

sophisticated way. The treatment group appeared to have internalized their new knowledge by thinking critically about information, and also demonstrated the higher cognitive states of analysis, synthesis, and evaluation in their reflections on their own learning. The authors state "Students genuinely appear to like the fact that they can see what others have written which appears to add to their own knowledge and promotes a reduced sense of uncertainty" (p. 463). These results highlight the value of the social constructivist aspect of becoming information literate via discussion and collaboration rather than working alone or passively being lectured. Walton & Hepworth argue that the asynchronous nature of online discussion threads has two advantages over face-to-face settings: maintaining a complete record of conversations, which allows students to review and re-read, and providing more time and "cognitive space" to formulate responses. This practice of writing and posting material to a wider audience than just an instructor also introduces students to the idea of being part of an academic community of practice and makes students producers as well as consumers of information (Walton & Hepworth, 2011). The results of this study, while limited to the context of a discussion forum in an LMS, suggests that online peer interaction can be a successful venue for teaching IL skills.

### 2.2.5. Implications for the research

Research into online credibility evaluation often focuses on identifying the criteria and heuristics of how people evaluate information, and theorizing models of credibility judgments. While the results of credibility research are often applied to website designers as a technique of increasing perceived credibility, these results are rarely applied to teaching students better evaluation skills. Less work has been done on studying the best techniques to teaching effective online credibility evaluation practices in students. Credibility research also rarely studies the collaborative, networked online tools that today's students use to evaluate credibility. Group evaluation through ratings and recommendations are common online practice, as is participation in discussion and chat forums. In the online information environment, users determine credibility by synthesizing multiple sources of credibility judgments. Bottom-up evaluations of information quality are often constructed online through collective or community efforts enabled by social media, which in some cases allow information consumers to bypass traditional authorities

altogether. Networked online tools offer new possibilities for integrating credibility evaluation instruction with the collaborative and social practices of today's students, and situating learning in authentic contexts is important.

This research explores a contextual approach that situates credibility evaluation education in the online environment. It aims to incorporate findings from online credibility evaluation research with the evaluation practices of today's students into a learning tool that teaches systematic web credibility evaluation practices situated in an online, networked environment. The use networked social interaction as a medium for teaching credibility evaluation skills has not been widely studied, which is one of the contributions this research makes to the field.

## 2.3. Computer-Supported Collaborative Learning

The research addresses techniques to best support students in learning credibility evaluation skills. This section reviews CSCL learning theories, in particular metacognition and scaffolding. The field of Computer-Supported Collaborative Learning (CSCL) provided the initial inspiration for the design and development of the prototype learning tool. While collaboration is not an explicit variable studied in this research, the importance of collaborative learning to today's students provides an important context to this research. Although the tool does not support explicitly collaborative actions by students, the exposure to other students' evaluations of sources and the comparison of different sources and their evaluations is intended to provide a learning environment that builds a sense of collaborative, group learning.

The focus of research in the field of CSCL has been characterized as the study of how technology can be used as a mediational tool within collaborative methods of instruction (Koschman, 1996), how students can collaborate on problem solving with the help of interactive technologies (Stahl et al., 2006), how technology can support learning in groups, both co-located and distributed (Ludvigsen & Mørch, 2010), and how collaborative learning supported by technology can enhance peer interaction and facilitate knowledge building (Lipponen, 2002). These characterizations share a common emphasis on interaction and mediation as key components, with computer technology serving not just as an instructional tool but as a connective medium between both student/student and student/teacher. Thus, the focus of CSCL research is on process rather than outcomes, through studying how students use mediational

technology as a part of learning, and understanding this process from the participant/learner's point of view (Koschman, 1996).

Software implementations of CSCL principles have been given a variety of names, including computer-supported intentional learning environments (Scardamalia et al 1989); constructivist learning environments (Wilson, 1996); knowledge integration environments (Bell, Davis & Linn, 1995); web-based learning environments (Hung, 2001); networked learning environments (Lipponen 2002); collaborative knowledge-building environments (Scardamalia & Bereiter, 1989); and technology-enhanced learning environments (Wang & Hannafin, 2005). Wilson (1996) defined the constructivist learning environment as "a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities" (p. 5). This early definition was echoed by DeCorte (1996), who stated that "Powerful learning environments should embed students' constructive acquisition process as much as possible in authentic, real-life contexts that have personal meaning for the learners, that offer ample opportunities for distributed learning through social interaction and cooperation, and that are representative of the tasks to which students will have to apply their knowledge and skills in the future" (p. 39).

As the focus of CSCL research is often interdisciplinary, researchers often employ mixed-method research techniques. These methodological orientations are characterized by Stahl et al. as experimental ("coding and counting" interactions and outcomes), descriptive ("exploring and understanding" variables that support meaning-making) and iterative design (continuous improvement of mediational artifacts) (Stahl et al., 2006). Also described as ethnographic, descriptive and observational (Lipponen, 2002), the techniques employed by CSCL researchers focus on investigating how learning can be supported and enhanced through the use of interactive technologies, and on creating educational software in which the computer facilitates in helping learners collaborate and construct knowledge (Sawyer, 2006).

This literature review discussed learning theories in the field, and then focuses on two key themes from CSCL that are important to the research: metacognition and scaffolding.

### 2.3.1. Learning theories

It is generally agreed that CSCL's origins began in the developmental psychology research of Piaget and Vyogtsky, who both investigated the processes by which children learn. While both researchers studied social activity as the basic unit of analysis, they theorized very different models of how knowledge develops. Piaget's socio-cognitive approach emphasized the intellectual conflict a child experiences when new information based on different points of view and conflicting perspectives interacts with prior knowledge (Dillenbourg et al., 1996), and how this conflict is ultimately resolved through a process of assimilation (Koschman, 1996). These conflicts give rise to learning through cognitive restructuring, with social interaction as the context and catalyst for change (Dillenbourg et al., 1996). However, while Piaget considered learning to take place within the individual's head, Vygotsky's socio-cultural approach emphasized social interaction as a crucial element of learning. In this model, mutual engagement forms the basis for co-construction of knowledge (Lipponen, 2002), placing learners in a reciprocal relationship with each other. Social interactions are internalized by the individual and cause cognitive change (Dillenbourg et al., 1996). Vygotsky saw the mind as socially constructed, with consciousness derived from the culture in which it was constructed (Stahl, 2011). Thus, the two models view the phenomena of learning through contrasting lenses. Socio-cognitive experiments generally involve two subjects of approximately the same age or developmental level and focus on outcomes, while socio-cultural experiments study pairs of different developmental levels and focus on interactions (Dillenbourg et al., 1996).

While Piaget's basic cognitive research helped lay the groundwork for CSCL, Vygotsky made a significant theoretical contribution with his conception of the "Zone of Proximal Development" (ZPD). Described by Vygotsky as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers" (Vygotsky, 1978, p. 86) , this model of a bridgeable gap in experiential knowledge underlies the design of much interactive learning technology. The ZPD suggests a site of intervention where theoretically-based support and guidance can enhance the capabilities of learners and help them to expand their knowledge and skills (Koschman, 1996). CSCL applications often employ some version of the ZPD model, with the computer in the role of

guide, in addition to or in place of the skilled peer or teacher. Scardamalia et al. state that "cognitive research provided the scientific basis to design programs that actually helped students learn how to learn, learn how to set cognitive goals, learn how to apply effective strategies for comprehension, self-monitoring, and organization of knowledge" (1989, p. 51). These skills are all important elements of the CSCL learning model, and researchers have developed specific programmatic techniques to support students in gaining experience in using these strategies.

The two main traditions within the learning sciences, cognitive psychology and sociocultural, share a common denominator in the Vygotskian paradigm that social interactions precedes learning and cognition at the level of the individual (Ludvigsen & Mørch, in press). While the traditional didactic pedagogy model was based on the transmission of decontextualized knowledge from the instructor to the student, there has been a change "from teacher controlled, prescriptive and didactic modes to learner-driven social, collaborative and participatory approaches to task design and learner engagement" (McLoughlin & Lee, 2008, p. 648). Most researchers in the field today understand learning as "a process whereby the social and cognitive are fundamentally intertwined" (Teasely, 2011, p. 131). The development of constructivist learning theories, based on active participation in constructing knowledge, was foundational to both library science and CSCL (Sawyer, 2006). While research in instructional technology historically relied on psychological theories of learning (either behavioral or cognitive), social science research emphasizing the social and cultural context of learning has been integral to CSCL (Koschman, 1996). Instead of a behaviorist model emphasizing teaching methods, or a cognitive model emphasizing interiorized mental development, the constructivist model emphasizes "meaningful, authentic activities that help the learner to construct understandings and develop skills relevant to solving problems" (Wilson, 1996, p. 3). Sociocultural studies began to incorporate the complex social environment in which the construction of learning occurs (Koschman, 1996).

The constructivist model of learning is characterized by reciprocity, an egalitarian environment where "participants feel they can both produce and evaluate knowledge and culture" (Ito et al., 2008, p. 39). This learning model emphasizes the acquisition of higher order thinking and problem-solving skills, and de-emphasizes the assimilation of isolated facts (Woodard, 2003). Constructivist theory sees learning as a social process in which students play an active role in building knowledge, discovering relationships among facts, and constructing

conceptual frameworks that explain those relationships (Woodard, 2003). In this view of learning, students create their own meanings and are best guided in learning through coaching and scaffolding of new information rather than being the passive recipients of information through the transmission model of lecture and occasional classroom discussion (Gibson, 2008, p. 16). This trend echoes the movement in IL instruction away from the "sage on the stage" model to the "guide on the side" model.

The development of Web 2.0 technologies has influenced the growth of pedagogy based on social constructivism (Farkas, 2012). Constructivist pedagogy views students as active participants in learning, who are able to construct knowledge based on their own existing understanding in interaction with peers and instructors. Farkas calls this "Pedagogy 2.0" and characterizes it as a "learning ecology that unlocks the benefits of participatory technologies" (2012, p. 87). Networked social media and participatory learning have the potential to fundamentally impact the field of education. McLoughlin and Lee (2008) suggest that utilizing these new tools may "assist us in breaking away from the highly centralized industrial model of learning" (p. 641). Kapitzke (2003) argues that the traditional educational model of rote learning, memorization and basic functional literacy was created to produce a standardized labor force for the 19th century industrial economy. The MacArthur Foundation report "Imagining the Future of Learning Institutions" states that the traditional educational model is out of sync with how today's students actually learn. Most academic institutions are "stuck in an epistemological model of the past" characterized by conventional models of learning that "tend to be passive, lecture driven, hierarchical, and largely unidirectional from instructor to student" (Davidson & Goldberg, 2009). This model of learning is disconnected from the way that students actually learn in their social lives, setting a dangerous precedent in which education in general can appear to be irrelevant to students.

To today's students, academic learning may seem disconnected from the "peer-to-peer distributed systems of collaborative work characteristic of the new internet age" (Davidson & Goldberg, 2009). Many students today collaborate in producing and sharing information in participatory online environments. Social interactions in online learning environments allow youth to participate in a conversation through collaboration with others, and therefore become involved in the process of credibility verification and knowledge creation (Lankes 2008). Information seekers become information producers in these contexts. These principles of

participation and collaboration can be seen as particularly relevant to today's students, the "digital natives" or Millennials (Manuel, 2002; Palfrey & Gasser, 2008; Tapscott, 2009). Networked social computing adds elements that Millenial students value: collaboration and peer-based learning (Manuel, 2002; Head & Eisenberg, 2010). These students expect to work in groups, sharing knowledge, and interact socially with peers (Flanagin & Metzger, 2008). These learners are empowered by situating their learning within a familiar socio-technical environment of social media tools that they are accustomed to using, such as blogs, chat, discussion forums, collaborative online editing, digital media creation, social networking (Halse & Mallinson, 2009). These media can be utilized as next generation e-learning tools that facilitate favored learning styles with "a balance among experiential learning, guided mentoring, and collective reflection" (Dede 2005, p. 7). Farkas notes that "participatory technologies have great potential for use in education as they have the potential to create a more engaging learning environment" (84). The connection-forming, just in time, reflective, and learner-centered characteristics of these networked tools facilitates active involvement in the learning process, which is crucial to effectively educating today's students (Halse & Mallinson, 2009). Social networks and tools offer the educational potential to facilitate self-monitoring, problem-based and collaborative activities through providing students the ability to "navigate and participate on the web and use it to actively solve problems" (Dalsgaard, 2006., n.p.). Another benefit of integrating social software into learning environments is that they can facilitate and strengthen relationships between students through the mutual sharing of work and engaging in group discussions (Dalsgaard, 2006). Together, these affordances offer new opportunities to engage today's college students in new forms of learning.

Davidson and Goldberg argue that "participatory learning" is a key term in thinking about these emergent shifts in education. This parallels the discussion in both IL and CSCL pedagogy about a change of focus from hierarchical, teacher-focused instruction to collaborative student-centered learning. Instead of "passive, lecture driven, hierarchical, and largely unidirectional from instructor to student" (Davidson & Goldberg, 2009, p. 20), participatory learning embraces how today's learners "use new technologies to participate in virtual communities where they share ideas, comment on one another's projects, and plan, design, implement, advance, or simply discuss their practices, goals, and ideas together" (Davidson & Goldberg, 2009, p. 12). This can be seen as part of the move from granting presumed authority to

traditional forms of print media towards new practices of online credibility evaluation. The Internet, along with offering unprecedented access to information sources, also demands that the learner shoulder the responsibility of evaluate the quality of information sources, and today's learning tools must support those skills. Training in these skills must be a major part of the future of learning, in which students must develop "methods, often communal, for distinguishing good knowledge sources from those that are questionable" or "collective credibility" (Davidson & Goldberg, 2009, p. 27-28).

### 2.3.2. Metacognition

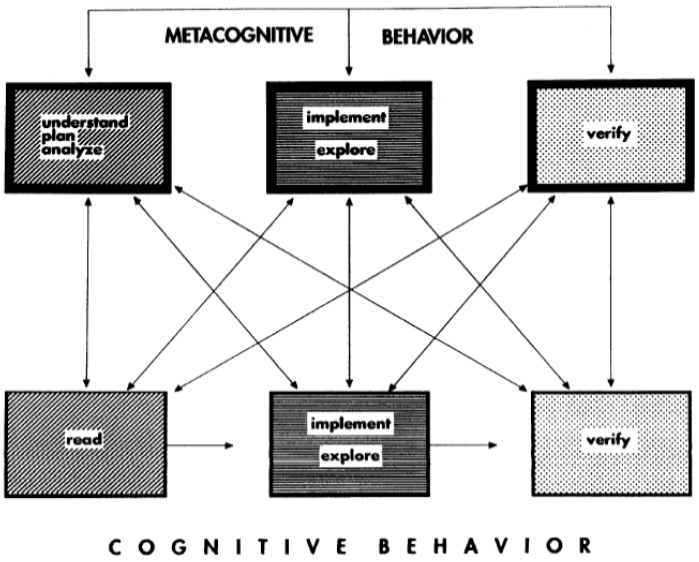
Along with the cognitive abilities of active construction of knowledge, learning also involves metacognition, which involves "planning cognitive tasks, monitoring one's progress to meet goals, taking appropriate steps to solve problems, and reflecting on past performance for future improvement" (Quintana et al., 2005, p. 2360). Metacognitively aware students follow a series of metacognitive activities while completing a task: planning, strategizing, making connections with prior knowledge, monitoring, regulating, and evaluating their own progress (Flavell,1979). Metacognition has also been described as the process of planning, monitoring, goal-setting, problem-solving and other higher-order skills (Scardamalia et al, 1989); the ability to reflect upon, understand, and control one's learning (Schraw & Dennison, 1994); an awareness of student's own knowledge and regulation of their cognition (Kaufman, 2004); the ability to set goals, plan, monitor, and control cognition, motivation, and behavior (Pifarre & Cobos, 2010); as awareness, knowledge, and control of cognition achieved through planning, monitoring, and regulating (Pintrich et al., 1991); as task understanding and planning, monitoring and regulation, and reflection (Quintana et al., 2005); and as the ability to "plan activities to meet goals, anticipate obstacles, monitor their own progress, approach information critically, evaluate information during the problem solving process and by these means to develop a personal information style" (Markless & Streatfield, 2007, p. 22).

Pintrich et al. define metacognition as composed of three dimensions: metacognitive knowledge, metacognitive monitoring, and self-regulation (Pintrich et al., 2000). Akyol and Garrison apply this construct to the online learning environment, and describe it as consisting of three interdependent dimensions: knowledge of cognition, monitoring of cognition, and

regulation of cognition (Akyol & Garrison, 2008). Knowledge of cognition consists of pre-task states such as knowledge of the inquiry process, and knowledge of critical thinking and problem solving. Monitoring of cognition consist of states such as commenting about self and others' understanding, and making judgments about the validity of content. Regulation of cognition consists of states such as procedural planning, setting goals, and questioning progress (Akyol & Garrison, 2008). Schraw and Dennison defined the components of metacognition as knowledge of cognition (consisting of awareness of one's strengths and weaknesses, knowledge about strategies, and why and when to use them) and regulation of cognition (consisting of planning, implementing, evaluating, and monitoring strategies) (Schraw & Dennison, 1994).

Artz and Armour-Thomas stated that cognition involves doing, whereas metacognition involves choosing and planning what to do and monitoring what is being done (Artz & Armour-Thomas, 1992). The authors categorized a set of problem-solving activities (read, understand, analyze, explore, plan, implement, verify, watch, and listen) as either cognitive or metacognitive (or both), and developed a model that shows the interactions between these states. The model developed by the authors is shown in Figure 1.

**Figure 1. Model of cognitive and metacognitive behaviors**




(from Artz & Armour-Thomas, 1992)

In essence, metacognition is thinking about thinking – understanding one's own thought process and their understanding of the task (Flavell, 1979). Higher levels of metacognitive ability facilitate the transfer of acquired knowledge and skills to new learning tasks and problems (De Corte, 1996). Thus, students who are learning unfamiliar content should be significantly helped by developing metacognitive skills, which can compensate for low domain knowledge and limited strategy repertoire (Bruning, et al., 2004). Metacognitively-aware learners have been shown to be more strategic and perform better than unaware learners, through planning, sequencing, and monitoring their learning in a way that directly improves performance (Schraw & Dennison, 1994). Good learners are also highly aware of their own thinking and memory and use that information to regulate their learning (Bruning, et al., 2004). The purpose of metacognitive training is to help students think about their learning, how they approach specific tasks, and the success of their strategies (Akyol & Garrison, 2011). Acquiring these skills is an important objective of education (Scardamalia et al., 1989) and "a hallmark of effective learning" (Kaufman, 2004, p. 142).

However, studies show that students often lack the ability or awareness to monitor and regulate their cognitive processes while engaged in problem-solving (Artz & Armour-Thomas, 1992), which likely relates to the lack of metacognitive skills (Ge & Land, 2004). Novice learners usually have weak metacognitive skills, which are important for engaging in complex practices like online inquiry (Quintana et al., 2005). These students are unlikely to be successful in completing complex web-based tasks, such as online credibility evaluation (Kauffman et al., 2008). Bruning (1994) noted that college students:

> "…show little awareness of their own thought processes and do not regulate themselves in a strategic manner. They are unable to compensate for their weaknesses and capitalize on their cognitive strengths, to select important topics for study, or to plan their approaches to problems effectively. To help them acquire these cognitive skills, we need to be prepared to model the kinds of thinking required by our fields (and) create the kind of classroom social communities that stimulate overt expressions of thought and generate peer feedback." (p. 18)

Supporting college students in modeling the metacognitivc strategies for online credibility evaluation, and facilitating reflection through peer evaluations, is a focus of this research project.

Metacognition is not just an internal practice, but is socially situated and includes communicating, explaining, and justifying one's thinking to others (Akyol & Garrison, 2011). The social constructivist learning model suggests that peers mediate each others' learning through effective dialogue, such as asking questions and providing examples (Ge & Land, 2004). Lajoie and Lu (2012) argue that a "key mechanism in improving metacognition or self-regulation is the ability to observe and listen to other perspectives" (p. 46). Peer interaction in the learning process through asking for help, clarifying ideas and responding to feedback can enhance self-regulated learning through reflection on key task-solving processes (Pifarre & Cobos, 2010). Interpersonal monitoring and regulating of members goal-directed behaviors can be encouraged by small group problem-solving (Artz & Armour-Thomas, 1992). Through participating in regulating each other's work on the social level, peers in networked collaborative-learning environments can help students became more aware of their own learning process (Pifarre & Cobos, 2010). Social interaction and communication through mediated tools can help structure self-regulation of behavior through reflection in action (Hung, 2001). When students compare their work to that of others or are exposed to multiple perspectives from other students they engage in spontaneous reflection (Lin, 2001). As students frame and resolve problems through social interaction, they not only develop content knowledge but practice critical thinking and analysis (Oliver, 2000). By contrasting their own hypothesis and evidence with those generated by their peers, and evaluating peer theories, students have the opportunity to reflect on what they do and do not understand (Lin, 2001). The act of explaining, questioning, clarifying, justifying, or collaboratively developing strategies can help students become metacognitively mature (Akyol & Garrison, 2011). Supportive social discourse is also regarded as an important aspect of metacognitive development (Lin, 2001).

Information literacy can be seen as inherently metacognitive in that it encourages individuals to become aware of their search and evaluation skills and apply them to specific information needs (Booth, 2011). The *Information Literacy Competency Standards for Higher Education* aim to support students in building a "metacognitive approach to learning" through gaining control over their interactions with information and through making explicit the criteria for gathering, analyzing, and using information (ACRL, 2000, p. 6). The Middle States Commission on Higher Education in their *Guidelines for Information Literacy in the Curriculum* echo the ACRL, stating that "one of the highest and best uses of information literacy is as a

metacognitive device for students to better manage the learning process" (MSCHE, 2003). Walton & Hepworth (2011) argue that IL should be regarded as "a metacognitive tool which provides a self-regulatory framework within a subject based programme" (p. 453). Any training in IL skills should not only equip students with guidelines to help them assess the credibility of websites, but should also encourage them to reflect on the process of evaluation (Madden et al., 2011).

It has been argued that the ACRL IL standards themselves support a constructivist learning approach since they advocate for "student-centered learning environments where inquiry is the norm, problem solving becomes the focus, and thinking critically is part of the process" and helping students "construct a framework for learning how to learn" (Bobish, 2010; Allen, 2008). The convergence between IL and metacognition, specifically self-regulation, can be described as an intersecting Venn diagram, with overlapping or shared skills in the center. See Figure 2 below for a diagram.

**Figure 2. Overlap between IL and metacognitive skills (from Wolf, 2007)**

This diagram shows that self-regulated learners monitor while information-literate learners evaluate (Wolf, 2007). While important components of both concepts lay outside the overlapping area, the commonalities between the two fields are significant. Students in the center area possess the skills and strategies to be self-regulated information seekers and evaluators.

Many, if not all, of the specific skills in both concepts can be applied directly to the task of evaluating online information. Effective searching of the web is a complex process of reasoning and decision making (Todd, 2000). In the online environment, a successful student has to continuously decide where to go next and constantly has to evaluate how the information they retrieve is related to their actual learning goals (Bennert & Mengelhamp, 2013). Strong self-regulation ability and metacognitive awareness are necessary in order to be successful in web-based learning (Raes et al., 2012). Iding et al. (2008) state:

> "The incorporation of a metacognitive framework and the use of metacognitive prompts… allows students to evaluate their own credibility determinations regarding Web-based information and decide whether their judgments are effective or not. It would also provide a basis for internalizing effective credibility criteria" (Iding et al. 2008, p. 79) .

Students with metacognitive skills stay focused and can better assess the legitimacy of online information (Garrison & Akyol, 2013). The use of metacognitive prompts can help students to develop strategies to be more critical in their evaluation of the credibility of web sources (Iding et al. 2008).

However, Markless (2009) points out that most IL models position reflection at the very end of the process or simply take it for granted. This approach is not likely to enable the development of the metacognitive strategies necessary to perform problem-solving with information, particularly when students are working independently online (Markless, 2009). Since they are part of an iterative process of learning, metacognitive strategies cannot simply be inserted into a linear model , but must be integrated into the IL framework (Markless, 2009). While metacognition is frequently studied in education and psychology research, it is infrequently researched in IL studies (Gorrell et al., 2009). This research explores integrating IL and metacognition instruction, and one of the outcomes that was measured in the experiment is the effect on metacognitive awareness of students using the IC tool.

### 2.3.3. Instructional scaffolds

Metacognition can be systematically supported by learning software applications through the use of instructional scaffolding. Wood, Bruner and Ross (1976) defined scaffolding as a "process that enables a child or novice to solve a problem, carry out a task or achieve a goal which would be beyond his unassisted efforts" (p. 90). Azevedo (2005) defined scaffolding as "instructional support in the form of guides, strategies, and tools that are used during learning to support a level of understanding that would be impossible to attain if the students learned on their own" (p. 199). Scaffolding consists essentially of rationalizing those elements of the task that are initially beyond the learner's capacity, thus enabling the learner to focus on and accomplish those elements that are within his range of competence. This definition of scaffolding corresponds to Vygotsky's concept of the Zone of Proximal Development, in which a knowledgeable adult or peer provides support to help learners accomplish tasks that are beyond their current level of proficiency (Vygotsky, 1978; Azevedo, 2005; Zhang & Quintana, 2012). Essentially, scaffolds change the task in some way so that learners can accomplish what would otherwise be out of their reach (Reiser, 2004). This assistance for the novice in performing a specific task operationalizes Vygotsky's concept of the relationship between instruction and psychological development (Sharma & Hannafin, 2007). Instructional scaffolds can help students to work through a difficult task and attain a higher level of proximal development that would be beyond their unassisted efforts (Ge & Land, 2004). With the assistance of scaffolds, learners can bridge the gaps between their current abilities and intended learning goals that would be unachievable through their unassisted effort alone (Rosenshine & Meister, 1992). Reiser argues that scaffolding supports student learning through two complementary mechanisms: 1) structuring the learning task, guiding learners through key components and supporting their planning and performance, and 2) shaping students' performance and understanding of the task in terms of key disciplinary content and strategies (Rieser, 2004). This scaffolding can supplement the learner's own metacognition, help them use epistemically appropriate practices and products, and help them engage in more productive cognitive activities (Quintana et al., 2004).

Metacognitive support aims to increase students' learning competence by means of systematic instruction in order to improve learning performance (Bennert & Mengelhamp, 2013).

CSCL software often incorporates automated prompts and questions which encourage student reasoning and justification of ideas, providing students structure for collaboratively discussing ideas, justifying them with evidence, or revising them after reflection on peer feedback (Oliver, 2000). This model of iterative, incremental learning emphasizes that students build knowledge via "the continual improvement of ideas through intentional interactions with one another" (Lai, 2006, p. 130). Social software tools are "increasingly being recognized as essential scaffolds and learning tools" (McLoughlin & Lee, 2008, p. 649) because their affordances support participatory knowledge creation through networking, socialization, communication and engagement with communities of learning (McLoughlin & Lee, 2008). Scaffolds can be both social and technological, ranging from a human tutor to embedded software prompts (DBRC, 2003). Scaffolding can take the form of instructional supports which provide explicit structures for an otherwise haphazard sequence of uncoordinated events (Azevedo, 2005; Stahl, 2006). These type of scaffolds can promote deep learning, especially if they are tailored to the learner's needs (Sawyer, 2006). These needs are rooted in the unique challenges and obstacles novices typically face when attempting to learn new disciplinary skills: superficial understanding, a focus on results rather than process, unfamiliar discourse practices, and unfamiliar strategies used by experts that are often tacit (Reiser, 2004). Thus, effective scaffolds help students expand their understanding from prior knowledge and misconceptions to more advanced understanding, challenging superficial beliefs and exposing students to expert discourses and strategies (Reiser, 2004; Sawyer, 2006). During this process, scaffolds enable learners to reflect in action (Hung, 2001), providing "opportunities for students to deepen their understanding by externalizing and comparing their knowledge and beliefs with those of their peers" (Sharma & Hannafin, p.43). Another form of scaffolding is guiding students to compare their work with others' or expose them to multiple perspectives, which can trigger spontaneous reflection (Lin, 2001). Research has shown that students asking each other questions and self-questioning constituted successful scaffolds, because while regulating each others' work on the social level helped students to self-regulate (Pifarre & Cobos, 2010). By contrasting their hypotheses and evidence with those generated by peers, students have the opportunity to reflect on what they do and do not understand (Lin, 2001).

The concept of scaffolding has been adopted in research on technological supports for learning, which have become increasingly important in pedagogical design (Quintana et al.,

2004). In computer applications, mechanisms of scaffolding can structure tasks in stages, decompose complex tasks into component parts, and monitor progress (Reiser, 2004). The procedural and rationalized structure of most educational software can make the implicit elements of metacognition more explicit to learners (Quintana et al., 2005). For example, the turn-based process of asynchronous online communication provides greater time for reflection on each message and allows less confident students to learn by observing others' conversations (Dillenbourg et al., 1996). Reflection is scaffolded by displaying, prompting, and modeling one's own and others' learning processes, as well as providing a forum for reflective social discourse (Lin, 2001). Students are encouraged to use their existing self-regulated learning strategies, including self-monitoring by automated instructional supports in the form of problem-solving prompts (Kauffman et al., 2008). By using visual representations, planning tools, and reflection support, learning software can help make the implicit nature of metacognition more explicit to learners (Quintana et al., 2005). Effectively using these metacognitive skills is central to the benefits of computer-supported learning environments (Pifarre & Cobos, 2010). It is important to provide carefully structured and sequenced instructional scaffolding in constructivist learning environments, because cognitive overload may be a challenge for novice learners (Ge & Er, 2005). Since students do not spontaneously engage in metacognitive thinking unless they are specifically encouraged to do so, it is important to include metacognitive support in learning environments (Lin, 2001).

Design principles that support metacognition include: providing frequent opportunities for students to self-assess what they know and do not know, helping students articulate their own thinking, fostering a shared understanding of goals, and developing knowledge of the self-as-learner in particular community (Lin, 2001). Specific techniques for supporting metacognition include the structured decomposition of learning tasks into discrete units and the segmentation of the learning goal into stages. Tools such as graphical organizers, progress monitors, behavioral prompts and online discussion structure and make visible metacognitive processes.

Scaffolds can be simple progress monitors, visualizations that give the student both an overview of the entire process and guidelines for achieving the individual component parts, through graphical organizers, inquiry maps and planning grids (Quintana et al., 2005). They can also include time and effort planning supports such as monitoring mechanisms that display a list of goals, marking goals that have not yet been completed, and indicating the time remaining

(Azevedo, 2005). These visual representations introduce explicit structures to what had previously been just a series of uncoordinated events (Stahl 2011), and are ultimately mechanisms for enhancing the development of the student's self-regulation processes (Pifarre & Cobos, 2010).

Scaffolds can also take the forms of question prompts, which can include procedural prompts, elaboration prompts, and reflection prompts (Ge & Land, 2004). Procedural prompts guide learners step by step through the entire process of a specific problem-solving task; elaborative prompts guide students to articulate their thoughts and elicit explanations; and reflection prompts encourage reflection on their learning on a meta-level that students do not generally consider (Ge, 2013). Prompts can be defined as measures to induce and stimulate cognitive, metacognitive, motivational, and/or cooperative behaviors during learning, which vary from hints, suggestions, reminders, and sentence starters (Morris et al., 2000). Metacognitive prompts are instructional measures integrated in the learning context that ask students to carry out specific metacognitive activities (Bannert & Mengelkamp, 2013). Question prompts have been shown to be beneficial in developing learners' metacognitive awareness and self-regulatory abilities (Ge et al., 2010). Metacognitive prompts require students to explicitly reflect, monitor, and revise their learning process (Bennert & Mengelhamp, 2013). Confidence judgments which ask students about their performance shortly after completing a task is also an effective approach to encouraging metacognitive skills, by invoking self-monitoring of the student's own performance (Kauffman et al., 2008). Confidence judgments are a good predictor of self-monitoring behavior, and self-monitoring is related positively to metacognitive knowledge (Kauffman et al., 2008).

Studies have shown that question prompting is an effective instructional strategy that guides students to the most important aspects of a problem, and encourages planning, monitoring, and self-reflection (e.g., Palincsar & Brown, 1984; Scardamalia & Bereiter, 1989). Procedural prompts help learners complete specific tasks, while elaboration prompts help learners articulate thoughts and elicit explanations (Ge & Land, 2004). Giving students prompts in the form of repeated guiding questions requires them to evaluate and elucidate their understanding (Iding et al. 2008). Ge and Land (2003) found that students who were prompted by questions increased showed increased efforts to seek and identify relevant information for their problem. Bixler and Land (2011) found that question prompts significantly improved

student problem-solving in a study of college students using a web-based learning environment. Another study by Ge and Er (2005) showed that question prompts helped students organize their thoughts, guided them through the complex problem-solving process, reminded them of the problem-solving steps and the specifics which they might not have thought about explicitly. Prompts can effectively teach students to generate critical metacognitive questions about learning tasks and to construct a deeper understanding of the domain (Lin, 2001). Question prompts play an important role in engaging learners in metacognitive actions such as self-explanation, self-questioning, and self-monitoring and reflection (Ge & Er, 2005). Such metacognitive scaffolds can "assist students in assessing their state of understanding, reflect on their thinking, and monitor their problem-solving processes" (Kim & Hannafin, 2011, p. 408). Table 5 lists examples of types of question prompts.

**Table 5. Examples of question prompts**

| Author | Prompts |
|---|---|
| Tanner (2012) | Planning |
| | What are all the things I need to do to successfully accomplish this task? |
| | What resources do I need to complete the task? |
| | Monitoring |
| | What strategies am I using that are working well or not working well to help me learn? |
| | What other resources could I be using to complete this task? |
| | Evaluating |
| | To what extent did I successfully accomplish the goals of this task? |
| | What worked well for me that I should use next time? |
| Kauffman et al. (2008) | Problem solving |
| | What do you see as the primary problem? |
| | What are possible solutions to the problem? |
| | Reflection |
| | How certain are you that you have identified the primary problem? |
| Ge & Land (2004) | Elaboration |
| | What do you think are the primary factors of this problem? |
| | Do you have evidence to support your solution? |
| | Reflection |
| | What are the pros and cons of the solution? |
| | What could have been done differently? |

Research has shown the effectiveness of using prompts in improving student performance. Encouraging planning for and reflection on activities through self-monitoring

prompts results in students demonstrating more integrated knowledge (Davis, 2000). Students who are prompted to monitor their progress achieve higher than do students who are not prompted to self-monitor (Kauffman, 2004). Studies have demonstrated that question prompts facilitates students' problem-solving processes, specifically in problem representation, making justifications, developing solutions, and monitoring and evaluating performance (Ge & Land, 2003; Ge & Land, 2004; Ge, Chen & Davis, 2005). In a study of 54 undergraduates using a web-based learning environment, Kauffman et al. found that students who received automated problem-solving prompts and reflection prompts provided better answers to questions than students who did not receive prompts (Kauffman et al., 2008). In a study of 96 undergraduates using a web-based cognitive support system, Ge at al. found that students who received problem-solving prompts and compared their own answers to their peers' significantly outperformed those who did not (Ge et al., 2010). These question prompts were also shown to be beneficial in developing learners' metacognitive awareness and self-regulatory abilities (Ge et al., 2010). In an experimental study with 119 students, those who received self-monitoring prompts showed significant improvement on achievement tests over those who did not (Kauffman, 2004). Bixler and Land (2011) studied 79 undergraduates and found that students who received metacognitive scaffolds during the study performed significantly better than those who did not, with moderate to high effect sizes.

Raes et al. (2012) conducted an experimental study on the effectiveness of technology-enhanced scaffolding to support both knowledge acquisition and metacognitive awareness. They studied 347 secondary school students (grades 9-10) in science classrooms conducting a web-based collaborative inquiry project. Their results showed that technology-enhanced scaffolding is effective for producing learning gains and improved metacognition. However, the authors also note:

> "Despite the widespread recognition of the need to scaffold students during web-based inquiry learning, the understanding of how students' meta-cognitive awareness can be supported in authentic classroom settings is rather limited. Especially, more insight is needed in how to foster students' web-based information problem solving skills, a pivotal 21st century skill which is required in everyday life in and out of the classroom. The Internet brings up-to-date scientific findings in the reach of everyone, yet searching and finding relevant, credible, and scientifically substantiated information on the Internet is a challenging task. Consequently, an important question

> that arises is how to support the information problem solving skills of a variety of students." (p. 90)

This question motivates the present research to incorporate instructional scaffolds into the online credibility evaluation in learning tool.

Ge (2013) reviewed the literature on question prompts and found that they play four main functions in facilitating self-monitoring and self-regulation by:

1. Directing students to important information that they may have missed
2. Guiding students to elaborate their thoughts, make justifications, and generate arguments
3. Facilitating reflection, metacognition and knowledge integration
4. Encouraging students' self-monitoring during problem-solving

Online learning tools often use these types of scaffolding and prompts. Quintana et al. (2005) describe several examples of effective utilization of prompts in learning environments. The Digital Ideakeeper tool is an online scaffolded notebook, which automatically frames a webpage with structured notetaking fields. The notebook is divided into three tabbed sections titled Skim, Read, and Summarize, which serve as a process visualization of the structured steps that the learner needs to complete. Each step is decomposed into sub-steps scaffolded with textual prompts. Another scaffolded inquiry tool, Symphony, provides a visual process map that represents the necessary steps of the research process, along with a planning grid that allow students to create and modify their research plans. By making the entire process explicit and visible, students are reminded that inquiry process involves a range of activities, not just the one foremost in their mind. A third scaffolded tool, Artemis, supports students in searching for and organizing information, and sharing questions and websites with each other. These tools make the inquiry process explicit and visible, which can help learners see the "big picture" and help them monitor and regulate their work (Quintana et al., 2005). These examples of scaffolded tools to support online inquiry through a structured process of explicit steps were inspirational for the design of the prototype IC tool.

Quintana et al. noted a lack of an empirically grounded consensus about successful scaffolding methods, and developed a design framework to define and evaluate scaffolding approaches for software tools (Quintana et al., 2004). Their Scaffolding Design Framework

synthesizes prior design efforts, theoretical arguments, and empirical work into a systematic set of guidelines and strategies. Situated within the domain of science inquiry learning, this framework is organized around the components of scientific reasoning: sensemaking, process management, and reflection and articulation. Sensemaking refers to the basic operations of science inquiry such as generating hypotheses, collecting observations, analyzing data, making comparisons, and constructing interpretations. Process management involves engaging in and managing new disciplinary processes. Reflection and articulation involves self-assessment through reviewing, evaluating and synthesizing one's work. The specific scaffolding strategies within each component of the Scaffolding Design Framework are shown in Table 6 below.

**Table 6. Scaffolding Design Framework (Quintana et al., 2004)**

| **Scaffolding guidelines** | **Scaffolding strategies** |
|---|---|
| Sensemaking | Use representations and language that bridges learners' understanding onto expert practice |
| | Organize tools and artifacts around disciplinary strategies |
| | Use representations that viewers can evaluate, such as graphs and charts. |
| Process management | Provide structure for complex tasks and functionality |
| | Embed expert guidance |
| | Automate nonsalient and routine tasks |
| Reflection and articulation | Provide prompts to facilitate planning, monitoring, and sensemaking |

This Scaffolding Design Framework provides detailed discussion of these guidelines and provides examples of successful implementations in learning software. The goal of the framework is to provide a basis to develop an integrated theory of pedagogical support for complex learning with software, and to provide general principles for evaluating what pedagogical approaches are effective in supporting learners (Quintana et al., 2004). This Scaffolding Design Framework was used in developing the pedagogical model and design features of the IC tool learning tool (see Chapter 3 for discussion of the incorporation of scaffolds into the design and development of the IC tool prototype).

### 2.3.4. Implications for the research

Although there is a significant amount of literature on case studies of IL instruction, there is little empirical research on its effectiveness beyond surveys, pre/post-tests and outcomes evaluation (Barclay, 1993; Coupe, 1993; Rockman, 2002; Orme, 2004). Scaffolding and metacognition have been studied in other fields, e.g. education and psychology (Kauffman, 2004; Iding, 2008; Pifarre & Cobos, 2010), educational media (Bannert, Hildebrand & Mengelkamp, 2009), pharmacy (Ge, Planas & Er, 2010; Ge, 2013), science (Qunitana, et al., 2004; Azevedo, 2005; Quintana, Zhang & Krajick, 2005; Raes, 2012; Tanner, 2012), and specific domains such as reading comprehension and writing skills (Lin, 2011). However, there has been little research on the application of scaffolding and metacognitive support to teaching students IL and credibility evaluation skills (Gorrell et al., 2009; Bannert & Mengelkamp, 2013), and in online learning environments (Akyol & Garrison, 2011). These gaps in the literature are addressed by the research through conducting an experimental study on the learning impact of an IC tool which incorporates scaffolding and metacognitive support.

The design of the IC tool was inspired by CSCL learning theory and its application to online learning tools. The constructivist model of learning and Vygotsky's Zone of Proximal Development were fundamental inspirations. Constructivist theory, which sees learning as a social process in which students play an active role in building knowledge, and the ZPD model of bridging students' current knowledge toward more advanced practice, both informed the pedagogical model of the prototype learning tool. The importance of collaborative and participatory learning to today's students also provides an important context to this research.

The metacognitive skills of planning, monitoring and reflecting on the IL process were supported by structuring tasks into stages, decomposing complex tasks into component parts, and monitoring progress. The design of the tool follows Quintana et al.'s Scaffolding Design Framework of supporting sensemaking, process management, and reflection and articulation. Learning is scaffolded by the structured decomposition of tasks into discrete units, and the segmentation of the learning goal into stages. The Digital Ideakeeper notebook created by Quintana et al. was an inspiration for the browser-based notebook in The IC tool. Tools such as a graphical organizer for online notetaking, a visual representation of the 3-stage IL process, a progress monitor of the student's relative completion of each stage, tips and question prompts regarding the credibility criteria and the evaluation process are built on the literature showing

their effectiveness in supporting student learning. These tools will help make visible the metacognitive processes required for effective online credibility evaluation. The key point for designers is to explicitly depict online inquiry tasks to students (Quintana et al., 2005).

The social constructivist model of learning provides a theoretical framework for scaffolding the online credibility evaluation process and for providing metacognitive support. This theoretical model has guided the design and development of the prototype IC tool. Through instructional supports that structure an otherwise haphazard sequence of actions, and visual representations that structure what had previously been just a series of uncoordinated events, the scaffolds embedded in the prototype learning tool enhance the development of the student's metacognitive and self-regulation processes. Since novice learners usually have weak metacognitive skills, which are important for engaging in complex practices like online credibility evaluation, the prototype learning tool provides needed practice and reinforcement of these important skills. In addition, the situated, just in time, web-based nature of the tool facilitates active involvement in the learning process by Millennial students who value collaboration and peer-based learning.

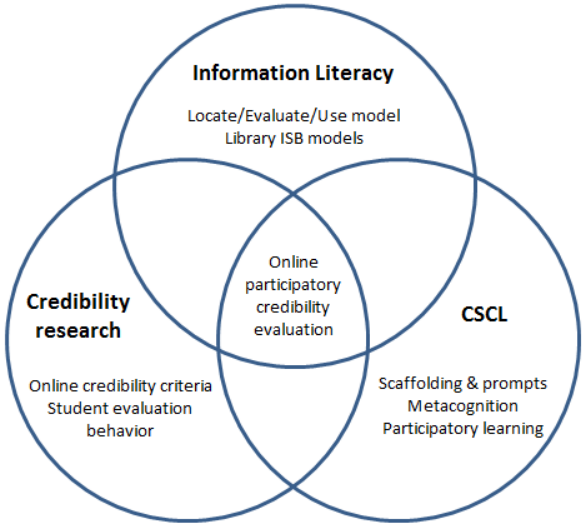
## 2.4. Literature Review Summary

This research intends to fill a gap in the literature that exists at the intersection of three fields: information literacy, online credibility evaluation, and CSCL learning models. While research in each of these fields is divergent and generally not connected, they share similar principles: developing models of online information evaluation processes, and investigating real world evaluation practices. Overall, IL research and practice remains focused on practical teaching practices and is segregated from research into credibility evaluation, despite the commonalities in their content and models. This separation reflects the origins of the two practices in library science and information science respectively. IL research often consists of simple cases studies and self-report, while credibility evaluation practices have often been empirically studied through observation and diary studies in the online environment. The results of credibility research are often applied to website designers as techniques of increasing perceived website credibility, but are rarely applied to teaching students better evaluation skills. While CSCL approaches to support learning - metacognition, scaffolding, and participatory

learning – have been shown to be effective, these techniques are usually applied in STEM (science, technology, engineering, and mathematics) fields and have not been utilized to teach IL and credibility skills instruction. CSCL applications are often domain-specific, with tools being built on specific disciplinary expert practice, primarily in the sciences (mathematics, physics, engineering). Most CSCL applications are not generalizable to any other content area of discipline. Thus, a tool for a different discipline must be built from scratch. However, IL and credibility evaluation skills can be applied to information in any discipline, particularly in the online information environment.

While LIS practitioners develop guidelines and checklists for IL training, they are usually not informed by research into online credibility evaluation practices, but are based in the traditional model of IL as bibliographic instruction. In reality, however, that model has lost much of its meaning in the contemporary online information environment. Information literacy is inherently metacognitive, and IL instruction can benefit from the application of CSCL learning theory, in particular, constructivist learning models, participatory learning, and the use of scaffold and prompts. While these three fields of research do not often interact, there are significant areas of conceptual overlap, as shown in Figure 3 below.

**Figure 3. Theoretical model for online learning tool**




This intersection point has not been explored in the existing literature. Combining theoretical backgrounds and findings from these three fields offers a new approach to teaching

effective online IL and credibility evaluation skills. Such an approach situates IL instruction in the real-world information environment of the Internet which students rely on for finding information, gives students practice in performing credibility evaluations in the online information environment using specific criteria, uses instructional scaffolds to support learning, teaches a structured and systematic process for evaluation, provides reflection and monitoring support metacognition, and employs the participatory learning functions that students are accustomed to. This study tests a pedagogical method that combines these elements into an online credibility evaluation learning tool. The purpose of the research is to investigate the effects of scaffolding and metacognitive support on student learning of online credibility evaluation skills. The study tests if the IC tool incorporating scaffolding and metacognitive support increases students' knowledge of the expert criteria that constitute credibility evaluations, the evidence-based source characteristics used in making credibility evaluations, and the metacognitive strategies used while evaluating online information. Developing students' metacognitive skills regarding credibility evaluation, and their understanding of IL as a structured process requiring practice, planning and reflection, will help students become critically aware users of online information, and will prepare them for success in their academic and professional careers.

# Chapter 3: Prototype Design and Development

This chapter describes the design and development of the prototype IC tool, including the design methodology, theoretical models, initial design documentation, and the development of the prototype. Section 3.1 describes the overall research approach. Section 3.2 discusses the theoretical models underlying the tool's design. Section 3.3 describes the initial design and development of the prototype tool. Section 3.4 describes the pilot testing of the prototype. Results from the pilot testing are described, and conclusions drawn from pilot testing are discussed, followed by the current plan for completing the final tool.

## 3.1. Design-Based Research

The IC tool prototype was developed using the methodology of design-based research (DBR), defined as "the study of learning in context through the systematic design and study of instructional strategies and tools" (DBRC, 2003, p. 5). Sandoval and Bell define DBR as "a means for studying innovative learning environments, often including new educational technologies or other complex approaches, in classroom settings" (Sandoval & Bell, 2004, p. 200). The DBR model emphasizes the inter-relationship between theory, design and practice, creating "a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually-sensitive design principles and theories" (Wang & Hannafin, 2005, p. 6-7). Situating research in its social context is crucial, as gathering input from both learner-subjects and teacher-partners is important to shaping the design of tools. A clearly shared focus of all DBR researchers is the integration of design and research, which is important for establishing a collaborative context (Hoadley, 2002). DBR can be seen as a blend of empirical educational research with theory-driven designs

(DBRC, 2003), or a hybrid methodology (Wang & Hannafin, 2005) combining a theory-driven approach with inductive design processes (Quintana et al., 2004). Researchers draw from multiple disciplines, including developmental psychology, cognitive science, learning sciences, anthropology, and sociology (Sandoval & Bell, 2004). To evaluate DBR tools, inductive qualitative approaches and quantitative and quasi-experimental approaches are used (Fishman, et al., 2004), employing both formative evaluation (Wang & Hannafin, 2005) and comparative analysis (Shavelson, et al., 2003).

The work of DBR researchers is "grounded in real-world contexts where participants interact socially with one another, and within design settings rather than in laboratory settings isolated from everyday practice" (Wang & Hannafin, 2005, p. 9). Following the model of constructivism, learning is seen as socially constructed and situated in an interactive, interpersonal context. DBR employs "theoretically framed, empirical research of learning and teaching based on particular designs for instruction" (Sandoval & Bell, 2004, p. 200). Real-world educational contexts are used as natural laboratories to study the effectiveness of learning environments on learning and teaching practices, simultaneously developing learning tools and studying their effects (Sandoval & Bell, 2004). Researchers work closely with teachers and students to design, develop, implement, and evaluate innovations in real classroom settings (Fishman, et al., 2004). These partners all share the goals of conducting rigorous and reflective inquiry, testing and refining innovative learning environments, and defining new design principles based on previous research (Ludvigsen & Morch, in press). The participation of practitioners helps to produce meaningful changes in the actual contexts of practice (Wang & Hannafin, 2005). Since the emphasis is on understanding real world practices in their naturalistic settings (Barab & Squire, 2004), the methodological orientation of DBR is pragmatic, grounded, and contextual (Wang & Hannafin, 2005).

The focus of DBR on the social context of learning and its constructivist nature indicates clear correspondences to Vygostsky's learning theory (Hung, 2001). Following the Zone of Proximal Development model, web-based learning environments create links between novices and more capable peers, connecting learners with varying levels of expertise within the knowledge building community in a continuum of participation structured through mediated discourse (Hung, 2001). Students are immersed in participatory contexts in which authentic

activities are conducted, allowing learners to begin developing an understanding of the domain (Quintana et al, 2006).

The DBR method is iterative, consisting not simply of research producing a final product, but of research informing a cycle of development and refinement. This approach of continuous refinement aims to improve the way a design operates in practice (Collins et al., 2004), through an ongoing cycle of design, enactment, analysis, and redesign (DBRC, 2003). Instructional activities and artifacts developed through this "design-analysis-redesign" process become the subject of further research into their the impact on the reasoning and thinking displayed by learners (Shavelson, et al., 2003). Testing these interventions in context can uncover unanticipated outcomes or consequences, which then subsequently shape the further development of the artifact and of the learning theory informing it (Hoadley, 2002). As opposed to laboratory or experimental research, DBR methods respond to emergent features of the setting (Wang & Hannafin, 2005). Overall, DBR methods are process focused, interventionist, collaborative, multileveled, utility oriented, and theory driven (Shavelson, et al., 2003). The outcomes of DBR are often specific "design principles" to guide, inform, and improve both practice and research in educational contexts (Anderson & Shattuck, 2012). These can take the form of evidence-based heuristics to inform the development and implementation decisions of future DBR researchers (Herrington et al., 2007). A second outcome of DBR is the production of "designed artifacts" which may range from software packages to professional development programs (Herrington et al., 2007). These outcomes demonstrate the practical, real-world orientation of the DBR method.

## 3.2. Theoretical models

The prototype design of the tool was based on a synthesis of three related but segregated theoretical models: IL and credibility evaluation research findings and computer-supported collaborative learning (CSCL) principles. This section describes the fundamental concepts from each field that informed the design of the tool.

### 3.2.1. Information literacy model

Underlying the IC tool's design is a 3-stage model that is the ACRL's definition of

information literacy—"a set of abilities requiring individuals to 'recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" (ALA, 2000). The tool represents each step of "locate, evaluate, and use" through a division into three stages identified as Investigate, Question, and Solve. Working through each stage, students apply credibility and relevance criteria to online information sources. Each stage builds upon the previous, providing students with multiple opportunities to apply the credibility and relevance criteria. The tool reinforces the three-part structure through a process map represented as a 3-part progress bar that highlights the current stage that the user is on and gives a visual depiction of the user's progress.

The design of the tool is also informed by theories of library-related information seeking behavior (ISB) discussed in Chapter Two. The first is "library anxiety" (Mellon, 1986), a sense of powerlessness which students may feel when they begin an information search that requires using the library, involving feeling lost, fearful of library staff, and unable to navigate the library. Unfamiliarity with new surroundings and general anxiety about success may affect students as they transition from the high school library to the academic research library (Onwuegbuzie, Jiao & Bostick, 2004). Students may also feel inadequate, embarrassed or intimidated in the library environment (Van Scoyoc, 2003). IC tool addresses these anxiety barriers by situating library instruction in the online context where students normally do their research, rather than relying on placing them physically in the library, or bringing a librarian physically to the classroom. Additionally, the online participatory learning tool incorporates social media components that will help students feel they are in a familiar environment.

The design of the tool also seeks to addresses the Principle of Least Effort (PLE) (Zipf, 1949; Rosenberg, 1974; Mann, 1993) and "satisificing" (Simon, 1956; Buczynski, 2005), both of which suggest that students often accept the first satisfactory alternative over the best possible alternative when searching for information. Research consistently shows that students accept the first answers they find when searching online (Lankes, 2008; Hargittai et al., 2010), and rely on familiar strategies to find satisfactory information with a minimum of effort as well as be unwilling to move beyond their current skill level (Warwick et al., 2009). The tool's design structures the information-searching process through a series of measured steps, each involving self-review and reflection on the part of students, as well as providing them a process map of the

overall task and progress monitors of completion and gives them repeated opportunities to practice new skills.

The tool also aims to address Competency Theory, which suggests that students who lack information literacy skills do not realize it and therefore are unlikely to seek out instruction (Gross & Latham, 2007). Low-skilled students also hold inflated views of their own competence in information seeking, do not know their own weaknesses, and often overestimate their abilities to find and evaluate online information (Manuel, 2002). The IC tool is designed to address this issue by using student performance on the tutorial to classify students as lower- or higher-skilled and providing a question asking-and-answering functionality that allows the higher-skilled students to assist the lower-skilled through threaded discussions. The three stages of the tool give students repeated, structured practice in evaluating their own work (Investigate) as well as the evaluating the quality of other students' evaluations (Question). Through this structured skills practice, students learn to evaluate their own skill level more realistically and compare their own skills to others based on shared performance.

### 3.2.2. 5Ws model

Credibility evaluation criteria are a crucial component of the tool's design. The literature on online credibility evaluation provides extensive insight into the actual practices students use, but without providing suggested methods to improve students' evaluation skills. Incorporating a research-based understanding of actual student credibility evaluation behavior into the design of a learning tool situated in the online information environment was one of the fundamental motivations for this research project.

As discussed in Chapter 2, the checklist model for teaching the evaluation of websites is popular in academic libraries (Myhre, 2012). During the development phase of the prototype, the research team reviewed several checklists for information evaluation used in IL instruction and chose two that are widely used: the CRAAP test and Kathy Schrock's 5Ws model. The CRAAP acronym (Currency, Relevance, Authority, Accuracy, Purpose) is a play on words that helps gain the attention in interest of college students (Myhre 2012), although its use would be considered inappropriate for high school, as suggested by several SMLs interviewed for this research. Schrock's simplified 5Ws model (Who, What, Where, Why, and When) employs non-expert language that is appropriate to the intended audience of the learning tool:(incoming college

students, and potentially high school and community college students (Appendix 3). These models, along with other examples found by searching the web for academic library IL teaching materials, were adapted and synthesized to create a set of credibility questions and prompts contained in the IC tool's Notebook, the browser-based plugin that students use to gather information about their sources during the initial Investigate stage (Appendix 5). In the learning tool's later stages, the 5Ws are mapped to more sophisticated credibility criteria language (authority, relevance, reliability, currency, and purpose), providing scaffolding to bridge the gap between students' unsophisticated understanding of online information evaluation and the more sophisticated models of evaluation criteria used by experts.

Although the checklist approach is popular with IL librarians, it does have its detractors who consider it reductionist and inflexible. For this reason, the IC tool does not rely on the question prompts alone but involves students in repeated practice of their use, comparison to the evaluations of other students, and reflection on their evaluation process to help them understand evaluation as a process, not merely a list of criteria. The questions in the Notebook are anchored in the student's Internet browser and are connected to the specific website being evaluated, not presented as an abstract checklist.

While Myhre (2012) conducted a small study (N=14) of the use of a version of the CRAAP test, the 5Ws model of website evaluation has not been empirically tested (Schrock, 2013) so this study represents the first research into the effectiveness of the 5Ws model for teaching website evaluation criteria.

### 3.2.3. Scaffolding model

The tool's design employs basic CSCL design principles. The tutorial utilizes elements of the cognitive tutor model of required sequential steps, while the three activity stages use a social constructivist model of encouraging active participation and knowledge construction through engaging students in problem-solving activity. To support students in building cognitive links between prior knowledge (experience searching online, using Google and Wikipedia) and new knowledge (the critical thinking skills used in evaluation of sources), the structure of the learning tool begins with simple concepts in a familiar context and gradually elaborates on them through prompts and hints that introduce higher-level concepts. To encourage student motivation,

learning is embedded in a realistic setting that students are accustomed to (online searching) and in a relevant context (a real class assignment). To encourage interaction and collaboration with other learners and teachers, social features such as comment threads and peer question answering are integrated into the tool. Process maps, regular feedback, progress monitors, and reflection on the students' own work build metacognition about the process of evaluation and the information-seeking process.

The IC tool's design is informed by CSCL principles of learner needs. Reiser (2004) described the obstacles that novice learners face due to their lack of knowledge of and experience with the topics they are learning. Overcoming these fundamental principles informed the design of the IC tool:

- Unfamiliar strategies
- Superficial understanding and unfamiliar discourse
- Lack of motivation

To address the unfamiliar strategies of online credibility evaluation, learners need step-by-step guidance in following a structured process. Novice learners are not familiar with the steps involved in evaluating sources, what criteria to use or where to find evidence that supports the claim that a source is credible and relevant. The IC tool addresses this obstacle by providing learners with process management tools, including a process map that visually summarizes the sequential steps that must be followed: Investigate (find evidence for evaluation), Question (make decisions about quality) and Solve (compare and synthesize multiple sources); progress bars which visually demonstrate each student's progress through the stages; a dynamic checklist showing the student's progress through the sub-steps of each stage; the sequential steps of the notebook guiding the student through the 5Ws (criteria for credibility evaluation); and the sequential steps of evaluation in the Question stage, which follows and reinforces the notebook sequence.

To address their superficial understanding and unfamiliar discourse, the IC tool gradually introduces students to the unfamiliar terminology of credibility evaluation and reinforces it to students throughout the process of using the tool. Novices tend to use sources without critically analyzing them, often using the first search results that they find. They are not familiar with the

terms such as “credibility” and “relevance” and may not know how to apply them to information sources. The Notebook and the Investigate stage of the tool enlists a simplified framework of “5W’s” (who, what, where, when, why), with basic descriptions and tips for finding answers. In subsequent stages, higher-level credibility terminology (accuracy, relevance, reliability, currency, purpose) is introduced and defined.

To addresses students’ lack of motivation, the tool places IL skills training in the online information environment where today’s students do their research, ties it directly to in-class research assignments, and utilizes components of social media that are familiar to students such as threaded conversations and peer commenting. Novices need to understand why they are learning skills. Today’s students may not see the point of the learning IL skills, since they feel they are already experts in searching and can get what they need from Google and Wikipedia. The tool is situated in the real life context of a class assignment.

These three obstacles can successfully be overcome by bridging learners’ prior knowledge - starting them with what they already know and then connecting it to more sophisticated concepts. Thus, InCredibility begins with basic online searching and introduces students to the criteria of credibility and relevance, while giving them practice on how to find evidence, make decisions, and synthesize the results of online source evaluation. It builds student motivation by situating learning in the realistic online environment and encouraging peer collaboration and discussion.

Along with a basis in learner needs, InCredibility is designed around principles of scaffolding learning. Quintana, et al. (2004) described the basic techniques by which successful scaffolding supports learning:

- Sensemaking: Use representations and language that bridge learners’ understanding
- Process management: Provide structure for complex tasks and functionality
- Articulation and reflection: Facilitate ongoing articulation and reflection

To support sensemaking, educational scaffolding must aid students in developing new skills by building on current knowledge (Quintana, et al. 2004). To bridge learner’s prior experience with Internet searching, the first part of the tool is an interactive tutorial that gives examples of where to look on websites for evaluation criteria. The tutorial provides hints based on student

performance; when students answer questions incorrectly more hints are provided. As they progress through the three stages of the tool, students build cognitive links between prior knowledge (experience searching online, using Google and Wikipedia) and new knowledge (the critical thinking skills used in evaluation of sources). The terminology of credibility evaluation is gradually introduced, starting with the simple version of 5Ws, and transitioning to higher-level terminology (authority, relevance, etc.) as students' expertise develops.

To support learning process management, educational scaffolding must decompose tasks to simple, easy-to-understand units (Quintana, et al. 2004). The Notebook tool serves to break down each task for students during the Investigate and Question stages by placing each individual credibility and relevance criteria (5 Ws) on a separate page. To help students monitor their progress, a process map on the Home page visually represents the three stages (Investigate, Question, and Solve) as a visual conceptual organizer. As students complete each stage, these bars progressively fill in with a new color to indicate completion of the tasks. Lastly, each stage has a quota set by the classroom teacher. For example, students are required to find and investigate a certain number of sources independently. Then, students must evaluate a certain number of sources added by peers. Finally, students select a specific set of sources to use during the Solve phase. Time-based reminders when students are close to the end and have not met goals. These features structure the complex task of evaluating online information into more manageable steps.

To support articulation and reflection, educational scaffolding must guide students in reviewing their own understanding and making it explicit (Quintana, et al. 2004). During the Investigate stage of the IC tool, students are prompted to enter comments on each source they evaluate, explaining why they rated it as they did. At the end of the stage, they are prompted to review their work and make any changes they feel necessary. A prompt asked "How confident in your answers?" to encourage self-reflection. During the Question stage, other students can see these comments and respond to them. Students receive comments on their own sources and make comments on others. During the Solve stage, students are prompted to choose between two sources and explain their rationale for choosing which is better, and then articulate their own understanding of the credibility criteria that they used. A confidence judgment was prompted. Because reflection is difficult for novices, they are supported through the use of sentence starters and drop-down menus.

These principles of scaffolding are incorporated into the design of the IC tool through gradually introducing new concepts and terminology of credibility evaluation that build on students prior understanding of web searching, providing structure for complex tasks (process maps, progress bars, prompts) and facilitating ongoing articulation of and reflection on their understanding through comments and discussion. Scaffolds support students in externalizing and comparing their knowledge and beliefs with those of their peers (Sharma & Hannafin, 2007). Scaffolds also support students in developing their metacognitive skills. Through introducing explicit procedural structure to what had previously been just a series of uncoordinated events, a student's self-regulation and self-evaluation processes are enhanced (Ge & Land, 2004; Pifarre & Cobos, 2010). The IC tool supports students in the important metacognitive skills of planning their tasks, monitoring their progress toward meeting goals, taking appropriate steps to solve problems, and reflecting on past performance (Quintana et al., 2005, p. 2360). At each stage of the IC tool, the unfamiliar and challenging process of evaluating the credibility of online information is structured as a process of planning, monitoring, and problem-solving, scaffolding the common activity of online searching with higher-order metacognitive skills. As students complete each stage of the learning tool and gain repeated practice in each activity, they learn how to regulate their online searching behavior and reflect on their own skills and understanding and to reflect on their own thinking. Specific examples of scaffolds mapped to Quintana et al.'s Scaffolding Design Framework are shown in Table 7 below.

**Table 7. Scaffolding Design Framework applied to IC tool design**

| Scaffolding guidelines | Scaffolding strategies |
|---|---|
| Sensemaking | Tutorial |
| | Hints |
| | Process map |
| | 5Ws mapped to expert terminology |
| Process management | Notebook with 5Ws tabs |
| | 5W Question prompts |
| | Automatic saving of URLs and screenshots |
| | Progress bar for each stage |
| | Process map |
| | Quotas and deadlines for each stage |
| Reflection and articulation | Confidence prompts |
| | Self-evaluation prompts |
| | Comparison prompts |
| | Reflection questions |

By providing a mediated tool through which students are not learning individually but are interacting and communicating, the IC tool structures self-regulation of behavior through reflection in action (Hung, 2001). The learning tool encourages students to participate in regulating each other's work on the social level, helping them to became more aware of their own learning process (Pifarre & Cobos, 2010). Peer interaction in the learning process is enhanced through asking for help, clarifying ideas and responding to feedback, structuring self-regulated learning through reflection on key task-solving processes (Pifarre & Cobos, 2010). The social experience of this online learning tool differentiates it from traditional learning software, which focuses on individual learning, and on existing learning environments, which are usually offline and based on physical co-location.

## 3.3. Initial prototype

The initial inspiration for InCredibility came from the researcher's experience on the design team of the BiblioBouts information literacy game (Markey et al., 2012). The game provided a model for teaching students the process of evaluating sources through an online interface that structured the evaluation process into a step-by-step process and guided students toward learning to use the library resources to create scholarly bibliographies. However, research shows that today's students overwhelming rely on online web-based sources when searching for information, rather than using library sources (Herring, 2011; Kolowich, 2011). Game mechanics were not employed because of the complexity of the design challenges, the expense of hiring a professional programmer, and the amount of time required for development. Games are also not suitable for all students. While some students thrive on competition and mastery, educational games run the risk of discouraging other types of students: non-gamers who have little or no experience with digital games, and players who do not enjoy competition or fear failure at an unfamiliar task (Magerko, Heeter, and Medler, 2010). Based on these factors, the researcher felt it was important to design and test a tool that focused on online sources and was integrated into an Internet browser, to locate the evaluation process where students actually do their information seeking.

The IC tool prototype was developed through an iterative DBR process. Based on the work of Reiser (2004) and Quintana et al. (2004) on learner needs and goals, an initial design document and storyboard was drafted that identified basic functionality, artifacts created, information needed to do the work, and conceptual scaffolding requirements for each stage of tool. Functionality included every specific action that students would complete in that stage; artifacts created included concrete outcomes of the actions either within the game or outside; information needed included both domain knowledge and task knowledge necessary to successfully complete that stage; and conceptual scaffolding requirements included sub-categories of domain support, task-based support, articulation support, metacognitive support, and procedural support. For instance, in the Investigate stage, the conceptual scaffolding requirements identified were:

1. Domain support: Students need to be reminded of the criteria for evaluation
2. Task-based support: Students need to know what question they are answering and what search terms to use
3. Task-based support: Students will have access to "Hints" or "Clues" about where to look for evidence of each criteria
4. Articulation support: Students need explicit areas to enter their comments and notes
5. Metacognitive support: Students need to be reminded of the steps of the overall process (process map)
6. Procedural support; Students need to be reminded of their progress in this task (progress bar toward quota)

This document was created as a final project in Professor Quintana's master's level class in the School of Education titled "Principles of Software Design for Learning." It was refined through several rounds of group discussion between three collaborators: a doctoral student and a master's student from the School of Information, and a doctoral student from the School of Education. Initial drawings of prototype screens were created and refined, and then mock-ups of screens were created in Adobe Illustrator. A basic sitemap was created to show the overall structure of the software and the workflow. The sitemap and screenshots were then integrated into the storyboard. At each step the design documents were iteratively reviewed and refined. Feedback from Professor Quintana was incorporated into the document before a final in-class presentation, which provided further feedback.

Following the initial design document development, the researcher presented a mockup of the storyboard screenshots to a master's class in Information Literacy at the School of Information, obtained their feedback, and incorporated the resulting feedback into a revised design. Another round of review took place with a clinical professor of Library and Information Sciences (LIS) and an informal group of school media librarians (SMLs) who reviewed the designs and provided more feedback which was used to refine the storyboards. As potential targeted users, the feedback from the SMLs was especially useful. Their feedback suggested that the tool was a good match for the needs of classroom IL instruction and could potentially be useful for teachers and librarians.

Grant funds from the Rackham Graduate Student Research Program enabled the researcher to hire student programmers to build a working prototype. The InCredibility prototype was comprised of two elements: the Notebook, a Firefox browser plug-in that students use to search for sources and to answer the criteria questions during the Investigate stage, and a dedicated website where students review their saved sources, and evaluate and synthesize them during the Question and Solve stages. The tutorial utilizes elements of the CSCL cognitive tutor model of introducing and reinforcing a structured sequential process, while the three activity stages use a social constructivist model of encouraging active participation and knowledge construction through engaging students in problem-solving activity and situating learning in a social context by encouraging collaboration and peer-learning.

### 3.3.1. Structure of the prototype

An important scaffold in the prototype IC tool is the decomposition of complex tasks into specific steps. The IC tool breaks down the process of online credibility evaluation into discreet stages, allowing students to learn and practice individual skills in a structured sequence. See Table 8 below for a description of the steps of the process that the student experience as they proceed through the stages of the InCredibility workflow.

**Table 8. InCredibility student workflow**

| |
|---|
| 1. Register/login |
| 2. Complete interactive tutorial |
| 3. Investigate stage: Search online for sources on group topic. Save sources with online plug-in (Notebook) and enter answers to credibility prompts (5Ws). Complete quota of sources. Review your saved sources and edit responses, if desired. |
| 4. Question stage: Review sources entered by other students. Agree or disagree with the responses describing that source. Enter your comments on the source. Repeat to meet quota. Review your evaluations and edit responses, if desired. |
| 5. Solve stage: Compare the quality of paired sources, using higher-level credibility terminology. Generate "in your own words" descriptions of credibility analysis online. |

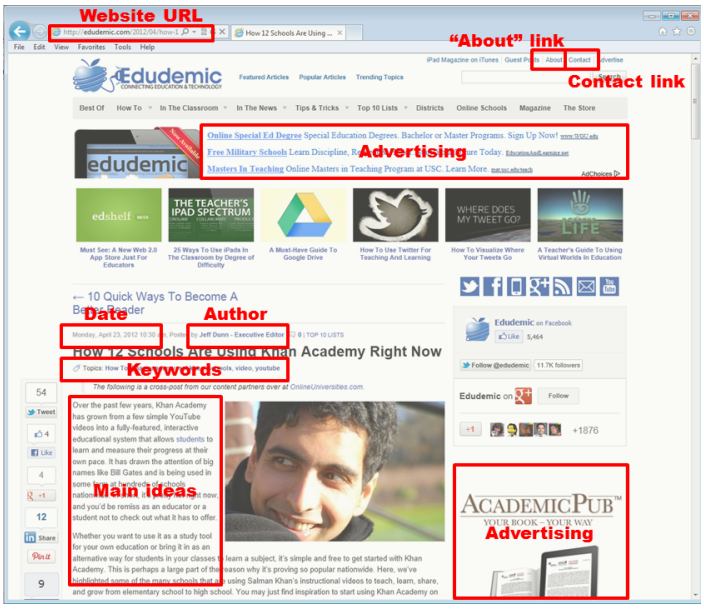
The registration/login stage is simple: students go to the InCredibility homepage and are prompted to enter their login information, or if they are not yet registered, to create an account. This login is also used for the Notebook, which saves all the users online activity to their account in the database. The major stages of the online credibility evaluation tool are described in sequence below.

The IC tool begins with a tutorial that introduces the basic credibility criteria for online information in an interactive format. Rather than the non-interactive, passive style of conventional IL tutorials, the online learning tool's tutorial allows students to learn by trial and error and provides feedback and tips based on their performance. It provides an initial static webpage that highlights several elements of a website that students should investigate to determine answers to the credibility questions:

- Website URL
- "About" link
- Contact link
- Date
- Author name
- Keywords
- Main ideas
- Advertising

These concepts are presented visually in the realistic context of an actual webpage, rather than merely listed or described (see Figure 4).

**Figure 4. Tutorial opening page**




After introducing these basic sections of the website that should be used in evaluating credibility, the tutorial moves to an interactive activity where the same example webpage is presented without the highlights, and students are prompted to click on the appropriate element of the webpage to answer each of the five credibility questions. The instructions read "Using this example webpage, find evidence to answer the questions Who, What, Where, When and Why. Select the section of the page that answers each question." Each prompt states "Look for clues about (5Ws question) and click on the evidence." A Tip button also accompanies each question. (See Appendix 5: Prototype Tutorial Questions, Tips and Answers). In Figure 5 the prompt "Look for clues about WHO wrote this information and click on the evidence" appears. The correct response to this question is to click on the author's name field, which was highlighted on the static page. The correct answers are hotspots identical to the static example page but without the visible highlights, which only appear after the correct answer is revealed (either by student selection of triggered by two incorrect responses). This tutorial provides scaffolding for sensemaking by helping student build on their prior knowledge of web evaluation by expanding it with greater detail.

**Figure 5. Example tutorial question**


The student may click on the "Tip" button to receive a reminder about what information to look for (see Figure 6).

**Figure 6. Tutorial tip text**


If the student clicks on the correct hot spot, a popup message informs them that they are correct, and highlights the correct answer field. Each question is reinforced by a re-statement of the criteria after the question is completed (see Figure 7)

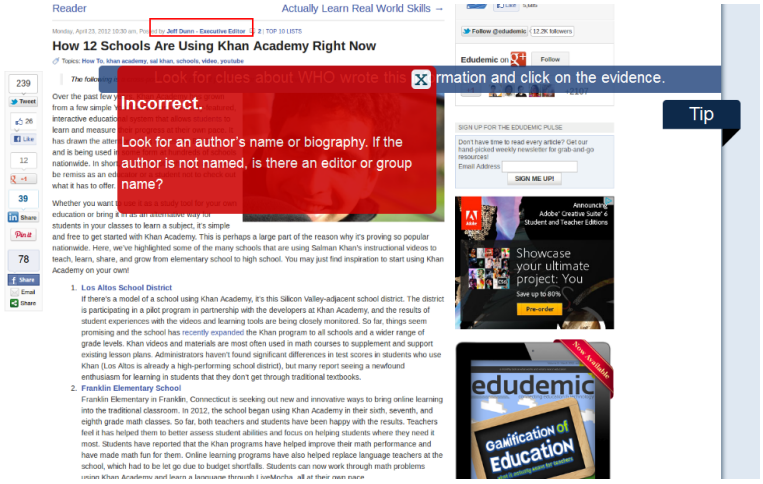
**Figure 7. Tutorial correct answer**


If the student clicks outside of the correct hot spot, a popup message informs them that they should try again, and gives a tip (see Figure 8).

**Figure 8. Tutorial wrong answer and tip**


These tips provide scaffolding for sensemaking by embedding expert guidance. If the student makes a second wrong response, a popup message informs them that they are incorrect, and highlights the correct answer field along with repeating the tip (see Figure 9).

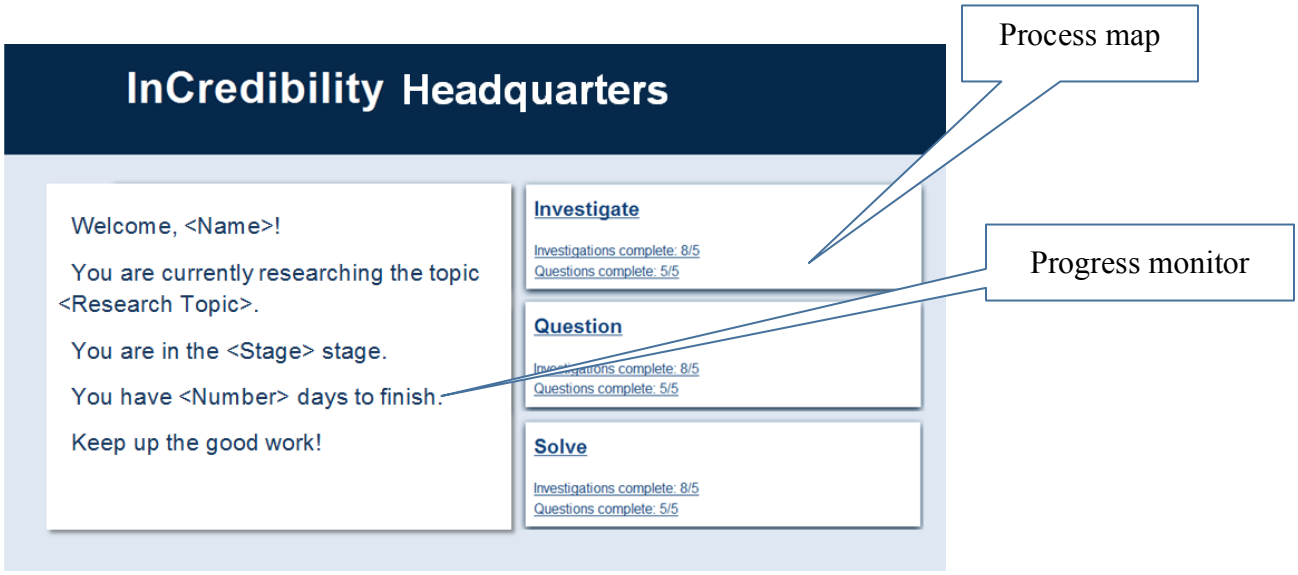
**Figure 9. Tutorial second wrong answer**




If the student answers the question correctly on the first try, they receive a congratulation message which reinforces the criteria. If they answer incorrectly, a feedback message tells them they are incorrect and provides tips. If they answer incorrectly again, they receive a second incorrect message and then are shown the correct answer. If the student is already familiar with this content, they should be able to proceed quickly through the tutorial by giving correct answers on the first try. If they need to learn or need reinforcement, the tutorial gives them practice. At the completion of each answer, the tutorial automatically advances to a new question. After all questions are completed, the tutorial provides a link to the first stage of the tool so that students can begin.

To provide overall structure for the learning experience, each student has an online "Headquarters" page on the online learning tool's site where they can monitor their progress and performance (see Figure 10). This visual conceptual organizer serves as a process map. Their progress in completing each activity is displayed. The system also issues time-based reminders when students are close to the end and have not met goals. These features help students plan and self-regulate their credibility evaluation process.

**Figure 10. Headquarters page**




To begin the Investigate stage, students search online for appropriate sources for their research question. To guide them in this process, they use the Notebook, a Firefox browser plug-in which is installed in the browser and can be opened by clicking on a small icon in the lower right corner of the browser (similar to Zotero). When the icon is clicked (in the prototype, this icon is a small graphic of a pencil next to the Zotero icon) the Notebook expands into a pane resembling a tabbed notebook, with each tab bearing one of the 5 Ws questions and text entry fields for entering data in response to the prompts (see Figure 11).

**Figure 11. Notebook expanded**

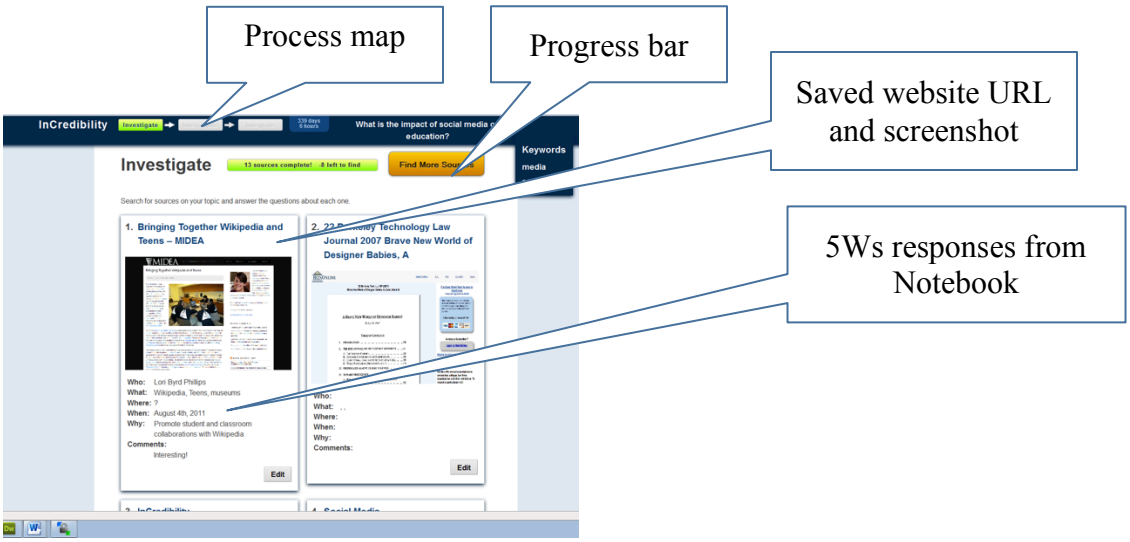

The highlighted tab in the Notebook shows which of the 5Ws the student is currently reviewing. Since the plugin resides in the browser, students can open the Notebook as they search online for information in the Investigate stage. When the Notebook is opened, the current webpage is automatically saved to the database, with the URL and a screenshot of the page, which provides scaffolding for process management by automating routine tasks. All entries to the Notebook are also automatically saved. This information was displayed for review by the student, and for evaluation by other students in the Question stage. When the Notebook is open, students are prompted to enter comments on each source they evaluate. These prompts for each of the 5Ws provide scaffolding for process management by decomposing the credibility evaluation task into an ordered sequence of steps with question prompts, and as scaffolding for sensemaking by making disciplinary strategies explicit. Each tab is decomposed into sub-steps scaffolded with textual prompts, again providing scaffolding for process management (see Table 9 for the original prototype Notebook question prompts). The structure of the 5Ws and the related question prompts function as procedural prompts to guide learners step by step through the process of credibility evaluation.

**Table 9. Prototype Notebook question prompts**

| Tab | Question |
|---|---|
| WHO | Who is/are the author(s) of this source? |
| WHAT | What 3 keywords best describe this source? |
| WHERE | Where was this source published? |
| WHEN | When was this source published? |
| WHY | Why do you think this source was published? |
| OTHER | Please add your own personal comments to help you with this source later in your project. |

After students have saved their sources and evaluation comments through the Notebook, they can review their work on the Investigate page. On all of the InCredibility pages, a process map is displayed along the top of the screen that highlights the student's current stage in the overall process through the stages of Investigate, Question, and Solve (see Figures 12, 13, and 14). A progress bar for each displays their current percentage completion of required quota of tasks for that stage. This process map provides scaffolding for sensemaking by presenting a visual conceptual organizer of the overall task process, and providing guidance to facilitate planning and monitoring of the students' current progress toward their quotas. If a student needs to complete more tasks, an indicator is displayed (for example, "Find more sources"). Students must complete a quota of actions before the end time of that stage (set by the instructor).

**Figure 12. Investigate stage**



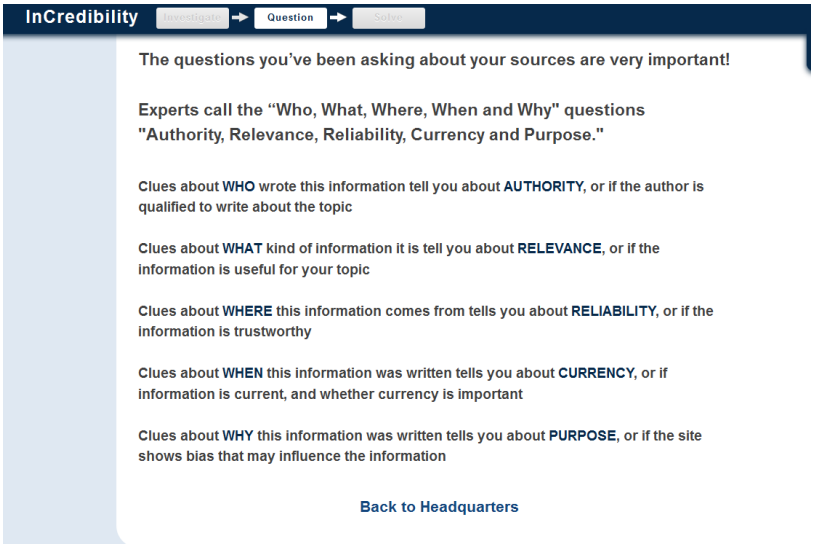
During the Question stage, students are prompted to evaluate the work of peers in answering the 5Ws questions. A source donated by another student is randomly displayed, and students review the quality of the responses entered about that source. For each of the 5W questions, student agree or disagree with the entered responses, and explain why (see Figure 13). These question prompts provide scaffolding through for articulation and reflection by providing guidance for reflection, monitoring, and self-reflection on the student's own performance. The visual presentation of the two evaluations side-by-side also facilitates students' self-reflection by comparing their own evaluations to that of other students.

**Figure 13. Question stage (part 1)**


Each source is reviewed by multiple players. The evaluation questions in this stage provide elaborative prompts to guide student in articulating their thoughts and elicit explanations of their judgments.

At the end of the Question stage, students were instructed that the 5Ws questions that they have learned correspond to the expert terminology of Authority, Relevance, Reliability, Currency and Purpose (see Figure 14).

**Figure 14. Question stage (part 2)**




The text of these prompts scaffold students understanding of credibility criteria from their original knowledge to a more advanced level (see Table 10).

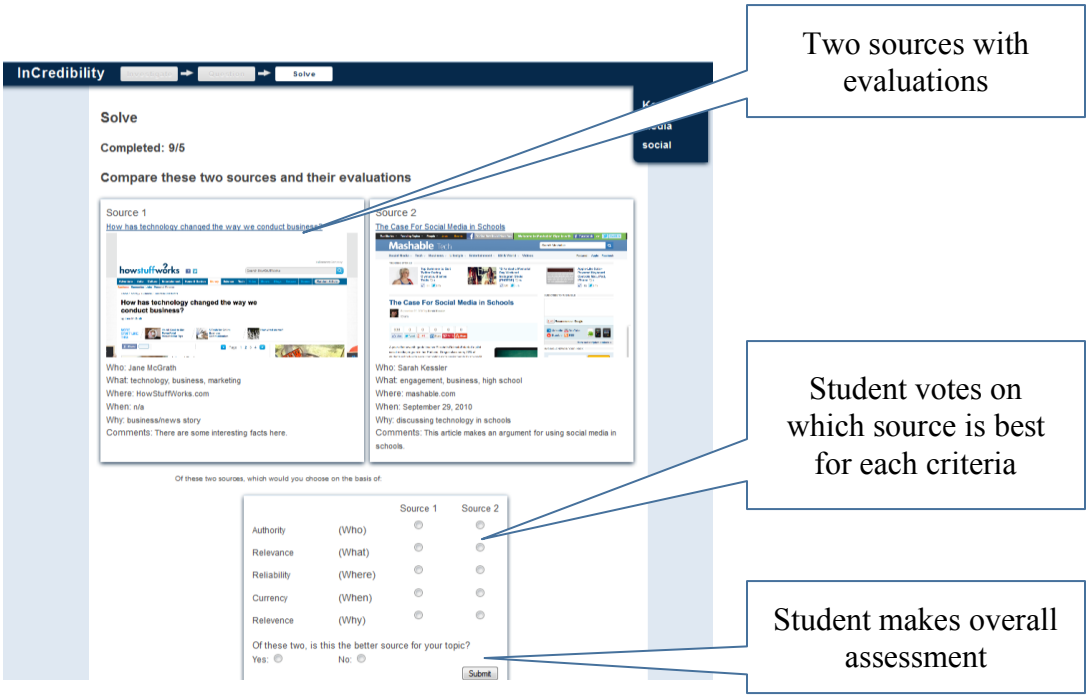
**Table 10. 5Ws correspondence to expert terminology**

| |
|---|
| Clues about WHO wrote this information tell you about AUTHORITY, or if the author is qualified to write about the topic |
| Clues about WHAT kind of information it is tell you about RELEVANCE, or if the information is useful for your topic |
| Clues about WHERE this information comes from tells you about RELIABILITY, or if the information is trustworthy |
| Clues about WHEN this information was written tells you about CURRENCY, or if information is current, and whether currency is important |
| Clues about WHY this information was written tells you about PURPOSE, or if the site shows bias that may influence the information |

This introduction of expert terminology connected to the novice terminology of the 5Ws provides scaffolding for sensemaking by bridging students' knowledge from a simple conceptual level to expert level. These definitions also appear in the Control Groups' online worksheet, to allow for comparison between groups.

During the Solve stage, students compare multiple sources and evaluate them. Through comparing sources and weighing the relative importance of each criteria to the overall usefulness of the source for their research questions, students learn that credibility is a multi-faceted concept, and not a simple yes-or-no proposition. For each of the credibility criteria (in the higher-level terminology introduced in the Question stage) they elect which of two side by side sources are the best for the research topic (see Figure 15).

**Figure 15. Solve stage**




These comparative questions ask the student to use critical thinking about their sources, and determine for each individual criteria which of the two sources they think would be best, and then to make an overall evaluation of which source is best for the research question. This step is intended to help students understand that credibility is composed of multiple criteria, that some criteria may be more important for some research topics than for others, and that an overall evaluative judgment about the quality of sources should be made based on specific evidence.

After the student completes their quota of comparisons, they are presented with reflective prompts (not shown in screenshot) that guide them through the metacognitive process of reviewing and articulating their evaluation process and assessing their own evaluation decisions

(adapted from Herring, 2011 and Ge, Planas & Er, 2010). Table 11 lists the text of the reflective prompts.

**Table 11. Reflective prompts**

| Looking back on the process of evaluating the credibility of online information.... |
|---|
| 1. How did you decide whether a webpage was credible or not? |
| 2. What specific criteria did you use to help you evaluate credibility? |
| 3. What strategies did you use to evaluate credibility? |
| 4. How confident were you in your evaluations of credibility? |
| 5. What have you learned about evaluating credibility on the web? |

Responses were open-ended text boxes, allowing students to articulate their own reflections on their learning. These reflection prompts encourage students to engage in a self-monitoring process, and promote reflection on the learning process at a meta-level that students do not generally consider.

This step of the Question stage completes the InCredibility evaluation process. Once students meet their quota, they recevie a congratualitions message, and then are able to review all the evaluated sources.

### 3.3.2. Initial evaluation of prototype

During the design stages, the initial working prototype was informally evaluated by a doctoral student from the School of Information and by a group of school media librarians (SMLs) who have experience with IL instruction in K-12 schools. These evaluations were not full pilot testing sessions, but presentations to experts who could provide informed feedback to shape the design, and help detect potential problems. The doctoral student specializes in human-computer interaction and provided feedback on the usability and understandability of the prototype. This review produced several suggestions to modify the tutorial to include more direction and clarification, as well as the recommendation to test the process of clicking on elements of a webpage to answer the credibility questions, to see if students understand the process and are able to perform it.

The SMLs strongly approved of the content and approach of the prototype, but they expressed concern at the idea of having to use an additional technology in the classroom which requires setting up and logging in. The SMLs were concerned about integrating the tool into their teaching, and expressed preference for a tool that would be integrated into an existing learning management tool such as Moodle. They also expressed concern about the use of the Firefox browser, which is often not permitted by high school IT departments. This feedback from the SMLs suggests that testing or using the InCredibility in high school classrooms may be impossible. It also raised the possibility of incorporating the InCredibility tool into the existing UM LMS, CTools, as it is open source and can be modified using the Learning Tools Interoperability (LTI) specification. Doing so would make InCredibility instantly implementable in any UM classroom that uses CTools, and potentially to any other LMS that employs the LTI framework. The researcher hopes to be able to implement this functionality in the final version.

## 3.4. Pilot-testing

The IC tool prototype was pilot-tested as part of the DBR process, before the final fully-featured tool is completed and ready for experimental testing. The focus of the pilot testing was on assessing the functionality and understandability of the prototype tool and its interface, and gathering feedback from subjects on their experience using the prototype. IRB exemption of the pilot test was secured.

Pilot testing of the working prototype consisted of two phases, online and in-person:

1. Online pilot test (tutorial)
    a. Usability questions
    b. Content questions
    c. Metacognition test
2. In-person pilot test (working prototype)
    a. Walk-through
    b. Think aloud

The online pilot test consisted of students taking the tutorial section of the online credibility evaluation tool, and then answering survey questions about the tutorial's usability and its content, followed by completing an online metacognition test and answering questions about

the test's understandability. The in-person pilot test consisted of students completing a walkthrough of the complete working prototype, giving their "think aloud" commentary and answering the researcher's questions about its usability. The demographics of subjects in both groups are listed below, and summaries of findings for both pilot tests.

### 3.4.1. Tutorial usability questions

In November 2012, students in a large, introductory undergraduate course were invited to participate in an online pilot test, which consisted of completing the online tutorial, a survey about its usability, and a trial of an online metacognition test. IRB exempt status was secured. Students were offered extra credit in the class for participating. Fifty-six students completed the online pilot test. Background demographic data was collected via the online survey, with the distribution being sophomores (35%), followed by juniors (31%), freshmen (22%) and seniors (13%). This mix of students is to be expected in an introductory level course that is not a freshman requirement. The few seniors represented likely are only taking the course to meet credit requirements. Subjects were asked to report their level of experience with searching for information on the Internet. A majority (62%) reported "average experience," followed by "above average experience" (29%) and "a little experience" (9%). No subjects reported "not at all experienced." Again, this is an expected distribution, with most students self-reporting as average with a smaller proportion showing greater confidence in their skills.

Next, subjects were asked "Have you previously received any formal instruction in Information Literacy skills (library research skills, bibliographic instruction)?" The majority responded "Yes" (60%) while 40% responded "No." This level of previous training was higher than expected. As a follow up, subjects were asked "If "Yes," where did you receive this instruction?" For this question, 63% responded high school and 31% responded college. Two subjects responded that they had training in both high school and college. When asked to describe what they learned from this Information Literacy instruction, responses ranged from "How to research scholarly articles and books" to "I learned more about analyzing information on web pages, its legitimacy, and where the information came from as well as the content of information and its relevance to my topic at hand (whatever that may be)." Thus, the range of background and experience with IL training in this subject population was very broad.

The usability survey itself asked the following questions about the students' experience using the online tutorial:

- Q6: Were the instructions for the tutorial clear?
- Q7: Were there any questions on the tutorial that were confusing?
- Q8: Were there any questions you had trouble answering?
- Q9: Did anything in the tutorial not work the way you thought it would?
- Q10: Did you use the Tip link that was available for each question?
- Q11: If you were going to improve this tutorial, what would you change?
- Q12: Please add any other comments you may have about the questions in this section.

All questions had a Yes/No response option and a prompt to add open text comments. A summary of the responses are shown below:

- Q6 Summary: 80% of responses indicated that the instructions for the tutorial were clear, although the negative responses to this survey question showed that the introductory instructions were not detailed enough.
- Q7 Summary: A slight majority of participants (52%) indicated that they were not confused by any questions, although nearly half indicated that they were confused. These responses frequently mentioned that "Where" and "Why" were the most confusing questions. This result supports the findings of Myhre (2012) that students have difficulty evaluating Accuracy and Purpose for a website. Some students were also unfamiliar with the About link on websites.
- Q8 Summary: A majority of participants (55%) of the respondents indicated they had trouble answering questions. Responses were similar to responses to Q2. While the intention in this question was to explore any conceptual difficulties students may have had in answering questions, the responses were mostly about technical issues. Some students had difficulty with clicking on the correct answer fields, possibly due to the small size of some targets.
- Q9 Summary: A majority of respondents (75%) indicated that they did not experience anything not working the way they thought it would. This suggests that the overall concept and functionality of the tutorial worked effectively. As with Q3, some students commented that they felt they had clicked the right answer but received an incorrect response.
- Q10 Summary: Over half of respondents (52%) did not use the tip button. Some students did not even notice it.
- Q11 Summary: Several students suggested better explanations of terms, including definitions in the question prompts, and adding a review at the end of what has been covered as reinforcement.

The comments on the tutorial showed a wide variety in responses from the participants. Some students found it easy, while others struggled with the definitions and instructions. This underlies the difficulty of building a learning tool that meets the need of a wide range of students. Since some of the students had previously received IL instruction while others had not, it may be difficult to keep students engaged. The participatory elements of the learning tool keep the higher-skills students engaged, while the tips and help functions meet the needs of lower-skilled students.

Specific improvement to the tutorial that resulted from the findings of this pilot test include:

- Make introductory instructions more detailed
- Add more explanation and examples of the 5Ws questions
- Make the target areas of fields as larger and easier to click; also add a visual change to the pointer when mousing over a target field
- Make the Tip button more visible in size and color
- Add the tip text directly to the 5Ws questions to help remind students what they are looking for
- Add a review at the end of what has been covered as reinforcement

### 3.4.2. Tutorial content questions

The next set of questions addressed the content of the tutorial, to investigate students' understanding of online information evaluation:

- Q12: How do you identify WHO wrote the information on a web page?
- Q13. Beyond just the author's name, how can you find out more information about the author's background and qualifications?
- Q14. What other techniques can you use to evaluate the authority of this information?
- Q13. Beyond just the author's name, how can you find out more information about the author's background and qualifications?
- Q14. What other techniques can you use to evaluate the authority of this information?
- Q15. How do you determine WHAT main ideas a web page covers?
- Q17: What other techniques can you use to evaluate the relevance of this information?
- Q18. How do you identify WHERE the web page is hosted or published?

- Q19. Beyond just the host/publisher's name, how can you find out more information about their background and qualifications?
- Q21: How do you determine WHEN the information on a web page was posted?
- Q22. How do you decide if the information is current enough for your topic?
- Q23. What other techniques can you use to evaluate the currency of this information?
- Q24. How do you determine WHAT the purpose of a web page is?
- Q25. How do you decide if the information may be biased?
- Q26: What other techniques can you use to evaluate the purpose of this information?

A summary of the responses to the tutorial content question are shown below:

- Q12 Summary: Locating an author's name is one of the easiest tasks in the tutorial. Only a few respondents indicated awareness that the author may not always be listed, or may not be an individual.
- Q13 Summary: Several respondents indicated awareness of using Google to find out more about an author's background and credentials. This is a strategy that was not included in the tutorial.
- Q14 Summary: Respondents seemed unclear on the meaning of "authority" in this context. They generally applied it to the overall site, rather than the author's expertise in the specific topic. Several mentioned relying on the domain name as an indicator of authoritativeness. This is one of the higher level credibility terms that are introduced through the prototype, so students will have a better understanding once they have used the tool.
- Q15 Summary: Respondents generally indicated a cursory approach to scanning an article's title, first paragraph and headings. While this is not a bad practice, there was little indication of actually scanning the content of the webpage or synthesizing any judgment of the entire contents. This may indicate satisficing by students when evaluating information.
- Q16 Summary: Determining usefulness also seemed to be a quick judgment for most respondents. Only a few respondents mentioned actually reading the content and assessing its usefulness for their research topic and argument, another indication of satisficing.
- Q17 Summary: Again, only a few respondents mentioned actually reading the content and assessing its relevance for their research topic and argument. Several respondents mentioned the presence of matching keyword, which in itself does not insure relevance to a topic. Some respondents mentioned relying on other peoples' comments on the article. A few mentioned relying on intuition.
- Q18 Summary: Most respondents relied on the URL and domain name to determine the source of the information. Only some mentioned investigating the hosting or sponsoring organization behind the site.

- Q19 Summary: Some respondents indicated awareness of looking at the homepage for more information about the site host or sponsor, and some mentioned the About page (although this may have been a result of having taken the tutorial).
- Q20 Summary: Responses to this question covered a wide variety of answers without much agreement, perhaps suggesting that reliability may be an unfamiliar or unclear concepts for students. Some mentioned checking sources, and some mentioned checking for bias.
- Q21 Summary: Checking the date of a webpage is very easy, along with finding the author's name. Most respondents were very clear about checking the date, and some relied on it as a major indication of credibility, usefulness or relevance.
- Q22 Summary: Most students indicated they just wanted the most current or recent information, while some mentioned the topic itself as determining whether up-to-date information is required
- Q23 Summary: Some students mentioned comparing the information to other sources. Some mentioned checking for recent comments or tags. Few students mentioned looking for a "last updated" notice or copyright date.
- Q24 Summary: There were many mentions of using the About page to determine purpose. This is interesting because in the in-person testing (below), few of the subjects were familiar with the About section of a website or had ever used it. It is unclear if participants in the survey learned about this feature of websites from the tutorial, or were familiar with it prior. Few responses mentioned identifying a specific purpose for a site (educational, commercial, research, etc). Few responses mentioned determining the type of source (blog, news, scholarly journal). IMore specific criteria for determining purpose were added to the Notebook.
- Q25 Summary: Many participants mentioned opinion or and objectivity. Several mentioned language specifically as a criteria for judgment of bias. The responses suggest a general awareness of evaluating bias as a recognized part of credibility judgment. This criteria was reinforced through using the tool.
- Q26 Summary: There were a variety of responses to this question without a general theme. Some mentioned looking for bias, others mentioned language. A few mentioned investigating the purpose of the hosting website, which is one of the strategies that the tool helps to reinforce.

Participants gave a wide variety of answers to most questions, demonstrating varying levels of skill and awareness of IL concepts. Most students do not show awareness of strategies for evaluating sources, but rather use simple techniques such as skimming an article or Googling the author. Most of the specific strategies mentioned in the responses were quick, perfunctory heuristics that suggest students satisficing in their evaluations of credibility. Some mentioned

simply relying on "gut instinct" or intuition when making judgments of credibility. The IC tool meets this need by introducing students to a step-by-step process of credibility evaluation structured around a series of questions and the specific evidence they should use in making evaluation judgments.

Searching the web to verify information was a very common response. Many students mentioned relying on comments or "shares" of articles as a measure of credibility, relevance, or currency. Asking friends or using social media to verify information were also mentioned, clearly indicating that these students are in the Net generation. There were many mentions of the About page in the content questions. Since some students indicated being unaware of this site feature earlier in the survey (and during the in-person pilot, below), it is possible that this may be one strategy that students learned from the tutorial.

This section of the tutorial pilot test did not produce specific changes to the prototype, as the focus was on student learning of the content and their understanding of online information evaluation.

### 3.4.3. Metacognition test

After subjects completed the questions regarding the tutorial, they were also asked to complete the metacognition test developed by Raes et al. (2012), as this test was being considered for use in the study at the time of the pilot testing. The aim of the pilot test was to establish if students found the test understandable and if it was appropriate for use in the experimental study. The 30-item test measures how students use metacognitive strategies when searching for information online, and has been experimentally validated. Questions address strategies for information problem solving strategies with questions such as "I ask myself periodically if I am meeting my goals" and "I try to use strategies that have worked well in the past." Students were asked to respond on a 5-item Likert scale from 'Strongly Disagree' to 'Strongly Agree' for each of the questions (see Appendix 6 for full results of this survey). The statements that received the highest agreement (averaging between "Agree" and "Strongly Agree") were: "I learn more information when I am interested in the topic" and "I try to use strategies that have worked well in the past." The statements with the lowest agreement (averaging between "Disagree" and "Neither Agree or Disagree") were "I think of several strategies and choose the best one" and "I know how well I did after I finish." While the results

of the metacognition test were not the focus of this pilot test, the results are interesting as an example of its application. Generally, students reported little metacognitive awareness of their online credibility evaluation practices.

After responding to the metacognition test questions, subjects were asked about the understandability of the metacognition test questions. When asked "Were there any questions that were confusing?" 95% percent of respondents answered "No." Only 3 respondents who answered "Yes" provided examples of specific questions that they found confusing. When asked "Were there any questions in this section that you had trouble answering?" 87% answered "No." Of the 7 who responded "Yes," several responses cited questions about using particular strategies. Subjects were then asked "Please add any other comments you may have about the questions in this section." Although they had indicated generally that the questions were not confusing and that they did not have trouble answering them, many respondents indicated a different concern on Q12: many of the respondents indicated that the questions were repetitive and similar, and that the survey felt too long. They also reported that the context of the questions also did not relate directly to the evaluation tasks that were covered by the tutorial. As a result of these responses, given the researcher's concern about the understandability of the test questions and the length of the question inventory, the decision was made not to use this metacognition test in the experimental study. A simpler, shorter and more understandable test of metacognitive awareness specifically related to the context of online credibility evaluation was developed (see Section 4.4.2)

### 3.4.4. Prototype pilot test

In the fall semester of 2012, students in a large, introductory undergraduate course were invited to participate in an in-person pilot test, which consisted of a guided walkthrough of the entire prototype. Students were offered extra credit in the class for participating. Eight students completed the in-person pilot test. The test took about 45 minutes to complete. IRB approval was secured. Background demographic data was collected via a manual form. The majority of subjects were sophomores (50%), followed by juniors (25%), with freshmen and seniors tied at 12.5%. This distribution closely parallels that of the online pilot test. Subjects were asked to report their level of experience with searching for information on the Internet. A strong majority (75%) reported "above average experience" followed by "average experience" (25%). No

subjects reported “a little experienced” or “not at all experienced.” This distribution is skewed higher than the online survey, and may reflect the self-selecting nature of students who were willing and interested in volunteering for the study.

Next, subjects were asked “Have you previously received any formal instruction in Information Literacy skills (library research skills, bibliographic instruction)?” A strong majority responded “Yes” (75%) while 25% responded “No.” As a follow up, subjects were asked “If "Yes," where did you receive this instruction?” For this question, 84% responded high school and 16% responded college. Again, these distributions skewed higher than the online survey demographics. While a majority of students responded that they had received IL training in high school, although several students mentioned that the training they received in high school was very simple, consisting of a one-shot session about types of sources that are credible or not. Several mentioned that librarians and teachers told them “Don’t use Wikipedia.” Few responses indicated that the students had any repeated practice of the skills or had applied them in the actual setting of online information searching.

The testing sessions were audio recorded and screen capture recorded. Participants were asked to “think aloud” as they completed the tasks. After the research gave an overview of the project and introduced the IC tool, the students proceeded to use the tutorial and tool at their own pace. I answered questions and addressed technical issues as necessary, but tried to give as little guidance as possible. (The text of the pilot test questionnaire is included in Appendix 6). Several repeated themes emerged from the in-person tests:

- Most participants liked the functionality of the Notebook, the structure of the 5Ws and the sequence of stages
- Some students suggested that there should be a video intro to both the tutorial and the tool functionality (the Notebook and the three stages).
- Most participants automatically searched for more information about the author without being prompted, reinforcing the findings from the online survey
- Most participants said that they needed more and clearer instructions and definitions.
- Most participants didn’t use the tips, or some did not notice the button at all
- Some participants didn’t read the text of the tutorial feedback (which reinforce the tips), just clicked to close the feedback box immediately
- Some participants had trouble noticing when a new tutorial question appeared, due to the speed

- Several participants needed clarification that the comments they evaluated in the Question section came from other students' responses to the 5Ws questions in the Notebook.
- Most participants liked the comparison of two sources side by side in the Solve stage. This seemed to be a new concept that they had not thought of before: the relative quality of different sources on the same topic
- Some participants were confused by the task in Solve. They were unsure if they were judging based upon the comments added by other students or on their own judgment of the quality of the source
- Some participants had difficulty with the terminology "keywords," which one student defined as terms assigned by the author or site to an article. He indicated that "main ideas" was a more familiar terminology for concepts determined by the reader that summarize the content. Other subjects had difficulty with the term "source"
- Few of the subjects were familiar with the About section of a website or had ever used it On several occasions I pointed this out in the Tip text and participants had not seen it

Specific improvement to the tutorial that resulted from the findings of this pilot test include:

- Make instructions clearer
- Add a video introduction to the tutorial and the tool
- Improve visibility of the Tip box
- Move the placement of the "OK" (close) button on the feedback box to the bottom rather than the top, to encourage students to read the feedback test and not just click to close the box immediately
- Slowing the rate that the feedback box appears, and the rate that new questions appear
- clarification that the comments they evaluated in the Question section came from other students' responses to the 5Ws questions in the Notebook.
- Clarify the task in Solve – judging based on their own judgment of the quality of the source, not the other players' comments
- Change terms "keywords" to "main ideas" and "source" to information"

During this pilot test, a great deal of time was spent on the use of the Notebook, which generated a number of useful improvements to the tool. Based on suggestions and feedback, the question prompts in the Notebook were revised and expanded. Table 12 lists the revised prompts.

**Table 12. Revised Notebook question prompts**

| Tab | Prototype Question | Revised Questions |
|---|---|---|

| | | |
|---|---|---|
| WHO | Who is/are the author(s) of this source? | Who is/are the author(s)?<br>What are the author's qualifications?<br>What can you find out about their background? |
| WHAT | What 3 keywords best describe this source? | What are the main topics?<br>What type of site is it? (commercial/educational/governmental/news/opinion/scholarly)<br>How useful is this information for your topic?<br>(A little/Somewhat/Very) |
| WHERE | Where was this source published? | Where is this site hosted or published?<br>What is the site's domain name? (.com, .edu, .gov)<br>Are there links to supporting evidence? |
| WHEN | When was this source published? | When was this webpage published or copyrighted?<br>Has it been updated?<br>How important is having current information for your topic? (A little/Somewhat/Very) |
| WHY | Why do you think this source was published? | Why do you think this site was created? (to educate/inform/ persuade/sell)<br>Do you see evidence of bias? (Yes/No/Not sure)<br>If yes, what is the evidence? |
| COMMENT | | Deleted. Replaced with Home button linking to IC homepage |

This pilot test reinforced the importance of clear and specific instructions and definitions. Some students suggested that there should be a video intro to both the tutorial and the tool functionality (the Notebook and the three stages). Rather than reading instructions these students seem to like being shown how to do it, which supports the findings of the literature about Net generation students. One student commented "video tutorials help me a lot."

Overall, the participants responded favorably to the experience of using the tool and understood its purpose. There did not seem to be any major issues with the functionality of the Notebook, the concept of the 5Ws, and the sequence of stages. Several mentioned that they found the tool to be effective and useful. Most participants liked the experience of comparing two sources side by side in the Solve stage. One student mentioned that critiquing other people's work (as in the Question stage) helps him learn how to evaluate better.

One highlight of the pilot test was this very positive feedback:

> "I really like it because it makes me go over the source, the text, really well. It forces me to look for more information about the source and about the author, what he's really talking about. I think it's a great way… because usually if I don't do this, I'll probably skim over the… what he's talking about, and probably jot down what he bolded. So it really helps me consolidate a more specific idea of why I would use this source and what information I'll pull out of it… I think it really helps me focus on an article more, instead of just skimming it. It definitely takes more time but I feel like I'm getting so much more than what I would just do on a skimming basis. It's a more efficient way of extracting information from an article than coming back and re-reading stuff again... (It's) a fun way to approach an instructional thing to do during class, 'cause it's on the Internet so I feel you're more engaged than if it were through a presentation."(S4)

## 3.5. Chapter summary

This chapter described the design and development of the current prototype IC tool, including the design methodology, theoretical models, initial design documentation, and the creation of the current prototype. The chapter also discussed the online pilot test of the tutorial and the in-person pilot test of the complete prototype. Results from the tutorial pilot test and survey responses provided valuable feedback on the usability of the tool, including specific questions that were added to the Notebook. Overall, the participants in both pilot tests responded favorably to the experience of using the tool and understood its purpose. There did not seem to be any major issues with the functionality of the Notebook, the concept of the 5Ws, and the sequence of stages. Some specific suggestions from the feedback were incorporated into the design of the IC tool. Several subjects mentioned that they found the tool to be effective and useful, with most subjects expressing positive reactions to the skills practice they experienced using the tool. This generally positive feedback, along with identification of specific improvements to be made to the tool, provides great motivation for moving ahead with the project.

# Chapter 4: Research design

This chapter provides an overview of the plan of research. Section 4.1 describes the general research objective and the specific research questions addressed. Section 4.2 describes the experimental design of randomly-assigned treatment and control groups, and the activities carried out by subjects in the two conditions, and section 4.3 describes participant recruitment. Section 4.4 describes the methods of data collection and the plan for data analysis is discussed in Section 4.5.

## 4.1 Purpose and research questions

Although there is a significant amount of literature on case studies of IL training there is little empirical research on its effectiveness, beyond pre/post-tests and outcomes assessment (Rockman, 2002; Orme, 2004). There has also been little research on the application of scaffolding and metacognitive support to teaching students IL skills (Gorrell et al., 2009). These gaps in the literature are addressed by the research through conducting an experimental study.

The purpose of the research is to investigate the effects of scaffolding and metacognitive support on student learning of online credibility evaluation skills. The study tests if the IC tool incorporating scaffolding and metacognitive support increases students' knowledge of the expert criteria that constitute credibility evaluations, the evidence-based source characteristics used in making credibility evaluations, and the metacognitive strategies used while evaluating online information. The expert credibility criteria that students will learn are the concepts of authority, relevance, reliability, currency, and purpose (based on a scaffolded model of "who, what, where, when and why") and their definitions. The evidence-based source characteristics students will learn to examine are evidence used for credibility evaluations such as author credentials, main ideas, references/links, site domain, contact information, date, and About and purpose statements. The metacognitive strategies students will learn are increased use of planning,

monitoring, and reflecting on their evaluation practices (see Section 4.5 for measurements of these outcomes). Based on these objectives, the research questions addressed by this study are:

**RQ1:** Do students who use the online credibility evaluation learning tool demonstrate greater understanding of expert credibility criteria in the process of evaluating online sources compared to groups of students who use a tutorial and an online form, or those who use only an online form?

**RQ2:** Do students who use the online credibility evaluation learning tool demonstrate greater application of evidence-based source characteristics as the basis for their credibility evaluations compared to groups of students who use a tutorial and an online form, or those who use only an online form?

**RQ3:** Do students who use the online credibility evaluation learning tool demonstrate greater metacognitive awareness compared to groups of students who use a tutorial and an online form, or those who use only an online form?

These research questions were examined through an experimental study of college undergraduates using two treatment groups and a control group to compare the performance of subjects using the IC tool to the performance of subjects on similar tasks without the use of the tool. The Treatment 1 (T1) group completed the online tutorial and use the three-stage IC tool to conduct credibility evaluations, the Treatment 2 (T2) group completed the tutorial without using the tool and using an online form to conduct credibility evaluations, and Control Group (CTRL) used only the online form to conduct their credibility evaluations. After completing their treatment/control group activities, all subjects completed two post-tests: a credibility criteria test and a metacognition test (see sections 4.3.1 and 4.3.2).

Based on these research questions, it was hypothesized that the IC tool, with its step-by-step structured learning process that enlists scaffolding and question prompts, would be more effective than the tutorial or online form methods. Specific hypotheses derived from the research questions are:

- H1: The Treatment 1 group will demonstrate greater use of specific credibility criteria compared to Treatment 2

- H2: The Treatment 1 group will demonstrate greater use of specific credibility criteria compared to the Control group
- H3: The Treatment 1 group will demonstrate greater use of evidence-based source characteristics compared to Treatment 2
- H4: The Treatment 1 group will demonstrate greater use of evidence-based source characteristics compared to the Control group
- H6: The Treatment 1 group will demonstrate greater metacognitive skills compared to the Treatment 2
- H7: The Treatment 1 group will demonstrate greater metacognitive skills compared to the Control group

Both qualitative and quantitative data collection methods were used in the experiment. Qualitative data included student responses entered to the Notebook credibility evaluation prompts, evaluation comments on other students' sources, and students' responses to the credibility criteria and metacognition post-tests. [Note: Quantitative logfile data was originally planned to be used, however, limitations of time and resources made it impractical to capture comparable logfile data for the T2 and CTRL groups, so this data source was not employed for data analysis]. Table 13 summarizes the experiment's data sources and analysis methods.

**Table 13. Data analysis methods**

| Research question | Data source | Analysis method |
|---|---|---|
| RQ1 | Credibility criteria responses | Coding and statistical |
| RQ2 | Reflective prompts | Content analysis |
| RQ3 | Metacognition post-test results | Scoring and statistical |

Data collection is discussed in section 4.4 and data analysis is discussed in section 4.5.

## 4.2. Experimental design

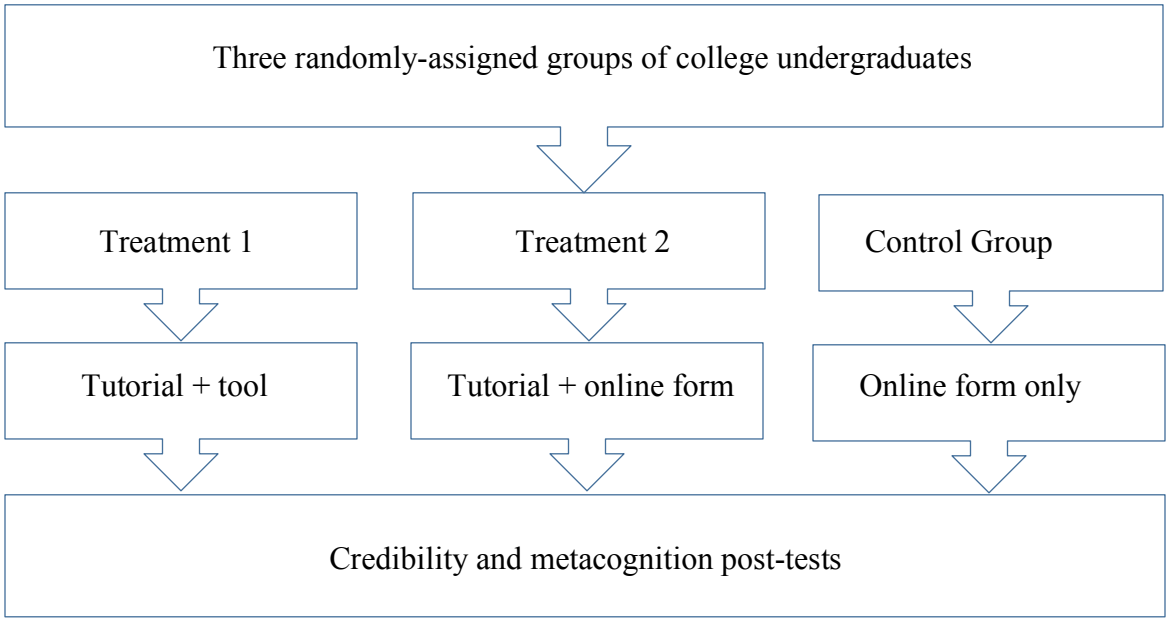
This experiment tested the IC tool as a support for students' online information evaluation as part of a class research project. The experiment reproduced as much as possible the real life conditions under which students would use the tool for academic research, instead of testing in the artificial setting of a lab. This section describes the study's experimental design, the activities carried out by subjects in the three conditions, and the measurements used to identify outcomes.

While many LIS studies use a pre-test/post-test research design, such design has poor internal validity (Mitchell & Jolley, 2004). It is not a true experimental design, since only one group of participants is tested, administered a treatment, and retested. The pre-test/post-test design does not use randomized assignment of subjects, since there is only one group of subjects. Because of this lack of randomization and experimental groups, the internal validity of this design is compromised by the testing effect, in which subjects are primed on the nature of the treatment by the pre-test, which may influence their performance on the post-test. In this design, the influence of the pre-test cannot be separated from the effect of the treatment, since improvements in scores may simply be the result of practice on the pre-test. In conditions where randomized assignment is not possible, a pre-test/post-test design is acceptable. However, randomized experiments are the best technique for determining which educational practices work and for comparing the relative benefits of different treatments (Cook & Singha, 2006). In a true experimental design with randomized assignment to treatment and control groups, the threat of the testing effect is removed and internal validity of the design is improved, allowing for a more reliable determination of the treatment's effect (Mitchell & Jolley, 2004). Internal validity insures that the treatment actually caused the measured effect, strengthening the quality of statistical analyses used to evaluate the results (Shadish, Cook & Campbell, 2002). Causal claims from randomized experiments are more credible than from other designs (Cook & Singha, 2006). The use of randomized samples to ensure data accuracy and generalizability is needed in IL studies (Metzger, Flanagin & Zwarun, 2003). For these reasons, the research design employs randomized assignment of subjects to treatment and control conditions and uses a post-test only design.

The T1 group completed the online tutorial and used the IC tool, consisting of the browser-based Notebook and the website containing the three-stage evaluation activities (described in Chapter 3). These subjects received the tool's scaffolded guidance through tips and question prompts and gain repeated practice in a step-by-step process of online credibility evaluation. They received metacognitive support through the use of process maps, progress monitors, and reflective questions, which helped them plan, monitor and reflect on their learning. Since there can only be one control group in an experimental design, the group which used only the tutorial but did not use the IC tool was designated as "Treatment 2" since they received a partial intervention. T2 group subjects completed the same online tutorial as the T1 group but did not use the IC tool. Instead, they used a static online form to answer the 5Ws questions about their sources. The form provides the same credibility questions and criteria as the complete tool, without the tips, prompts, or scaffolds. The form also provides the same introduction to the higher-level credibility terminology from Part 2 of the Question Stage to provide equivalent learning content (see Appendix 7: Online Form for Control Groups). Control group subjects did not take the tutorial or use the IC tool, but only used the static online form to answer the 5Ws questions about their sources. Due to the random assignment to condition, receiving identical instruction, and completing equivalent tasks in an online learning environment, the T2 and CTRL group subjects were hopefully unaware that they are experiencing different experimental conditions from the T1 group.

All subjects worked online and received the same initial instructions, which reduced the threat of treatment diffusion by minimizing the possibility of subjects realizing they were assigned to different conditions, and increased the treatment integrity by providing quantifiable evidence that all subjects performed similar tasks (Shadish, Cook & Campbell, 2002). Subjects were randomly assigned to one of three groups: 1) the T1 group, which completed the tutorial and use the three-stage IC tool to conduct credibility evaluations, 2) the T2 group, who completed the tutorial but did not use the IC tool and instead used an online form to conduct credibility evaluations, and 3) the CTRL group, which used only the online form (see Figure 16 for a diagram of the experimental design.) After completing their treatment/control group activities, all subjects completed two post-tests: a credibility criteria test and a metacognition test (see sections 4.1 and 4.2).

**Figure 16. Experimental design**




The independent variable in this research design is exposure to the structured sequence of scaffolded instruction and guided practice that constitutes the design of the IC tool. The dependent variables are the students' demonstrated understanding of the credibility criteria, their use of evidence-based source characteristics to evaluate credibility of online information, and their metacognitive awareness of the steps of the evaluation process.

The experimental study took approximately two weeks to complete, including subject recruitment. Subjects in the T1 group were given two days to register and complete the online tutorial, two days to complete each of the three stages of the IC tool, and two days to complete the post-tests, for a total of ten days. Subjects in the T2 and CTRL groups followed the same timeline, although they used the online form instead of using the three-stage tool. This timeline was intended to equalize the tasks and study length between the three experimental groups. See timeline in Figure 17 below:

**Figure 17. Study timeline**

| 2 days (Tue-Wed) | 2 days (Thur-Fri) | 2 days (Sat-Sun) | 2 days (Mon-Tue) | 2 days (Wed-Thur) |
|---|---|---|---|---|
| Treatment 1 group | | | | |
| Register & complete tutorial | Investigate stage | Question stage | Solve stage | Post-tests |
| Treatment 2 group | | | | |
| Register & complete tutorial | Find & evaluate sources | Review own sources | Choose own best sources | Post-tests |
| Control Group | | | | |
| Register | Find & evaluate sources | Review own sources | Choose own best sources | Post-tests |

Subjects completed the tasks outside of class on their own time using their own computers, which allowed students to complete the required tasks at their own pace rather than under the artificially constrained conditions of a laboratory experiment. This design was also intended to recreate the conditions of an in-class assignment for which students would do their own online research to find sources.

Subjects were randomly assigned using a random number generator to one of the three experimental groups, using stratified assignment by year to insure equivalency in experience level between the experimental groups. All groups were assigned the same research topic and instructed to search the web for relevant sources on the topic "What is the effect of social media on education?" This topic was relevant to the nature of the course in which subjects were enrolled (see Chapter 5 for details on the final demographics and assignment of subjects).

## 4.3. Subject recruitment

Student subjects were recruited from a large undergraduate introductory course at the University of Michigan (SI 110: Introduction to Information). This student population was appropriate to the research goals because many are usually incoming freshman recently graduated from high school, which is the target audience for the IC tool. A smaller percentage of students in this class come from a mixture of other years in college, providing a variety of subject backgrounds and skill levels. The class is large enough that an appropriate number of

subjects could be obtainable for each of the three conditions, with the desired goal of having 30 subjects in each group to ensure statistical validity and generalizability (Creswell, 2002). The content of the class is broad and general, so specific knowledge or expertise is not required; this is appropriate for this study because the IC tool is designed to be discipline-neutral. The research topics in the class are generally related to current issues in information technology, and thus lend themselves to online information searching.

Students were contacted via in-class announcements and through online messages through the class Learning Management System. Potential subjects were offered extra credit in the course for their participation in the study. They were encouraged to use their online research as part of the study for their in-class writing assignments, to increase their motivation and the relevance of the study.

IRB approval of the study was secured before the start of the experiment. An "exempt from ongoing IRB review" status was received because the research was conducted in established or commonly accepted educational settings, involving normal educational practices.

## 4.4. Data collection

All data in this study were collected online through automatic recording of all subject responses to prompts and responses to post-test questions. Online assessments been shown to be stronger predictors of learning outcomes than offline assessments such as questionnaires, interviews, and self-report (Veenman, 2013). Correlations among online measures and learning outcomes are higher than correlations among offline measures, suggesting that subjects do not do what they prospectively say they will do and do not accurately recollect in retrospect what they actually did (Veenman, 2013). There is also evidence that online assessments are more valid than offline assessments of metacognitive skills (Veenman, 2013). Thus, online assessment measures are used in this study.

Both quantitative and qualitative data was collected during this study, allowing for a multimodal evaluation of the study outcomes. Qualitative data included student responses entered to credibility evaluation prompts, comments on other students' sources, responses to reflective prompts, and definitions of the credibility criteria. Quantitative data on subject self-evaluation of their skills and metacognitive awareness was collected through the post-test. After completing their treatment/control group activities, all subjects completed two post-tests: a test

of credibility criteria and a metacognition test. Both instruments were pilot tested prior to the start of the experiment, and were modified as needed based on results from cognitive interviews with pilot test subjects. The instruments are described below.

### 4.4.1. Credibility criteria test

The researcher originally intended to utilize a standardized IL skills test as a pre-test for this study. There are several widely available IL skills test that are commonly used for assessment of college students. Tests reviewed for this study are described in Table 14.

**Table 14. Standardized IL tests**

| Name | Developed by | Description | Source |
|---|---|---|---|
| Information Literacy Test (ILT) | James Madison University | 60-item multiple-choice test | www.madisonassessment.com/assessment-testing/information-literacy-test |
| Standardized Assessment of Information Literacy Skills (SAILS) | Kent State University | 45 questions (cohort), 55 questions (individual) | www.ProjectSAILS.org |
| iSkills | ETS Corporation | 14 tasks | www.ets.org/iskills/about |
| Research Readiness Self-Assessment (RRSA) | Central Michigan University | 50 tasks | rrsa.cmich.edu/twiki/bin/view/RRSA/WebHome |

All four of these tests are described as based on the ACRL *Information Literacy Competency Standards for Higher Education.* ILT is described as reliable and validated (Cameron, Wise, & Lottridge, 2007). These tests cover a broad array of topics from traditional bibliographic instruction, including identifying magazines and journals, understanding call numbers, catalog searching, and using library resources. The SAILS test groups the ACRL outcomes and objectives into eight skill sets: Developing a Research Strategy, Selecting Finding Tools, Searching, Using Finding Tool Features. Retrieving Sources, Evaluating Sources, Documenting Sources, and Understanding Economic, Legal, and Social Issues. Many of the SAILS questions are specifically related to libraries (i.e., "What are the best things to do when you need help with library research?" with correct answers "Ask at the reference desk" and "Call the reference desk") and research skills such as using online catalogs and databases and understanding citations. Evaluation of online sources is barely covered, although general questions about the reliability of the Internet are asked. The iSkills test also focuses on information and

communication technologies (ICT) proficiency, such as web tools use, database management, and typical office software. The RRSA's website states that their objectives include explaining the value of using libraries to students and motivating students to use libraries. Thus, much of the material on these tests falls outside the scope of this study, while minimally covering the critical evaluation of online sources, if at all. Additionally, the length of the questionnaires and the time commitment for students to complete them made them prohibitive for this study. All these tests are also fee-based and require subscription or per-user fees, making them cost-prohibitive. As a result, the researcher determined that these assessments were not appropriate for this study, and that a custom test needed to be developed that focused specifically on the credibility criteria and evaluation skills that are the subject of the learning tool.

The custom credibility criteria post-test developed for this study asks 10 specific questions about the criteria for evaluating the credibility of online information, based on the expert terminology and definitions introduced in the Question stage (as opposed to the novice-level terminology of the 5Ws). The open-ended questions ask students to demonstrate their knowledge of both the criteria themselves and the strategies for evaluating each criteria. Table 15 lists the questions in the post-test.

**Table 15. Credibility criteria post-test**

| |
|---|
| 1. How do you define the "authority" of information? |
| 2. Why is it important to evaluate the authority of online information? |
| 3. How do you define the "relevance" of information? |
| 4. Why is it important to evaluate the relevance of online information? |
| 5. How do you define the "reliability" of information? |
| 6. Why is it important to evaluate the reliability of online information? |
| 7. How do you define the "currency" of information? |
| 8. Why is it important to evaluate the authority of online information? |
| 9. How do you define the "purpose" of information? |
| 10. Why is it important to evaluate the authority of online information? |

The post-test was conducted as an online survey using the Qualtrics online survey software.

### 4.4.2. Metacognition test

As with the IL tests, several pre-existing metacognition tests were evaluated for use in this study. The first test to be considered was developed by Schraw and Dennison (1994). The Metacognitive Awareness Inventory (MAI) is a 52-item self-report questionnaire to assess students' knowledge about their own monitoring competence during a learning task (see Appendix 8 for the complete inventory). The questions are specific to classroom-based assignments (i.e., "I know how well I did once I finish a test" and "I know what the teacher expects me to learn"). Subjects who took the MAI answered a series of questions by self-rated their metacognitive abilities on100-point continuous scales from "Poor monitoring ability" to "Excellent monitoring ability." Students were also asked to rate their level of confidence in their response to each question on a 100-point continuous scale from "0% confident" to "100% confident." Scores on pre-test confidence, test performance, and monitoring accuracy were calculated. Monitoring accuracy was computed by taking the difference between each student's average confidence rating and their actual test score expressed as a proportion. This inventory was found to reliably test metacognitive awareness (Schraw & Dennison 1991, p 464).

Subsequently, this inventory was modified by Raes, et al. (2012) to address online information problem solving (i.e., "Once I finished searching the Internet, I asked myself how well I had answered the information problem"). Because of the length of time necessary to complete Schraw and Dennison's original 52-item test, and to reduce the required effort from test subjects, the researchers reduced the number of questions to 32 (see Appendix 12 for the complete inventory). Responses were converted to a 4-point Likert scale with agree/disagree responses instead of the original 100-point continuous scale, again to reduce the required effort from test subjects. After the testing the question inventory, a one-way analysis of co-variance (ANCOVA) was conducted with post-test scores as dependent variable, condition as independent factor, and pre-test scores as covariate to measure differences in condition. The researchers found that technology-enhanced scaffolding realized the highest learning gains.

When the Raes, et al. (2012) inventory was pilot tested, comments from students repeatedly focused on the repetitiveness and length of the questions (see section 3.4.1). This feedback suggests that the even longer 52-item Schraw and Dennison inventory would be even more problematic for students. After reviewing these tests, it seemed that no test was available

that met the specific needs of this study, so a custom metacognition test was developed. A set of 12 questions was selected from the Raes et al. inventory, and the language of the questions was customized specifically to the process of evaluating the credibility of online information. Based on the metacognition literature, questions are conceptually grouped into three categories focusing on planning, monitoring, and reflecting (see Table 16 below).

**Table 16. Adapted metacognition test questions**

| Category | Question |
|---|---|
| Planning | I think about what information I need to evaluate the credibility of online information |
| | I ask myself questions about the topic before I begin evaluating the credibility of online information |
| | I think of several ways to find evidence for evaluating the credibility of online information |
| | I organize my time to best accomplish evaluating the credibility of online information |
| Monitoring | I plan the steps of evaluating the credibility of information |
| | I analyze the effectiveness of my evaluation strategies |
| | I compare information from different websites when I evaluate them |
| | I periodically review the evidence I find while evaluating the credibility of online information |
| Reflecting | I try to find specific evidence to justify and support my evaluations |
| | I try to look at the evidence from different perspectives when making evaluations |
| | I ask myself if there was a better way to find evidence after I finish evaluating the credibility of online information |
| | I ask myself if I found as much evidence as I could once I finish evaluating |

Raes et al.'s (2012) model of 4-point Likert scale responses was employed (strongly disagree, disagree, agree, strongly agree). This post-test was conducted as an online survey using the Qualtrics survey software.

## 4.5. Data analysis

This study's research questions were answered based on analyses of both qualitative and quantitative data, which provided a multi-dimensional understanding of student behavior and strengthened findings and conclusions regarding the impact of the online participatory learning

tool. Qualitative data (student responses entered in response to credibility evaluation prompts, reflective prompts, and students' final definitions of credibility criteria) were coded for the presence of categories of credibility evaluations and sub-categories of evidence-based source characteristics. Quantitative data based on scores for understanding the credibility criteria and for the metacognitive post-test were conducted using the SPSS statistical software package.

The data analysis methods employed to answer this study's research questions are described below for each question:

**RQ1:** Do students who use the IC tool demonstrate greater understanding of expert credibility criteria in the process of evaluating online sources compared to groups of students who use a tutorial and an online form, or those who use only an online form?

For this study, "understanding" was defined as the ability to 1) accurately define the criteria and 2) articulate their importance. Subjects' qualitative responses were scored based on a rubric covering the components of each criteria's definition and importance (see Table 17). The highest-scoring responses demonstrated greater knowledge of the components of the expert concept of credibility, their definition, and their importance.

**Table 17. Coding rubric for student knowledge of credibility criteria**

| Criteria | Definition | Importance |
|---|---|---|
| Authority | If the author is qualified to write about the topic | Anyone can post to the Internet, and qualifications need to be verified |
| Relevance | If the information is useful for the research topic | There is a lot of information on the Internet, but you need to choose relevant information for your research topic |
| Reliability | If the information is trustworthy | The sources of online information are not always apparent, and need to be verified |
| Currency | If information is up-to-date | Up-to-date information is often most accurate, although not for every topic |
| Purpose | If the site shows bias | The purpose(s) of online information are not always apparent, and may influence its value |

For example, a high-scoring answer to the test question "What does authority mean, and why is it important to evaluate?" would be "Authority means that the author of the work has credentials

that show he/she is qualified to write about the subject. It's important because anyone can post information online, and you need to verify that they know what they are talking about." A mid-scoring response would be "Authority means the author knows what he's talking about. It's important to check if he has credentials." A poor-scoring response would be "Authority means who the author is. You should check their background."

## 4.6. Qualitative Coding

In this study, students provided qualitative responses to open-ended question prompts in the post-test. These responses were reviewed by coders and assigned numerical scores based on a standardized coding rubric. The researcher developed the rubric for numerical scoring against three levels of scoring based on demonstrated student comprehension of the topics. The three levels of scoring equate to a "high/medium/low quality" quality level using a scale of 2/1/0 (see complete rubric in Table 18 below). The rubric defines the terms or concepts that needed to be present in the answer to achieve that score. A high quality answer (score of 2) showed clear evidence that the student understood the concept by expressing that in the context of credibility evaluation, "authority" means both identifying the author AND the author's credentials or qualifications. Responses did not need to use the specific language in the criteria as long as the coder was confident that the student understand the concept. A medium quality answer (score of 1) showed some evidence that the student knows something about the concept by mentioning either of these two elements of a definition, but didn't completely meet the criteria. These answers sometimes required interpretation on the part of the coder. The coders were generous if they felt that the student showed partial understanding. A low quality answer (score of 0) didn't demonstrate any understanding of the question, and met none of the criteria.

**Table 18. Coding rubric for student open-ended questions**

| Question | Score | | |
|---|---|---|---|
| | 2 | 1 | 0 |
| What does "authority" of information mean? | identify author AND credentials/qualifications | identify author OR credentials/qualifications | neither |
| Why is it important to evaluate how authoritative online information is? | anyone can post online AND importance of verification | anyone can post online OR verification | neither |

| | | | |
|---|---|---|---|
| What does "relevance" of information mean? | content/topics are useful /related to question | generic mention of content/topics | neither |
| Why is it important to evaluate how relevant online information is? | filter/select information AND judge value | filter/select information OR judge value | neither |
| What does "reliability" of information mean? | trustworthiness AND sources | trustworthiness OR sources | neither |
| Why is it important to evaluate how reliable online information is? | Internet skepticism AND need to verify/evaluate sources | Internet skepticism OR verify | neither |
| What does "currency" of information mean? | up to date/recent | time/when published (or just "current") | neither |
| Why is it important to evaluate how current online information is? | useful/relevant/valid AND depends on topic | useful/relevant/valid OR depends on topic | neither |
| What does "purpose" of information mean? | why the information was written/published/presented (goal/intent/bias) | generic mention of "goal/intent/bias" | neither |
| Why is it important to evaluate what the purpose of online information is? | detect bias AND judge value/credibility/usefulness | detect bias OR judge value/credibility/usefulness | neither |

Responses for each question were scored according to this rubric for both the definition and importance elements of each criteria. Table 19 below shows examples of the rubric applied to potential response to the question "What does "currency" of information mean?" The first example meets both of the requirements for the definition and receives a high score of 2. The second example only mentions one of the criteria and receives a medium score of 1. The third example meets neither criteria and receives a low score of zero.

**Table 19. Potential responses and scores to definition responses**

| What does "currency" of information mean? | Score |
|---|---|
| The "currency" of information means that the information isn't outdated. Similarly to the "relevance" of information, the "currency" means the information is current, pertinent, and up to date. | 2 |
| The currency of information refers to the time a piece of information is created. | 1 |
| What type of information it is. | 0 |

Table 20 below shows examples of the rubric applied to potential response to the question "Why is it important to evaluate what the purpose of online information is?" The first example meets

both of the requirements for the explanation of importance and receives a high score of 2. The second example only mentions one of the criteria and receives a medium score of 1. The third example meets neither criteria and receives a low score of zero.

**Table 20. Potential responses and scores to importance questions**

| Why is it important to evaluate what the purpose of online information is? | Score |
|---|---|
| By evaluating the purpose of online information, you can determine if there is a bias to the source and how to then evaluate the source's credibility. | 2 |
| It is important to evaluate what the purpose of online information is because one should make sure it is not biased. | 1 |
| The purpose dictates what kind of message the information is trying to send. | 0 |

An overall score for understanding of the criteria was obtained by averaging the two scores for the definition and importance of each criteria. Table 21 lists the pairs of answers that were averaged together per criteria.

**Table 21. Components of understanding score**

| Criteria | Component responses for understanding score |
|---|---|
| Authority | What does "authority" of information mean? |
| | Why is it important to evaluate how authoritative online information is? |
| Relevance | What does "relevance" of information mean? |
| | Why is it important to evaluate how relevant online information is? |
| Reliability | What does "reliability" of information mean? |
| | Why is it important to evaluate how reliable online information is? |
| Currency | What does "currency" of information mean? |
| | Why is it important to evaluate how current online information is? |
| Purpose | What does "purpose" of information mean? |
| | Why is it important to evaluate what the purpose of online information is? |

The average scores for understanding of each criteria were compared between groups to determine differences in outcome between experimental conditions.

**RQ2:** Do students who use the IC tool demonstrate greater application of evidence-based source characteristics as the basis for their credibility evaluations compared to groups of students who use a tutorial and an online form, or those who use only an online form?

Subjects' qualitative responses were scored based on a rubric covering the source characteristics mentioned when describing the evaluation process. The highest-scoring responses demonstrate knowledge of the specific evidence that should be examined when evaluating each criteria of credibility. Specific components of a correct answer are listed in Table 22.

**Table 22. Rubric for scoring post-test**

| Criteria | Evidence |
|---|---|
| Authority | Author credentials, contact link |
| Relevance | Main ideas, keywords, tags |
| Reliability | URL/domain, host, references/sources |
| Currency | Copyright date, updates, importance of currency to topic |
| Purpose | About link, purpose statement, advertising, biased language |

For example, a high-scoring answer to the test question "How do you evaluate the authority of online information?" would be "You can evaluate authority by looking for evidence such as the author's biography, credentials, and contact info to ask questions." A mid-scoring responses would be "You can evaluate authority by looking at the author's credentials." A poor-scoring responses would be "The author should have a degree." Subjects' qualitative responses were coded based on the credibility evaluation categories developed by Markey et al. (2014). This model categorizes student credibility evaluations into three types: (1) Evidence-based, (2) Projection, and (3) Intuition (see Table 23).

**Table 23. Categories of credibility evaluations (Markey et al., 2014)**

| Category | Definition |
|---|---|
| Evidence-based | Cites specific evidence supporting evaluation |
| Projection-based | Speculates without evidence |
| Intuition-based | Makes unfounded assertions without evidence |

These categories summarize the types of explicit justifications that students gave to support their credibility judgments of sources. The Evidence-based category consists of justifications citing specific criteria of the source, either internal factors such as author affiliation, date of publication, length, format/genre, and cited references, or external evidence such as the database or online repository from which the source was retrieved. The Projection category consists of speculations on a source's credibility, such as "well-written" or "not well-written," that did not cite specify criteria as evidence for their judgment. The Intuition category consists of broad assertions without any supporting evidence, such as "seems credible enough" and "appeared relevant." (Note that these categories relate to Rieh's 2002 model of evaluative vs. predictive judgments.) Clearly, only the Evidence-based category shows reasoning and attempts to verify credibility judgments through examining and evaluating characteristics of the source. This model for categorizing the credibility judgments made by students, and the evidence cited to support them, is a helpful tool in assessing the actual source evaluation practices of students.

For both RQ1 and RQ2 above, after coding was finalized, an interrater reliability analysis using the Cohen's Kappa statistic was performed to determine consistency between raters. Cohen's Kappa calculates that agreement between coders adjusted for that expected by chance. It is the amount by which the observed agreement exceeds that expected by chance alone, divided by the maximum which this difference could be (Landis & Koch, 1997).

**RQ3:** Do students who use the IC tool demonstrate greater metacognitive awareness compared to groups of students who use a tutorial and an online form, or those who use only an online form?

Scores on the Likert-scale metacognitive post-test (described in section 4.4.2) were analyzed descriptively to compare the self-ratings between groups. Statistical tests were not appropriate due to the similarly high scores from all subjects (see Chapter 5 for discussion of these results). Responses were grouped by category of metacognition (planning, monitoring, reflecting) to show differences between the groups in self-reported skills. Subjects' quantitative scores on the metacognitive post-test were automatically converted to a 4-point scale (strongly disagree = 1, disagree = 2, agree = 3, strongly agree = 4). Subject scores were compared across groups for evidence of different metacognitive awareness by treatment condition.

Note: Originally, subjects' qualitative responses to the metacognitive prompts at the end of the Solve stage (see section 3.3.2.) were intended to be coded for presence of key words or phrases that show metacognitive awareness, based on the coding model in Ge, Planas, and Er (2010) as either "superficial" or "deeper" reflection. However, based on the insufficient effort from the subjects and lack of full responses, this analysis method was not used. See Chapter 5 for discussion.

# Chapter 5: Findings

This chapter describes the findings from the experimental study of the "InCredibility" tool (IC tool) that were used to answer the following research questions:

**RQ1:** Do students who use the IC tool demonstrate greater understanding of expert credibility criteria in the process of evaluating online sources compared to groups of students who use a tutorial and an online form, or those who use only an online form?

**RQ2:** Do students who use the IC tool demonstrate greater use of evidence-based source characteristics as the basis for their credibility evaluations compared to groups of students who use a tutorial and an online form, or those who use only an online form?

**RQ3:** Do students who use the IC tool demonstrate greater metacognitive awareness compared to groups of students who use a tutorial and an online form, or those who use only an online form?

Before describing the study results, this chapter reviews the participant demographics from the experimental groups, and the subjects' contributed sources, as these were the basis for their credibility evaluations.

## 5.1. Subject recruitment

As described in Section 4.3, subjects were recruited through a large undergraduate course in the School of Information at the University of Michigan. Students enrolled in this class came from a range of academic majors and years in school: of the 220 students there were 15% freshmen, 51% sophomores, 21% juniors, and 12% seniors. The content of the course covered a wide variety of internet-related topics (computers, networks, social media) that lent themselves

to students doing online research. An invitation to participate in the study was announced to the entire class soliciting participation. In total, 193 responses were received (out of 220) indicating that students were interested in participating in the study. When subjects responded to the initial recruitment message, they indicated their interest in participating by completing a short demographic survey. After completing the survey, they were instructed on how to begin the study.

## 5.2. Randomized assignment of subjects

Subjects were randomly assigned to one of the three study groups: T1 group (T1) used both the IC tool and the introductory tutorial, T2 group used the tutorial and an online form to record their sources, and the CTRL group used only the online form. The goal of the subject assignment was to have approximately 30 subjects per group to enable statistical validity and generalizability (Creswell, 2002). To ensure that the group assignments reflected the original population of the class, the total class registration was broken down by percentages per grade level, with the aim of assigning similar proportions of each year in the experimental groups. Randomized assignment with stratification was used to assign subjects to the experimental groups by grade level, in order to ensure a comparable composition to the original distribution of grade levels in the entire class: 15% freshmen, 51% sophomores, 21% juniors, and 12% seniors. See Table 24 for the initial assignment of participants by grade level. Each experimental group consisted of over 50% sophomores, reflecting the original class registration. This stratified random assignment equalized the distribution of year levels between groups, and thus helped CTRL for the level of experience between groups.

**Table 24. Initial condition assignment (193 subjects)**

| Year | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Freshmen | 18 | 20% | 10 | 20% | 10 | 20% |
| Sophomore | 48 | 53% | 28 | 55% | 28 | 55% |
| Junior | 15 | 16% | 7 | 14% | 7 | 14% |
| Senior | 10 | 11% | 6 | 12% | 6 | 12% |
| Total | 91 | 100% | 51 | 100% | 51 | 100% |

After subjects were assigned to their respective experimental groups, they were contacted via email with instructions on how to begin the study. Subjects were blind to their experimental condition, and were asked to indicate their agreement to an honor code statement specifying that they would work independently and not share their work with others. This statement was intended to reduce the possibility that students in the class would talk to each other about the study, or compare their experiences with each other and potentially realize that they were in different conditions. Subjects were instructed to complete each of the three stages of the study within the same time periods.

Although students were incentivized for their participation in the study, not all of the students who initially responded to the recruitment phase successfully completed the experiment. Out of the total 193 subjects who expressed interest in participating and completed the initial survey, 84 subjects completed the study, resulting in a 44% completion rate. This large drop-off in participation may reflect the fact that the study took more effort than many students expected to invest, consisting of several steps over several days. Since it was an extra credit opportunity, and not a required for-credit assignment, some participants may have opted not to complete it. However, the final totals were close to the desired goal of having 30 subjects in each group to enable statistical comparability. By treatment group, there were 33 subjects in T1, 25 subjects in T2, and 26 subjects in CTRL (see Table 25). This small variation in the size of groups does not effect the statistical analysis. The percentage of freshman in the final experimental groups was higher than the original class distribution (15%), and the percentage of sophomores in the experimental groups was lower than the original class distribution (51%) as a result of the attrition of participants from the original assignments. Given the amount of attrition, this was still considered to be fair approximation of the original class distribution.

**Table 25. Final participant distribution (84 subjects)**

| Year | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Freshmen | 9 | 27% | 7 | 28% | 8 | 31% |
| Sophomore | 12 | 36% | 11 | 44% | 10 | 38% |
| Junior | 6 | 23% | 3 | 12% | 4 | 15% |
| Senior | 6 | 18% | 4 | 16% | 4 | 15% |
| Total | 33 | 100% | 25 | 100% | 26 | 100% |

The distribution of gender among the final study participants is shown in Table 26. Groups T1 (48% M, 52% F) and CTRL (46% M, 54% F) ended up with fairly equal gender representation although the T2 group turned out to be skewed towards males (76% M, 24% F). Since the subject assignment was randomized, the gender distribution overall was not considered as a factor in the analysis of results.

**Table 26. Final participant gender by group**

| Gender | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Male | 16 | 48% | 19 | 76% | 12 | 46% |
| Female | 17 | 52% | 6 | 24% | 14 | 54% |
| Total | 33 | 100% | 25 | 100% | 26 | 100% |

After the education level and gender questions, students were asked the following questions regarding their background experience and knowledge:

- How experienced are you with searching for information on the Internet?
- Have you had any formal instruction in information literacy (how to do library research)?
- If yes, where did you have this information literacy/library research instruction?
- Did this information literacy/library research instruction include how to evaluate the quality of online information?

These questions sought to identify the subjects' level of experience and skills with online information seeking and credibility valuation, based on both prior experience and explicit IL instruction. Prior experience with online searching and prior IL instruction could both be potential confounding factors in this study, and might skew the results by allowing some students to perform better regardless of their treatment condition since prior instruction could potentially increase the subject's skill level and performance. The responses to these questions were used in evaluating the study results. Responses to the first question "How experienced are you with searching for information on the Internet?" are shown by group in Table 27 below.

**Table 27. Experience with searching the Internet**

| Experience level | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Not at all experienced | 0 | 0% | 0 | 0% | 0 | 0% |
| A little experienced | 4 | 12% | 4 | 16% | 3 | 12% |
| Moderately experienced | 16 | 48% | 12 | 48% | 14 | 56% |
| Very experienced | 13 | 39% | 9 | 36% | 8 | 32% |
| Total | 33 | 100% | 25 | 100% | 25 | 100% |

These results show that the groups are roughly equivalent in their distribution of experience, with "moderately experienced" being the most frequent response for all groups at 48% (T1), 48% (T2) and 56% (CTRL). The second most frequent response from subjects was "very experienced" at 39% (T1), 36% (T2), and 32% (CTRL), which suggests that many subjects considered themselves to be above average in their search skills. A small percentage of subjects responded that that they were "a little experienced" at 12% (T1), 16% (T2), and 12% (CTRL). It is interesting to note that none of the subjects reported themselves to be "not at all experienced," which may reflect either the universality of Internet use among these subjects, or alternately that none of the subjects were willing to self-identify as inexperienced.

Responses to the second question 'Have you had any formal instruction in information literacy (how to do library research)?" are shown in Table 28.

**Table 28. Prior IL instruction**

| Response | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Yes | 18 | 55% | 14 | 56% | 15 | 60% |
| No | 15 | 45% | 11 | 44% | 10 | 40% |
| Total | 33 | 100% | 25 | 100% | 25 | 100% |

While these results show that the distribution of prior IL instruction is roughly similar between groups, the CNTRL group subjects had a somewhat higher percentage of prior IL training (60%) than did the T1 (55%) and T2 groups (56%). While this difference is fairly small, in retrospect the study would have been improved if this factor had been considered in the subject assignment process as well as year level, in order to further equalize the experience level of subjects between the groups.

The 47 subjects who responded "yes" they had received prior IL instruction (18 T1, 14 T2, and 15 CTRL) were given a follow-up question that asked "Did this information literacy/library research instruction include how to evaluate the quality of online information?" The intent of this question was to identify the extent to which these subjects had been explicitly instructed in credibility evaluation skills, as opposed to traditional bibliographic and citation instruction. Results of this follow-up question are shown below in Table 29.

**Table 29. Prior IL instruction included quality evaluation**

| Response | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Yes | 12 | 67% | 10 | 71% | 12 | 80% |
| No | 6 | 33% | 4 | 29% | 3 | 20% |
| Total | 18 | 100% | 14 | 100% | 15 | 100% |

Of those subjects who reported receiving prior IL instruction, a majority of each group reported that their instruction had included how to evaluate the quality of online information at 67% (T1), 71% (T2), and 80% (CTRL). The CTRL group reported a slightly higher level of agreement, which corresponds with their reporting of a higher level of prior IL training. For each group, a smaller percentage responded that their prior instruction had not included how to evaluate the quality of online information at 33% (T1), 29% (T2), and 20% (CTRL). This suggests that their prior IL instruction may have been very traditional bibliographic instruction, focused on evaluating print materials and library databases. Alternately, students may not have remembered or retained evaluation instruction, even if it was presented in their IL instruction.

A Pearson's chi-square test was performed to determine if there significant differences between the groups on these demographic variables: year in school, gender, experience with searching the Internet, and prior IL instruction. The results showed no significant differences on any of the demographic variables between the groups. (See Appendix 11: Study demographics Chi Square Tests for complete results). This suggests that the stratified assignment was effective in keeping the groups demographically comparable.

## 5.3. Analysis of sources found by subjects

Before addressing the results of the experimental study of the IC tool, it is useful to examine the sources that were contributed by the subjects. This helps to understand the types of information sources that students were evaluating in making their credibility judgments, and also gives a clear picture of the type of information seeking behaviors that these students employ when conducting online research. Analysis of these sources revealed clear trends in the subjects' searching and evaluating habits.

All study subjects were given the imposed query of "What is the effect of social media on education?" as their research topic, in order to ensure comparability among the sources and to allow the subjects to make comparisons between sources. This topic was appropriate to the content of the class, which discussed many aspects of social media and their impact on many impacts of modern life. Thus, the topic would potentially be of more relevance to the subjects since it related directly to the content of the class, and sources that they found could potentially be used in class assignments. If subjects were allowed unrestricted searching on their own topics, the task of making comparative evaluations of the merits of two sources would have been very difficult. Limiting all experimental groups to the same topic ensured that all contributed sources would be broadly similar, and thus, subjects were able to focus their attention on the evaluation of credibility criteria of each source.

### 5.3.1. Comparison of sources contributed by group

The three experimental groups searched on the same research topic, but in each group the conditions were different. The T1 group used both the IC tutorial and the IC tool, which guides students through the entire process of evaluating sources based on credibility criteria and using source-based characteristics as evidence, comparing evaluations, and comparing sources to decide on the best ones to use for their research topic. The IC tutorial gives an introduction to the types of evidence students should use in their evaluation, but does not include scaffolding to help practice and learn, and does not provide any support for metacognitive strategies. The CTRL group used only an online form that only provides definitions of the credibility criteria.

Subjects in the T1 condition completed the IC tutorial and then were automatically directed to the IC tool's Headquarters page and were instructed as follows:

> ***You are currently researching the topic "What is the effect of social media on education?" Your task in the Investigate stage is to search online and find credible information about your topic. When you find information you want to use, open the Notebook in the lower right corner of the browser, and answer questions about the credibility of the information***

T1 subjects were able to search freely online and automatically save their chosen sources through the Notebook plugin (see Chapter 3 for description of the functionality of IC). T2 subjects took the IC tutorial, but did not use the Notebook plugin or the IC tool itself. Instead, they used the Google Bookmark browser plugin to bookmark the sources that they found (see Chapter 4 for description of the study design). CTRL subjects did not take the IC tutorial and used only the online form.

The sources found and saved by subjects were either recorded automatically (T1) by the IC tool or recorded by the subjects into the online form (T2 and CTRL). The URLs of all sources found by subjects were reviewed by the researcher, titles were retrieved manually, and the type of genre of each source was identified. Summary statistics were generated, including the multiple use of identical sources. The comparison of these sources between the experimental groups is described below.

Subjects in the T1 condition saved a total of 185 sources through their Notebooks. Disregarding duplication among the results, there was a total of 85 unique sources. For the most frequently contributed sources, titles, genre type, URL of the source, and the number of times contributed are shown in Table 30. Note that the number of times contributed (N) includes multiple contributions of the same source by different subjects. Of these 10 most frequently saved sources, 50% were blogs on education or social media topics. Of the remainder, 3 were commercial sites, 1 was a newspaper, and 1 was a research report from the ERIC database (Education Resources Information Center) sponsored by the US Department of Education and the Institute of Education Sciences. This last source is the only one that would be considered scholarly for the purposes of this study. Note that there is duplication between the sources; they were counted individually each time they were contributed by a subject.

**Table 30. T1's most frequently contributed sources**

| Title | Type | Source | N |
|---|---|---|---|
| The 10 Best And Worst Ways Social Media Impacts Education | Blog | edudemic.com | 19 |
| How Social Media Is Changing Education | Blog/Commercial | sproutsocial.com | 11 |
| Social Networking In Schools: Educators Debate The Merits Of Technology In Classrooms | Blog | huffingtonpost.com | 11 |
| Social Media In Higher Education: A Literature Review And Research Directions | Research report | academia.edu | 9 |
| Why Social Media Can And Is Changing Education | Blog | connectedprincipals.com | 8 |
| Social Networking: Teachers Blame Facebook And Twitter For Pupils' Poor Grades | Newspaper | telegraph.co.uk | 8 |
| How Is Social Media Affecting Education? | Commercial (video) | curiosity.discovery.com | 6 |
| The Challenging Effect Of Social Media On Education | Blog | educationandtech.com | 6 |
| 5 Reasons Social Media Enables Genuine Education | Blog | socialmediatoday.com | 5 |
| Teaching, Learning, And Sharing: How Today's Higher Education Faculty Use Social Media | Research report | eric.ed.gov | 5 |

Five of most frequently used sources for the T1 group were blogs. The first is Edudemic.com, self-described as "one of the leading education technology sites on the web" featuring "a regular flow of tools, tips, resources, visuals, and guest posts from dozens of authors around the world." Sharing links for a number of social media services (Twitter, Facebook, Google+, LinkedIn, Pinterest) can be seen beneath the headline. The site also carries ads. Based on these characteristics, the site was categorized as a blog. The second most frequently contributed blog was the Huffington Post, a news aggregator and blog, which features social media links, user comments, and advertising. Connectedprincipals.com is a group blog described as "the shared thoughts of school administrators that want to share best practices in education" (the contributed article is now archived and not available). Educationandtech.com is a personal blog maintained by a teacher. Socialmediatoday.com describes itself as "an independent, online community for professionals in PR, marketing, advertising, or any other discipline where thorough understanding of social media is mission-critical."

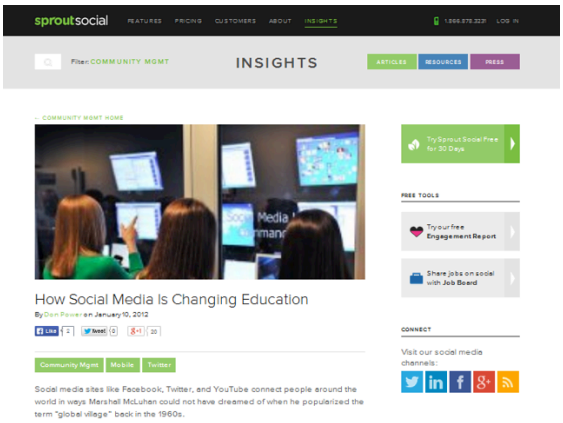
Screenshots of these blog results are shown below in Figure 18. Since research in student credibility evaluation practices has shown that students often rely on the visual characteristics of websites in evaluating credibility, considering the visual similarity of many of these sources and the lack of traditional credibility markers it is important to bear in mind. As discussed in the literature review, online information sources present challenges to credibility evaluation due to the lack of traditional credibility cues. One goal of this study was to instruct students how to identify the specific criteria they should use in evaluating the credibility of online sources, yet these criteria may be challenging for students to identify in the types of sources that were used in this study. Note that many of these sites are visually similar, and any differences in genre or intended purpose of the site (professional, commercial, personal) may not be apparent to students, suggesting that they may consider the content of each source to be equivalent as information sources.

**Figure 18. Blog search results**




The second most frequently contributed source overall for the T1 group comes from the commercial site SproutSocial.com, which sells social media services (see Figure 19). While it could also be characterized as a blog, it is hosted by a for-profit company and was categorized as a commercial source. This is arguably a grey area, though, since Huffington Post is also a commercial entity. Sproutsocial.com, though, seems primarily to be selling its company services, with a blog as a sideline (note that Sprout Social advertises on the Social Media Today site). Note that this site is visually similar to the blogs shown above, and it would be difficult for many students to determine the difference in purpose between this commercial blog and other information sources. At first glance, it appears to be a news source, although it is unlikely to be objective in its presentation of information since the company is directly involved in the industry it is reporting on.

**Figure 19. Commercial search results**




Another one of the top 10 sources was a video titled “How is social media affecting education?” from the website of the “Curiosity” TV show produced by the Discovery Channel, a commercial cable television channel (see screenshot in Figure 20). This site features multiple video clips apparently taken from a television show (preceded by ads), with each clip titled with a provocative question (possibly these questions are submitted by users, although it is not clear from the description of the site). A search box features the question prompt “What are you curious about?” and presents a video clip of someone responding to the question “How is social media effecting education?”

**Figure 20. Video search result**


The cited video clip shows an interview with a "marketing and product development officer" from a corporation, and provides a transcript of the interview below the video. It is unclear how a student might evaluate the credibility of this information. The site is apparently aimed at K-12 students, based on the broad array of question types listed under the Topics tab, and the informal style of the text. However, it is difficult to determine how to classify the Curiousity site, because no "About" statement is given, and its purpose and intended audience are unclear. The branding of the Discovery Channel is prominent on the site, and the main page (http://www.discovery.com/) advertises current episodes of the channel's programming, including "Fat N' Furious," "American Muscle," and "Shark Week" which are clearly popular entertainment. This overt marketing undermines the credibility of the site as an information source, especially as the site describes Discovery Communications, LLC as "The World's #1 Nonfiction Media Company." The Discovery Channel notoriously produced a fake documentary that claimed that an extinct prehistoric shark had been discovered alive (Davidson, 2013). Animal Planet, a TV channel also owned by Discovery Communications, has produced a fake documentary about the purported existence of mermaids (Davidson, 2013). Both of these examples show that the company is not above producing false, misleading misinformation masquerading as fact for the purposes of television ratings.

However, it is possible that students could view the Discovery Channel's Curiosity site as a credible source of information along the lines of a TV channel such as PBS, since the site presents a list of "experts" who apparently answer the questions posed on the site. These experts

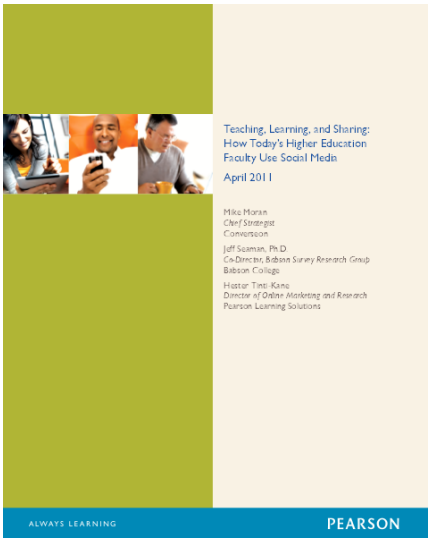
are shown under a link titled “Meet the Experts” (see Figure 21) and represent a varied mix of backgrounds and training.

**Figure 21. Experts presented by TV channel website**


Prominently displayed are Richard Saul Wurman, an architect, author and creator of the TED Conferece, and Elie Wiesel, Nobel Prize winning author, along with TV personality Dr. Mehmet Oz, known for his appearances on the Oprah Winfrey TV show, and Deepak Chopra, a popular author and proponent of alternative medicine. Note that two advertisements are also prominently displayed in this section. Many other experts are listed below by topic, although what criteria for determining their expertise might have been used is unclear. It is a widely varied group, ranging from chefs to engineers to scientists to businessmen, which raises questions about what exactly “expertise” is and how it is presented online. In the case of the Curiousity site, topical expertise appears to be determined by any professional experience in the area, possibly moderated by the extent to which the person is well known. An expert may well be just “someone who has something to say” about the topic. Overall, this site with its apparently user-submitted questions, its multi-media resources, and its broad application of the term “expertise,” is another example of the hybrid genres emerging from the Internet, with a mix of commercial and educational content and a reliance on branding to establish credibility.

For comparison, the research report included in the list of most used sources is a PDF of a report by Pearson Learning Solutions and Babson Survey Research Group hosted on the ERIC website. This source reports the findings of a survey of faculty on the topic of social media usage, and supplies detailed data analysis and findings (see screenshot in Figure 22 below).

**Figure 22. Research report search result 1**




It also is designed to be printed, and uses a more professional visual format. This source represents the most "academic" or expert-level source among the most frequently-contributed sources by the T1 group, although it is not a scholarly peer-reviewed journal article.

Subjects in the T2 group contributed a total of 27 sources. Without duplicates, there were 18 unique sources. Titles, genre type, URL of the source, and the number of times contributed of the sources donated more than once are shown in Table 31. Note that there is duplication between the sources; they were counted individually each time they were contributed by a subject.

**Table 31. T2's most frequently contributed sources**

| Title | Type | Source | N |
|---|---|---|---|
| Social Media in Higher Education: A Literature Review and Research Directions | Research report | academia.edu | 5 |
| Teaching, Learning, and Sharing: How today's Higher Education Faculty Use Social Media (PDF) | Research report | eric.ed.gov | 3 |
| Teaching, Learning, and Sharing: How today's Higher Education Faculty Use Social Media (abstract & download link) | Research report | eric.ed.gov | 2 |
| State and Local Education Agencies "Like" Social Media | Blog | ed.gov | 2 |
| Effects of Student Engagement with Social Media on Student Learning: A Review of Literature | Student paper | studentaffairs.com | 2 |

The most frequently donated source of the T2 group is a literature review posted on the repository site Academia.edu (see Figure 23). The site describes itself as:

> "a platform for academics to share research papers. The company's mission is to accelerate the world's research. Academics use Academia.edu to share their research, monitor deep analytics around the impact of their research, and track the research of academics they follow." (http://www.academia.edu/about)

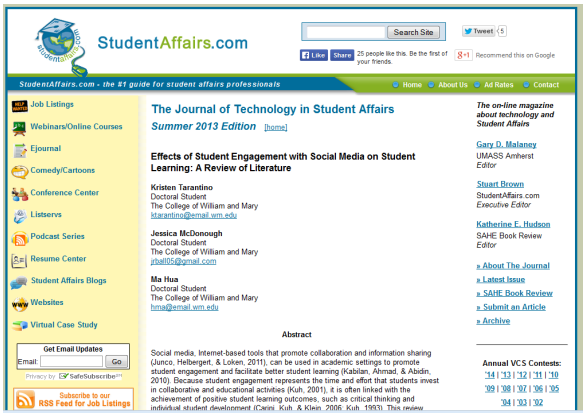
It is apparently a for-profit company, since they list their investors and amount of investment capital they have received on their About page. Thus, it is unclear if this site could be considered scholarly; since the researchers are academic, their work is likely to be scholarly, the papers submitted do not seem to be peer-reviewed or vetted. In the case of this source, two of the authors are professors and two are graduate students. However, since it consists only of a literature review, it was classified as a research report rather than a scholarly journal article.

**Figure 23. Research report search result 2**


The second and third items from the T2 list of sources are the same research report that was contributed by the T1 group and shown in Figure 21. However, the T2 group contributed both the PDF version and the ERIC database listing containing the abstract and download link to the report. This may suggest that these subjects did not read the report at all, and only perused the abstract.

Another source that may be scholarly yet is difficult to determine is the article from StudentAffairs.com (see Figure 24). This site describes itself as "one of the web's premier resources for posting and finding a job for student affairs professionals."

**Figure 24. Article search result**




The site hosts *The Journal of Technology in Student Affairs*, which describes itself as "The on-line magazine about technology and Student Affairs" and as "a forum for student affairs generalists on issues relating to student affairs and technology." This journal does not appear to exist outside of the website. The issue of the journal containing the cited article states:

> "In this issue, we have published the winning three articles from our recent contest for graduate student authors. In an effort to allow our readers to see the papers as they were submitted, we made very minor edits to the manuscripts." (http://studentaffairs.com/ejournal/Summer_2013/index.html)

Although the title of the journal sounds scholarly, and students may assume that it is scholarly, there is no indication of peer-review or editorial vetting of the content. For this reason, this source was categorized as a student paper. Note that the visual layout of this webpage is similar to the layout of scholarly database, and it could be quite difficult for students to recognize the difference.

Subjects in the CTRL group submitted a total of 27 sources in the post-test. Without duplicates, there were 16 unique sources. Titles, genre type, URL of the source, and the number of times contributed of the sources donated more than once are shown in Table 32. Note that

there is duplication between the sources; they were counted individually each time they were contributed by a subject.

**Table 32. CTRL's most frequently contributed sources**

| Title | Type | Source | N |
|---|---|---|---|
| Social Media in Higher Education: A Literature Review and Research Directions | Research report | academia.edu | 5 |
| The 10 Best and Worst Ways Social Media Impacts Education | Blog | edudemic.com | 4 |
| Overcoming Hurdles to Social Media in Education | Research report | educause.edu | 3 |
| Social Networking In Schools: Educators Debate The Merits Of Technology In Classrooms | Blog | huffingtonpost.com | 2 |
| How Social Media Is Changing Education | Blog/Commercial | sproutsocial.com | 2 |

The most contributed sources for the CTRL group include three of the sources also contributed by the T1 group: the Acedemia.edu research report, the Edudemic.com blog post, and the Huffington Post blog post. The third source is an article from the online journal EDUCAUSE Review Online, which posts a mixture of peer-reviewed and not reviewed articles (see Figure 25). This particular article is written by an AVP of Marketing at the Pearson corporation, discussing the findings from a survey conducted by at Pearson Learning Solutions. Since the article presents original research results, it was categorized as a research report.

**Figure 25. Research report search result 3**

Several sources were contributed by subjects in all three of the experimental groups, all of which appear in the most frequent results above. Titles, genre type, and URL of the shared sources are shown in Table 34.

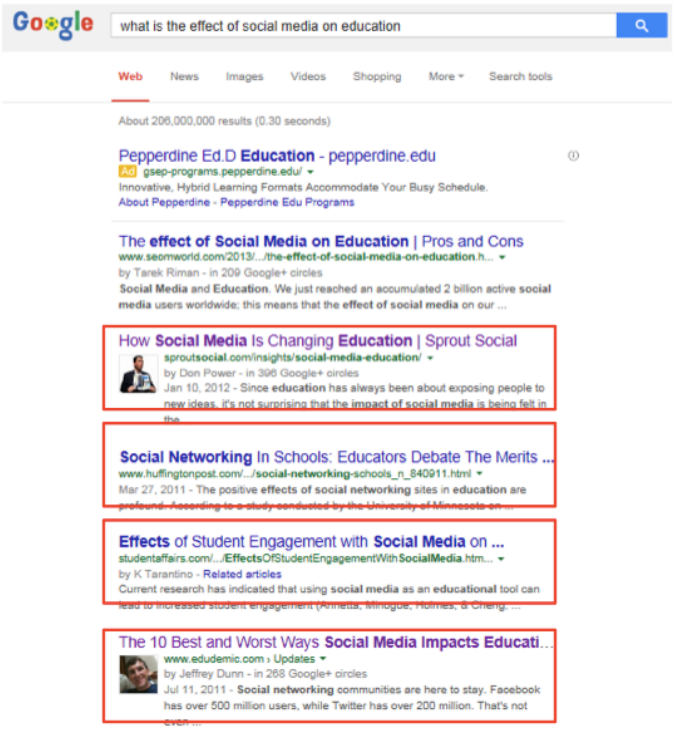
**Table 33. Sources shared between groups**

| Title | Type | Source |
|---|---|---|
| Social Media in Higher Education: A Literature Review and Research Directions | Research report | academia.edu |
| The Challenging Effect of Social Media on Education | Blog | educationandtech.com |
| The 10 Best and Worst Ways Social Media Impacts Education | Blog | edudemic.com |
| Social Networking In Schools: Educators Debate The Merits Of Technology In Classrooms | Blog | huffingtonpost.com |
| How Social Media Is Changing Education | Blog/Commercial | sproutsocial.com |

Three of the five contributed articles are from blogs, and one is from a blog hosted on a commercial social media company's site. The other shared source is a research report hosted on an academic sharing site or repository.

The similarity in titles of several of these sources is notable (How social media is changing education, Why social media can and is changing education, How is social media affecting education?, How today's higher education faculty use social media) suggest that subjects may have relied on natural language queries when searching, that is, typed the exact topic question into a search engine as their query. To examine the degree to which subjects relied on this method for finding their sources, the researcher entered the exact query into Google and recorded the first page of the search engine results. Four of the most frequently contributed sources show up in in the first page of Google search results for the query "what is the effect of social media on education" (see screenshot in Figure 26).

**Figure 26. Google search engine results**




Some of the other popular sources are found further down in this search results list. This fact strongly suggests that many of the subjects in this study relied on the first page of results from a Google search on the exact phrasing of the assigned research topic.

### 5.3.2. Summary of contributed sources

All sources contributed by subjects were classified by genre and totals calculated by group and across the entire subject pool. Overall, the T1 group used more sources and more diverse sources than the T2 or CTRL groups. Table 35 lists the summary data.

**Table 34. Contributed sources by genre**

| Genre | T1 | | T2 | | CTRL | | Total | |
|---|---|---|---|---|---|---|---|---|
| Blog | 105 | 59.3% | 14 | 51.9% | 8 | 29.6% | 127 | 55.0% |
| Book | 1 | 0.6% | | | | | 1 | 0.4% |
| Commercial website | 5 | 2.8% | | | | | 5 | 2.2% |
| Commercial (video) | 7 | 4.0% | | | 1 | 3.7% | 8 | 3.5% |
| Conference Proceedings | 1 | 0.6% | 1 | 3.7% | | | 2 | 0.9% |
| Course Site | 1 | 0.6% | | | | | 1 | 0.4% |
| Dissertation | 1 | 0.6% | | | | | 1 | 0.4% |
| Educational website | 1 | 0.6% | | | | | 1 | 0.4% |
| Magazine | 4 | 2.3% | | | | | 1 | 0.4% |
| News Organization | 1 | 0.6% | | | | | 1 | 0.4% |
| Newspaper | 17 | 9.6% | | | 2 | 7.4% | 19 | 8.2% |
| Press Release | | | 1 | 3.7% | | | 1 | 0.4% |
| Research Report | 22 | 12.4% | 8 | 29.6% | 11 | 40.7% | 41 | 17.7% |
| Scholarly Article | 8 | 4.5% | 3 | 11.1% | 3 | 11.1% | 14 | 6.1% |
| Student Paper | 3 | 1.7% | | | 2 | 7.4% | 5 | 2.2% |
| Total | 177 | 100.0% | 27 | 100.0% | 27 | 100.0% | 231 | 100.0% |

Blogs and research reports were the most frequently contributed genres of sources across all groups. For the T1 group, blogs were 59.3% of 177 total sources, for the T2 group blogs were 51.9% of 27 total, and for the CTRL group blogs were 29.6% of 27 total. The second most frequent genre was Research Report, with 12.4% of T1's total, 29.6% of T2's total, and 40.7% of CTRL's total. The third most contributed genre for T1 was Newspaper (9.6%), while for T2 and CTRL it was Scholarly Article (11.1% for both groups). Scholarly Article came in fourth for T1 (4.5%). In the overall total of sources across all groups, blog was the overwhelming majority of genres at 55.0%, followed by Research Report at 17.7% and Newspaper at 8.2%.

Overall, T1 contributed a wider variety of genres (13) than T2 (5) and CTRL (6). The genres that were contributed by T1 but not by either other group were: Book, Commercial website, Conference Proceedings, Course Site, Dissertation, Educational website, Magazine, and News Organization. The inclusion of sources such as Book, Conference Proceedings, and Dissertation by the T1 group show a greater familiarity and use of higher-quality scholarly information. This suggests that the subjects who used the IC tool learned to make better judgments about which sources to use based on their quality and credibility.

## 5.4. Data analysis

This experimental study used both qualitative and quantitative data analysis methods in analyzing subject data, to provide a multi-dimensional understanding of student behavior and answer the research questions regarding the impact of the online participatory learning tool. Since the study employed randomized subject assignment to experimental groups, statistical tests could be conducted on the results to demonstrate effects of the treatments.

Qualitative data (subject responses entered in response to open-ended credibility criteria questions on the post-test and responses to open-ended reflective prompts) were analyzed through coding against a rubric and textual analysis. Quantitative data (demographic data and scores on criteria understanding responses) were analyzed using one-way analysis of variance (ANOVA). Statistical tests were conducted using the SPSS statistical software package. Table 36 below lists the data analysis methods that were used to answer each research question:

**Table 35. Data analysis methods**

| Research question | Data source | Analysis method |
|---|---|---|
| RQ1 | Credibility criteria responses | Coding and statistical |
| RQ2 | Reflective prompts | Content analysis |
| RQ3 | Metacognition post-test results | Scoring and statistical |

## 5.5. Understanding of expert credibility criteria

Research Question 1 asked: "Do students who use the IC tool demonstrate greater understanding of expert credibility criteria in the process of evaluating online sources compared to groups of students who use a tutorial and an online form, or those who use only an online form?" The main finding for this research question is that the T1 group (which used the tutorial and the online InCredibility tool) achieved significantly higher scores for understanding of the five credibility criteria for in comparison to the T2 group (used only the tutorial) and the CRTL group (used only the online form). Two of this study's research hypotheses are:

- H1: The T1 group will demonstrate greater understanding of expert credibility criteria compared to T2
- H2: The T1 group will demonstrate greater understanding of expert credibility criteria compared to the CTRL group

Based on the findings that show that the T1 group demonstrated greater understanding of expert credibility criteria than the T2 and CTRL groups, the hypotheses HI and H2 are supported by this study. The process of finding these results, through coding of the subject's open-ended responses to credibility criteria questions and conducting ANOVA tests on the between-group differences, is described below.

After students completed their use of the IC tool, they were presented with a post-test that asked them about their understanding of credibility criteria by defining each criteria and explaining its importance. As described in Chapter 4, subjects' answers to the credibility questions were coded according a rubric which assigned a score of 0-2 for each answer, with 0 indicating the response did not meet the standards of the rubric and 2 meaning it met them satisfactorily (see Section 4.7 for details on the coding process). The rubric for scoring the subject responses is shown in Table 37 below.

**Table 36. Coding rubric for student criteria responses**

| Question | Score | | |
|---|---|---|---|
| | 2 | 1 | 0 |
| What does "authority" of information mean? | identify author AND credentials/qualifications | identify author OR credentials/qualifications | neither |
| Why is it important to evaluate how authoritative online information is? | anyone can post online AND importance of verification | anyone can post online OR verification | neither |
| What does "relevance" of information mean? | content/topics are useful /related to question | generic mention of content/topics | neither |
| Why is it important to evaluate how relevant online information is? | filter/select information AND judge value | filter/select information OR judge value | neither |
| What does "reliability" of information mean? | trustworthiness AND sources | trustworthiness OR sources | neither |
| Why is it important to evaluate how reliable online information is? | Internet skepticism AND need to verify/evaluate sources | Internet skepticism OR verify | neither |
| What does "currency" of information mean? | up to date/recent | time/when published (or just "current") | neither |

| | | | |
|---|---|---|---|
| Why is it important to evaluate how current online information is? | useful/relevant/valid AND depends on topic | useful/relevant/valid OR depends on topic | neither |
| What does "purpose" of information mean? | why the information was written/published/presented (goal/intent/bias) | generic mention of "goal/intent/bias" | neither |
| Why is it important to evaluate what the purpose of online information is? | detect bias AND judge value/credibility/ usefulness | detect bias OR judge value/credibility/ usefulness | neither |

Examples of scores for responses at all three levels are shown for both the definition and importance responses to the Authority criteria in Table 38 below. These examples were coded based on the presence or absence of the specific terms stated in the rubric, and for the coder's evaluation of how much understanding of the criteria was evidenced in the response. A score of 2 means that the response met both of the criteria listed in the rubric, a score of 1 means that the response met either of the criteria listed in the rubric, and a score of zero means that the response met neither of the criteria listed in the rubric.

**Table 37. Examples of scored criteria responses**

| What does "authority" of information mean? | Score | Why is it important to evaluate how authoritative online information is? | Score |
|---|---|---|---|
| It's finding out **who wrote the information** and what that person's **qualifications and background** are. | 2 | It's important to evaluate how authoritative online information is because **it is possible for anyone to put anything on the Internet** and claim it to be true. By evaluating if the author has the authority to write about a specific topic you are confirming that the information is **valid and useful**. | 2 |
| The credibility of the author and the website make up the authority. If a person has higher authority, then the information is more **trustworthy.** | 1 | It tells us whether the information is from a **reliable** resource. So we can decide whether to believe it or not. | 1 |
| The power or weight that that information holds. How effectively it can be used to do things like build further information or persuade based upon what is known. | 0 | It is important because you need to make sure the information you are consuming is accurate and useful. | 0 |

A Master's student from the School of Information coded the responses along with the researcher. Both coders initially met to review the coding rubric and jointly coded several examples, then each made an independent first pass at coding. Next, the coders met again to review the results and discuss any discrepancies. While there was general agreement on the scoring of the definition responses, most discrepancies centered around how to score the "importance" responses. Differences in coding arose from the approach of one coder to evaluate strictly on whether specific words were stated in the responses, while the other coder interpreted the overall intent of the answer. The two coders met to discuss these discrepancies, and the coding rubric was subsequently expanded and defined more clearly to enable more consistent coding based on interpreting the intent of the answer, that is whether it attempted to fully answer the question rather than relying strictly on specific terminology. The coders then again coded independently. Subsequently, an inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among the coders. The result was found to be Kappa = 0.534 ($p<.001$). Generally, a Kappa value of between 0.40 and 0.59 is considered moderate agreement (Landis & Koch, 1977). While moderate agreement is not as strong as would be ideally desired, given the shortness of many responses and the degree of interpretation sometimes demanded to determine the intention behind responses, the researcher concluded that reliability of the coding was high enough to proceed with analysis.

In order to answer Research Question 1, which defined "understanding" as composed of the subjects' ability to both define the criteria and express its importance, the scores for these two responses to the open-ended prompts were averaged to produce a score for understanding of each criteria. See Table 39 below for the understanding scores of all three groups.

**Table 38. Understanding scores for credibility criteria**

| Group | Authority | Relevance | Reliability | Currency | Purpose |
|---|---|---|---|---|---|
| T1 | 1.03 | 1.40 | 0.94 | 1.45 | 1.32 |
| T2 | 1.02 | 1.33 | 0.68 | 1.15 | 1.10 |
| CTRL | 0.88 | 1.33 | 0.84 | 1.16 | 0.93 |
| Av. | 0.98 | 1.35 | 0.82 | 1.25 | 1.12 |

These results show that the T1 group had higher understanding scores for all of the criteria compared to both the T2 and CTRL groups. For T1, Currency received the highest understanding

score (1.45), followed by Relevance (1.40), Purpose (1.32), Authority (1.03), and Reliability (0.94). The T2 group had the second-highest scores for Authority (1.02) and Purpose (1.10), while the CTRL group had the second-highest scores for Reliability (0.84) and Currency (1.25), and they tied on the Relevance (1.33). Overall, Relevance received the highest average score across all three groups (1.35) while Reliability received the lowest average (0.82). These results suggest that for most students, the concept of relevance is the most easily understandable, while reliability is the least understandable. This may be because "relevance" is often easy to determine at a surface level ("Does this information fit with my topic?") while reliability ("Is this information trustworthy?") is much harder to determine because it requires critical thinking, evaluation, and judgment based on evidence. Another factor may be that the word is unfamiliar to some students, in comparison to the other terms that are more common. However, the fact that all subjects still rated the lowest on understanding of reliability suggests that even after using the IC tool, this topic is still challenging for students and needs greater emphasis in IL education, especially in the online information environment.

To determine if the differences in outcomes between the groups was statistically significant, a one-way ANOVA was used to test for differences among the three groups' scores. Results showed that the scores differed significantly across the three groups, $F(2, 79) = 5.224$, $p = .007$. A Tukey post-hoc comparison of the three groups indicated that the T1 group ($M = 1.23$, 95% CI [1.11, 1.34]) had significantly higher scores than the T2 group ($M = 1.03$, 95% CI [0.93, 1.11]), $p = .033$, and the CTRL group ($M = 0.99$, 95% CI [0.85, 1.14]), $p = .014$. A comparison between the T2 group and the CTRL group was not statistically significant at $p < .05$. (See Appendix 12 for full test results.) These tests demonstrate that the differences between the results for the T1 group and the T2 and CTRL groups are greater than what would be expected by chance, and thus show an effect of the treatment condition on the learning outcomes.

Thus, the findings for **Research Question 1** are that the T1 group (which used the IC tutorial and the IC tool) achieved significantly higher scores for understanding of the credibility criteria in comparison to the T2 group (used only the IC tutorial) and the CRTL group (used only the online form). This means that the T1 group was better able to express the definitions of and importance of the credibility criteria (the two components of understanding) than the other groups. The difference between the T2 group and the CTRL group was not significant, showing that the effect of the IC tutorial alone was not related to the difference in learning outcomes.

These results demonstrate that use of the IC tool increased students' understanding of the expert criteria that they should use in making credibility evaluations. These expert criteria (authority, relevance, reliability, currency, and purpose) were scaffolded upon an initial model of "who, what, where, when and why" questions which were subsequently expanded into more expert terminology. Using the IC tool, subjects not only learned the definitions of these terms but also learned to express their importance, which is an important component of learning. Since the T1 group had the experience of repeatedly practicing the application of these criteria to real-life examples, and learned techniques for evaluating various elements of online sources for credibility, they gained a greater understanding of online credibility criteria and may be better able to apply them in the future. This explicit support for the understanding of credibility criteria was not supplied to the T2 or CTRL groups, and thus the difference in outcomes can be attributed to IC tool. These results show the advantage of a scaffolded model over simply providing a checklist of questions or criteria and asking students to answer them without context, especially in the online information environment where credibility evaluation can be challenging.

## 5.6. Evidence-based source characteristics

Research Question 2 of this study asked: "Do students who use the IC tool demonstrate greater application of evidence-based source characteristics as the basis for their credibility evaluations compared to groups of students who use a tutorial and an online form, or those who use only an online form?" Two of this study's research hypotheses were:

- H3: The T1 group will demonstrate greater use of evidence-based source characteristics compared to T2
- H4: The T1 group will demonstrate greater use of evidence-based source characteristics compared to the CTRL group

The experimental results were not significantly different between groups, so a conclusion cannot be made and the hypotheses H3 and H4 are not statistically supported. A larger sample size may be necessary to draw a statistical conclusion. On a purely descriptive basis, however, the T1 group did show somewhat greater use of evidence-based source characteristics than the T2 and

CTRL groups. The process of finding these results, through textual analysis of the subjects' open-ended responses to reflective prompts, is described below.

After the T1 subjects completed their use of the InCredibility tool, and the T2 and CTRL subjects completed their parallel tasks using the online form, they were presented with a post-test that included reflective questions regarding their evaluation process and assessing their own evaluation decisions (adapted from Herring, 2011 and Ge, Planas & Er, 2010). The questions on this post-test are shown in Table 40.

**Table 39. Reflection prompts**

| Looking back on the process of evaluating the credibility of online information.... |
|---|
| 1. How did you decide whether a webpage was credible or not? |
| 2. What criteria did you use to help you evaluate credibility? |
| 3. What strategies did you use to evaluate credibility? |
| 4. What have you learned about evaluating credibility on the web? |

The questions were the same for each group, and were open-ended to allow students to demonstrate their understanding in their own words.

Overall, the T1 group provided more answers (39) than T2 (25) and CTRL (26), however answers given by T1 subjects were much shorter and less thoughtful than were those of T2 and CTRL subjects for all the questions. Many T1 subjects gave terse responses in the form of a few words or a phrase, while many T2 subjects gave longer and more complete responses that showed more reflection and effort. See Table 41 for examples of the difference in the quality of responses between groups. Total word counts demonstrate the terseness of T1 responses compared to the responses of T2 and CRTL subjects. The T1 group gave 39 responses with a total word count of 3,959 words. The T2 group, with only 25 responses, used nearly the same number of words at 3,529. The CTRL group, with 26 responses, used a total of 5,162 words. Thus, the T1 group used on average 101 words each, while the T2 group used on average 141 words each and the CTRL group used 198 words on average. Since the T12 group used fewer words overall, between-group comparisons based on word count are unreliable.

**Table 40. Length of responses between groups**

| Group | How did you decide whether a webpage was credible or not? |
|---|---|
| T1 | by looking at the authors and their credentials, and date |
| T1 | Whether more of the information was provided in the notes or not |
| T1 | Author qualifications, domain ending (edu), currency |
| 2 | I looked to see the references, I googled the author, and I checked to see if I had heard of the specific source already. (Such as the newspaper or magazine) |
| T2 | Multiple ways. The greatest factor is if it is published in a peer reviewed journal, and if not I checked to see who the author was and the relative credibility of the website. If the author was a PhD this obviously led me to see it as more credible. |
| T2 | I looked for information that contained the least amount of bias as possible. I also researched the authors to find out their qualifications and how knowledgeable they are about the subject. |
| CTRL | I looked at who was writing the article or piece, and what background they had in the subject area. I read the articles and looked for biases, deeming the most unbiased the more credible articles. Direct quotations and references to other works (citing other credible sources) were what I looked for. |
| CTRL | I looked up the author and their level of expertise in the field they were discussing. I also considered the accessibility of the site, and how restrictions on who could/could not post information |
| CTRL | I looked at whether or not it listed sources/references, was the published content peer reviewed studies, or opinion pieces. The more reviewed studies the webpage had in comparison to it's opinion pieces, the more credible it was to me. |

This was an unexpected result. However, it seems likely that since the T1 group had already been asked to complete many actions and give many responses to various prompts throughout the use of the IC tool, that they may have become fatigued or uninterested or unmotivated to provide thoughtful responses to these questions on the post-test. The overall number of questions asked and time and effort demanded of the T1 group during the experiment was much higher than for the other two groups, who were only required to search online and enter notes about their sources into an online form. This lack of consistency in the response data made it difficult to complete an analysis of word-count differences between the group. The original research design involved applying a coding rubric based on the amount of specific evidence-related terms supplied by subjects in their responses. While the responses to the reflective prompts do often evidence some use of the expert terminology, the differences in elaboration and depth between the T1 and the other two groups makes meaningful comparisons between them impossible.

The research design also included coding the groups' open-ended responses based on the categories from Markey et. al. (2014) of Evidence-based, Projection-based, and Intuition-based comments (see Chapter 4 for description of this coding methods). The criteria for these three categories of coding are shown in Table 42 below. One additional category emerged through the coding process based on the types of responses given by subjects. Some subjects gave descriptive or narrative responses of how they evaluated credibility without mentioning specific criteria. Those responses were coded as Description-based.

**Table 41. Coding categories (adapted from Markey et al., 2014)**

| Code | Definition |
|---|---|
| Evidence-based | Cites specific evidence supporting evaluation |
| Projection-based | Speculates without evidence |
| Intuition-based | Makes unfounded assertions without evidence |
| Description-based | Descriptive or narrative responses |

In some cases, there were elements of both Evidence and Projection or Description in their responses, and these responses were coded as a combination of both categories. Some subjects relied on repeating the terms used in the InCredibility tool, that is, by stating simply "who, what, when, where, why" in their responses. These responses were coded as 5Ws (see examples of coded responses in Table 43).

**Table 42. Examples of coded reflection responses**

| Category | Response | Group |
|---|---|---|
| Evidence-based | Author qualifications, domain ending (edu), currency | T1 |
| | I based my decision on which source had the most reputable sources: for example, a post by the Huffington Post was informative, but offered no author / authors, so I did not view it as very reputable. | T2 |
| | This source was the most credible because the author's qualifications were the most legit and he had the most background and education in the field. | CTRL |
| Projection-based | How much information it had and how relevant the information was. | T1 |
| | Does there job having something to do with social media and/or education? Does their opinion matter? | T2 |
| | This source's author had more ethos than a few of the other authors, which helped me narrow the sources down to this one and another one. I ultimately picked this one because it seems to explore the topic more thoroughly than the others. | CTRL |

| | | |
|---|---|---|
| Description-based | I felt like this source really highlighted particular uses for social media. Yes, social media is a great way to stay connected with friends, campus safety, and tailgate events but we are talking about what educators want from social media. This article highlights how social media can be used as a strategy tool to fix the problem that everyone seems to have with education today, which is mostly cost and return on investment. Colleges can take this data and use it to address the some of the problem and get a first hand look at what people are saying | T2 |
| Evidence/ Projection | The source (Discovery Channel) is familiar and the person speaking has very high qualifications. | T2 |
| | Firstly, the author seemed to be a credible source as she has worked for a company directly interested in understanding and improving learning. Also, the article was the most recent, and one of the few that had a distinct list of sources. | CTRL |
| Evidence/ Description | When we were given the question "What is the effect of social media on education?" I wanted to find an article that not only stated the negative aspects but also ways that it can be used effectively. All of my sources did provide some insight into how education was effected by the student use of social media but the site I selected best answers the posed question. This article discusses both sides of the conversation and ways in which social medias can be beneficial, if used effectively. The author, Jeff Dunn, goes in great depth in describing his evidence and ways to avoid problems that may arise. The author provides many examples about the positives and negatives and what he thinks will come next for our growing technology society. He believes the best way to use social media to benefit education is to manage the amount students use it. | T2 |
| | This source was most credible because it incorporated several forms of evidence in support of its claim. First, the author clearly defines "what is social media" to inform her readers what the basis of the debate is about. It is important to make this distinction in order for every reader to understand her view on why social media enhances learning. Moreover, she gives the specific example of one social media platform, Emodo, being incorporated in a high school. This direct account and the findings that resulted from it provide clear evidence of the success of social networking use in the classroom. | CTRL |
| 5Ws | By looking at if there was information on the who, what, where, when, and why | T1 |
| | To help me evaluate credibility, I answered "who, what, where, when, and why." | T2 |
| | I checked the Who, What, Where, When and Why - if the article didn't successfully answer all of these points, then it lacked credibility. | CTRL |

The examples above show that responses coded as Evidence-based cited specific evidence supporting the subject's credibility evaluations. Responses coded as Projection-based speculated about credibility without citing specific evidence to support the evaluation. Responses coded as Description-based provided descriptive or narrative responses of the subjects actions or behaviors but did not provide any supporting evidence for the basis of their evaluations.

Combinations of these categories were also possible. Some subjects combined both Evidence and Projection in their responses by citing some evidence ("the person speaking has very high qualifications") while at the same time invoking Projection ("the source is familiar"). Some subjects also combined the Evidence and Description by both mentioning specific evidence ("The author provides many examples…") and describing their actions or behaviors ("I wanted to find an article that…"). Responses coded as 5Ws often just listed the five questions.

Thus, with the addition of a new category and two combined categories, the final categories used in coding the open-ended responses were:

- Evidence-based
- Projection-based
- Intuition-based
- Description-based
- Evidence/Projection
- Evidence/Description
- 5Ws

Subject responses to the first two reflective prompts were coded according to this rubric, since two these questions directly related to the criteria used in making evaluation evaluations:

> Reflective prompt #1. How did you decide whether a webpage was credible or not?
> Reflective prompt #2. What criteria did you use to help you evaluate credibility?

A second Master's student from the School of Information coded these responses along with the researcher. The coders initially met to review the rubric, jointly coded several examples, then each made an independent first pass at coding, and then met again to review the results and discuss any discrepancies. Most discrepancies centered around the distinction between the Evidence and Evidence/Projection categories, which sometimes relied on the coder making a judgment of how much projection was involved in the response. Reviewing and clarifying the rubric helped to resolve most of the discrepancies in coding. Subsequently, an inter-rater reliability analysis using the Kappa statistic was performed to determine consistency among the coders. The result was found to be Kappa = 0.745 ($p < .001$). Generally, a Kappa value of between 0.60 and 0.70 is considered substantial agreement (Landis & Koch, 1977). This strong result allowed the researcher to feel confident in the reliability of the coding results.

After responses to both of the open-ended reflective prompts were coded, percentages of each category out of the total number of responses for each group were calculated. Due to the difference in sample sizes, and the small number of instances of some codes, statistical tests are not appropriate and only descriptive analysis was used. Comparisons were made between groups based on the percentages of each category of evaluation type. Coding results for the first reflective prompt are shown in Table 44 below. The T1 group had the highest percentage use of purely Evidence-based responses (74%) than the T2 group (60%) and the CTRL group (65%). Projection-based responses were used by 5% of T1, 4% of T2 and 4% of T3. The T2 group used 28% Evidence/Projection and the CTRL group used 23% Evidence/Description, while the T1 group used a small percentage of Projection-based responses (5%) slightly larger than T2 and CTRL (4%).

**Table 43. Reflective prompt #1: How did you decide whether a webpage was credible?**

| Category | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Evidence-based | 29 | 74.36% | 15 | 60.00% | 17 | 65.38% |
| Projection-based | 2 | 5.13% | 1 | 4.00% | 1 | 3.85% |
| Intuition-based | 1 | 2.56% | 0 | 0.00% | 0 | 0.00% |
| Description-based | 0 | 0.00% | 1 | 4.00% | 0 | 0.00% |
| Evidence/Projection | 0 | 0.00% | 7 | 28.00% | 2 | 7.69% |
| Evidence/Description | 0 | 0.00% | 1 | 4.00% | 6 | 23.08% |
| 5WS | 7 | 17.95% | 0 | 0.00% | 0 | 0.00% |
| Total | 39 | 100.0% | 25 | 100.0% | 26 | 100.0% |

Coding results for the second reflective prompt are shown in Table 45. The T1 again group had the highest percentage use of purely Evidence-based responses (87%) than the T2 group (72%) and the CTRL group (76%). Projection-based responses were used by 5% of T1, 4% of T2 and 8% of T3. The T2 group used 8% Evidence/Projection, while the CTRL group used 8% Projection and 4% Evidence/Projection.

**Table 44. Reflective prompt #2: What criteria did you use to help you evaluate credibility?**

| Category | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Evidence-based | 33 | 86.84% | 18 | 72.00% | 19 | 76.00% |
| Projection-based | 2 | 5.26% | 1 | 4.00% | 2 | 8.00% |
| Intuition-based | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% |

| | | | | | | |
|---|---|---|---|---|---|---|
| Description-based | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% |
| Evidence/Projection | 0 | 0.00% | 2 | 8.00% | 1 | 4.00% |
| Evidence/Description | 0 | 0.00% | 0 | 0.00% | 0 | 0.00% |
| 5WS | 3 | 7.89% | 4 | 16.00% | 3 | 12.00% |
| Total | 38 | 100.0% | 25 | 100.0% | 25 | 100.0% |

The responses to both of the reflective prompts were combined into a total count, shown in Table 46 below. The highest responses overall are highlighted.

**Table 45. Total responses to prompts #1 and #2**

| Category | T1 | | T2 | | CTRL | |
|---|---|---|---|---|---|---|
| Evidence-based | 63 | **80.52%** | 33 | 66.00% | 19 | 70.59% |
| Projection-based | 4 | 5.19% | 2 | 4.00% | 2 | 5.88% |
| Intuition-based | 1 | 1.30% | 0 | 0.00% | 0 | 0.00% |
| Description-based | 0 | 0.00% | 1 | 2.00% | 0 | 0.00% |
| Evidence/Projection | 0 | 0.00% | 9 | **18.00%** | 1 | 5.88% |
| Evidence/Description | 0 | 0.00% | 1 | 2.00% | 0 | **11.76%** |
| 5WS | 10 | **12.99%** | 4 | 8.00% | 3 | 5.88% |
| Total | 77 | 100.0% | 50 | 100.00% | 25 | 100.00% |

Overall, the T1 group showed the highest percentage of Evidence-based responses (80%) compared to T2 (66%) and CTRL (70%). T2 showed the highest percentage of Evidence/Projection, while CTRL showed the highest percentage of Evidence/Description. The T1 group also showed the highest percentage of using the 5Ws, which might be simply a shorthand for repeating what they had been taught, or lack of interest after answering a lot of questions.

These findings are purely descriptive. Thus, the findings for **Research Question 2** are that the experimental results were not significantly different between groups, so a conclusion cannot be made. A larger sample size may be necessary to draw a statistical conclusion. On a descriptive basis, however, the T1 group (which used the tutorial and the IC tool) showed a higher percentage of solely Evidence-based responses than the T2 group (used only the tutorial) and the CTRL group (used only the online form). The T2 and CTRL groups showed a higher percentage use of combined categories (Evidence/Projection or Evidence/Description) rather than solely based on evidence. This suggests that the T1 group may have looked for and found more evidence to support their evaluations, while the other groups relied more on projection and

description. Thus, the IC tool may have supported T1 subjects in learning that they should use specific evidence in their credibility evaluations, instead of relying on projection-based or description-based evaluations. The evidence-based source characteristics such as author credentials, main ideas, references/links, site domain, contact information, date, and About and purpose statements were demonstrated through the tutorial and then reinforced through the IC tool's Notebook question prompts which asked subjects to record the specific evidence that they used in their evaluations. This explicit support for identifying specific evidence to be used as the basis for credibility evaluations was not supplied to the T2 or CTRL groups, and thus the descriptive difference in outcomes may be attributed to the IC tool.

## 5.7. Metacognitive awareness

Research Question 3 asked: "Do students who use the IC tool demonstrate greater metacognitive awareness compared to groups of students who use a tutorial and an online form, or those who use only an online form?" Two of this study's research hypotheses are:

- H5: The T1 group will demonstrate greater metacognitive awareness compared to the T2
- H6: The T1 group will demonstrate greater metacognitive awareness compared to the CTRL group

The experimental results were not significantly different between groups, so a conclusion cannot be made and the hypotheses H5 and H6 are not statistically supported. A larger sample size may be necessary to draw a statistical conclusion. On a purely descriptive basis, however, the T1 group showed greater metacognitive awareness than the T2 and CTRL groups. The process of finding these results, through a test of metacognitive skills, is described below.

As part of the post-test, subjects responded to a series of statements regarding their metacognitive strategies on a Likert scale of Strongly Disagree, Disagree, Agree, or Strongly Agree (see section 4.4.2 for a description of the metacognition test). The statements are categorized into three types of metacognition: Planning, Monitoring, and Reflecting (note: these categories were not displayed to subjects). The test questions are shown in Table 47 below.

**Table 46. Metacognitive statements by type**

| Type | Statements |
|---|---|
| Plan 1 | I think about what evidence I need to evaluate the credibility of online information |
| Plan 2 | I think of several ways to find evidence for evaluating the credibility of online information |
| Plan 3 | I ask myself questions about the topic before I begin evaluating the credibility of online information |
| Monitor 1 | I analyze the effectiveness of my evaluation strategies |
| Monitor 2 | I compare information from different websites when I evaluate them |
| Monitor 3 | I periodically review the evidence I find while evaluating the credibility of online information |
| Monitor 4 | I plan the steps of evaluating the credibility of online information before I start |
| Reflect 1 | I ask myself if I found as much evidence as I could once I finish evaluating |
| Reflect 2 | I ask myself if I used the best strategies once I finish evaluating |
| Reflect 3 | I try to consider multiple perspectives when making evaluations |
| Reflect 4 | I try to find evidence to justify and support my evaluations |

The subjects' responses on the Likert scale were converted into a numerical score of Strongly Disagree = 1, Disagree = 2, Agree = 3, and Strongly Agree = 4 by the Qualtrics survey software. Scores for each statement were averaged by group. These average scores range from a low of 2.24 (slightly above "Disagree") to a high of 3.42 (between "Agree and "Strongly Agree"). Overall, most subjects rated themselves as 3 or 4. Fewer rated themselves a 2, and almost none rated themselves as a 1 on any statement. Table 48 below lists the averages for each metacognition statement by group.

**Table 47. Average scores of metacognitive statements by group**

| Type | Statements | T1 | T2 | CTRL |
|---|---|---|---|---|
| Plan 1 | I think about what evidence I need to evaluate the credibility of online information | 3.06 | 3.28 | 3.12 |
| Plan 2 | I think of several ways to find evidence for evaluating the credibility of online information | 3.03 | 3.12 | 2.81 |
| Plan 3 | I ask myself questions about the topic before I begin evaluating the credibility of online information | 3.03 | 3.20 | 3.00 |
| Monitor 1 | I analyze the effectiveness of my evaluation strategies | 2.53 | 2.44 | 2.50 |
| Monitor 2 | I compare information from different websites when I evaluate them | 3.26 | 3.32 | 3.42 |
| Monitor 3 | I periodically review the evidence I find while evaluating the credibility of online information | 3.00 | 2.96 | 2.81 |
| Monitor 4 | I plan the steps of evaluating the credibility of online | 2.24 | 2.72 | 2.35 |

| | | | | |
|---|---|---|---|---|
| | information before I start | | | |
| Reflect 1 | I ask myself if I found as much evidence as I could once I finish evaluating | 2.88 | 2.80 | 2.81 |
| Reflect 2 | I ask myself if I used the best strategies once I finish evaluating | 2.71 | 2.56 | 2.62 |
| Reflect 3 | I try to consider multiple perspectives when making evaluations | 3.26 | 3.20 | 3.00 |
| Reflect 4 | I try to find evidence to justify and support my evaluations | 3.41 | 3.12 | 3.27 |
| | Overall average | 2.95 | 2.97 | 2.88 |

The overall averages for each group are quite similar, with T2 scoring slightly higher overall and CTRL slightly lower and T1 scoring in the middle of the two. Between-group chi-square tests were performed for each metacognitive statement, but none of the results were significantly different.

Since a statistical test was not usable, simpler descriptive techniques were used to understand trends in the data. For the results in Table 49, the highest score for each statement was identified to compare each group's average response per question (highest score is highlighted). This revealed that the T2 group rated themselves higher than the other groups on Plan statements, while the T1 group rated themselves higher on Reflect statements, with the T1 having two of the highest Monitor statements and T2 and CTRL one each.

**Table 48. Highest average scores of metacognitive statements**

| Type | Statements | T1 | T2 | CTRL |
|---|---|---|---|---|
| Plan 1 | I think about what evidence I need to evaluate the credibility of online information | 3.06 | **3.28** | 3.12 |
| Plan 2 | I think of several ways to find evidence for evaluating the credibility of online information | 3.03 | **3.12** | 2.81 |
| Plan 3 | I ask myself questions about the topic before I begin evaluating the credibility of online information | 3.03 | **3.20** | 3.00 |
| Monitor 1 | I analyze the effectiveness of my evaluation strategies | **2.53** | 2.44 | 2.50 |
| Monitor 2 | I compare information from different websites when I evaluate them | 3.26 | 3.32 | **3.42** |
| Monitor 3 | I periodically review the evidence I find while evaluating the credibility of online information | **3.00** | 2.96 | 2.81 |
| Monitor 4 | I plan the steps of evaluating the credibility of | 2.24 | **2.72** | 2.35 |

| | | | | |
|---|---|---|---|---|
| | online information before I start | | | |
| Reflect 1 | I ask myself if I found as much evidence as I could once I finish evaluating | **2.88** | 2.80 | 2.81 |
| Reflect 2 | I ask myself if I used the best strategies once I finish evaluating | **2.71** | 2.56 | 2.62 |
| Reflect 3 | I try to consider multiple perspectives when making evaluations | **3.26** | 3.20 | 3.00 |
| Reflect 4 | I try to find evidence to justify and support my evaluations | **3.41** | 3.12 | 3.27 |

Since the Reflect tasks involved more a greater degree of level thinking and self-evaluation than the Plan tasks, the T1 group might be seen as being slightly more self-aware of their own evaluation processes. Overall, the T1 group had more of the highest scores per statement (6) than the T2 group (4) and the CTRL group (1). This pattern suggests that the T1 subjects might have been slightly more aware of their own metacognitive strategies.

For each experimental group, the average scores per statement were sorted from high to low in order to compare the groups' self-rating of their strengths and weaknesses (Table 50). For the T1 group, the statement "I try to find evidence to justify and support my evaluations" (Reflect 4) received the highest average score (3.41), followed by the statement "I compare information from different websites when I evaluate them" (Monitor 2, average score 3.26). Monitor 2 also received the highest score from both the T2 group (3.32) and the CTRL group (3.42). The T2 group also gave high average scores to the statement "I think about what evidence I need to evaluate the credibility of online information" (Plan 1, 3.28) and "I ask myself questions about the topic before I begin evaluating the credibility of online information" (Plan 3, 3.20). The CTRL group also gave high scores to Reflect 4 (3.27) and Plan 1 (3.12). Since these statements all capture some of the main aspects of the experiment, these scores suggest positive outcomes from participation in the study for all groups.

**Table 49. Group average metacognition scores from high to low**

| Question | T1 | Question | T2 | Question | CTRL |
|---|---|---|---|---|---|
| Reflect 4 | 3.41 | Monitor 2 | 3.32 | Monitor 2 | 3.42 |
| Monitor 2 | 3.26 | Plan 1 | 3.28 | Reflect 4 | 3.27 |
| Reflect 3 | 3.26 | Plan 3 | 3.20 | Plan 1 | 3.12 |
| Plan 1 | 3.06 | Reflect 3 | 3.20 | Plan 3 | 3.00 |
| Plan 2 | 3.03 | Plan 2 | 3.12 | Reflect 3 | 3.00 |
| Plan 3 | 3.03 | Reflect 4 | 3.12 | Plan 2 | 2.81 |
| Monitor 3 | 3.00 | Monitor 3 | 2.96 | Monitor 3 | 2.81 |
| Reflect 1 | 2.88 | Reflect 1 | 2.80 | Reflect 1 | 2.81 |
| Reflect 2 | 2.71 | Monitor 4 | 2.72 | Reflect 2 | 2.62 |
| Monitor 1 | 2.53 | Reflect 2 | 2.56 | Monitor 1 | 2.50 |
| Monitor 4 | 2.24 | Monitor 1 | 2.44 | Monitor 4 | 2.35 |

Interestingly, three of the metacognitive statements consistently scored the lowest across all groups. The statements "I plan the steps of evaluating the credibility of online information before I start" (Monitor 4) received the lowest average scores from T1 (2.24) and CTRL (2.35). The T2 group gave their lowest average response to the statement "I analyze the effectiveness of my evaluation strategies" (Monitor 1, average 2.44). This statement also received the second-lowest average scores from T1 (2.53) and CTRL (2.50). T2 gave their second-lowest score to the statement "I ask myself if I used the best strategies once I finish evaluating" (Reflect 2, 2.56). These are all important metacognitive strategies and the uniformly low scores suggest that higher-level metacognition may still be a challenge for many of these students.

While there are intriguing descriptive trends in the average scores, overall the subjects self-rated themselves very highly on this test. This tendency to over-estimate their own abilities supports the literature that shows students in general are overly-confident in their skills and do not make accurate judgments of their actual abilities. It is also possible that students don't simply over-estimate their skills, but that the concepts of the metacognitive questions could be too abstract and difficult for students to answer accurately, since they may not be aware of their own abilities or unable to realistically assess them; another possibility is that social desirability played a role in influencing the answers, that is none of the students wanted to admit to be low-skilled.

To provide an empirical check on whether the subjects' self-ratings of their metacognitive skills related to the quality of the sources that they found, a comparison was conducted of the average metacognitive score for each individual in the T1 group and the sources

they contributed. The 33 subjects in the T1 group were ranked by their average self-rating on the metacognition test on a scale of Strongly Disagree (1), Disagree (2), Agree (3), or Strongly Agree (4). They were then divided into three groups by low/medium/high scores. The scores for the "low" group ranged from 2.45-2.82, the scores for the "medium" group ranged from 2.91-3.00, and the scores for the "high" group ranged from 3.07-3.09. Due to clustering of scores, there were 14 subjects in the "low" group, 9 subjects in the "medium" group, and 10 subjects in the "high" group. A total of 141 sources contributed by the 33 subjects in the T1 group were identified by genre (see Table 51 below). Note that there is duplication between the sources; they were counted individually each time they were contributed by a subject.

**Table 50. T1 sources categorized by metacognition score**

| Genre | Low | | Medium | | High | |
|---|---|---|---|---|---|---|
| Blog | 40 | 63.49% | 26 | 60.47% | 18 | 51.43% |
| Book chapter | | | 1 | 2.33% | | |
| Commercial (video) | 4 | 6.35% | 1 | 2.33% | | |
| Dissertation | | | | | 1 | 2.86% |
| Magazine | 4 | 6.35% | | | 2 | 5.71% |
| Newspaper | 3 | 4.76% | 5 | 11.63% | | |
| Nonprofit research | 1 | 1.59% | 3 | 6.98% | 1 | 2.86% |
| Policy brief | | | | | 1 | 2.86% |
| Research report | 5 | 7.94% | 4 | 9.30% | 8 | 22.86% |
| Scholarly article | 4 | 6.35% | 2 | 4.65% | 2 | 5.71% |
| Student newspaper | 1 | 1.59% | 1 | 2.33% | | |
| Student research paper | | | | | 1 | 2.86% |
| Technical report | | | | | 1 | 2.86% |
| University PR site | 1 | 1.59% | | | | |
| Total | 63 | 100.00% | 43 | 100.00% | 35 | 100.00% |

While blogs were the highest percentage of sources for all three groups, the high-score group contributed the smallest percentage (51.43%) compared to the medium-score group (60.47%) and the low-score group (63.49%). The groups show other differences in types of genres contributed. The high-score group used a much higher percentage of research reports (22.86%) than the medium-score group (9.30%) and the low-score group (7.94%). The high-score group contributed some genres not contributed by the other groups: a dissertation, a policy brief, a student research paper, and a technical report. All these sources would be considered of higher

potential credibility than many of the other genres shown. The medium-score group contributed one unique source, a book chapter. The medium-score and low-score groups both contributed commercial videos, newspapers, and student newspapers. The low-score group contributed one genre not contributed by the other groups: a university PR site. Magazines were contributed by both the high-score and low-score groups. Scholarly articles were contributed by all three groups, which may suggest that many students understand that they should use scholarly databases to find these sources. However, the differences in quality of the other contributed sources suggests that the subjects who scored themselves the highest on the metacognitive test tended to contribute better quality genres than the medium-score and low-score groups. This result suggests that the metacognitive self-ratings, while overall still quite high, may actually correlate to the ability of the subjects to identify and evaluate sources.

These findings are purely descriptive. Thus, the findings for **Research Question 3** are that the experimental results were not significantly different between groups, so a conclusion cannot be made. A larger sample size may be necessary to draw a statistical conclusion. On a descriptive basis, however, the T1 group showed somewhat greater metacognitive awareness than the T2 and CTRL groups. The IC tool provided metacognitive support through the use of process maps, progress monitors, and reflective questions, which helped subjects plan, monitor and reflect on their learning. The metacognitive strategies of planning, monitoring, and reflecting were supported by the IC tool through the decomposition of the complex task of credibility evaluation into a sequence of steps, tracking progress in the completion of tasks, and prompts which asked students to think about what they had learned. This explicit support for metacognitive strategies was not supplied to the T2 or CTRL groups, and thus the descriptive difference in outcomes may be attributed to IC tool.

## 5.8. Student skills

In addition to the findings for the three research questions described above, this study produced additional findings of interest related to students skill levels in four areas: subjects' prior experience level with online searching and prior IL instruction, their self-reported evaluation strategies, their self-reported learning, and their self-evaluation of their skills. The findings in these four areas are discussed below.

### 5.8.1. Experience level and prior IL instruction

As part of the preliminary demographic survey, all participants answered background questions that included their level of experience with searching for information on the Internet and their prior IL instruction (see section 5.2). After the completion of the study, this self-reported data was compared to the final scores assigned by the coders to subjects' understanding of the five credibility criteria (see section 5.5). The intention of this comparison was to determine whether the subjects with higher self-reported levels of prior experience searching for information on the Internet and prior IL instruction received higher scores. For each subject, an overall average of their understanding scores was calculated. A Pearson's chi square test was performed to determine if either of the two demographic variables (Internet experience or prior IL instruction) was related to the final scores. In both cases, no significant difference was found in scores between subjects who reported greater experience or prior IL instruction and those who did not. This suggests that students' level of experience in searching the Internet does not correspond to learning online credibility evaluation skills, so that even if students are highly experience searchers they cannot be expected to have learned better credibility evaluation skills. It also suggests that students who have received prior IL instruction have not learned better online credibility evaluation skills. Two possible explanations for this are that either the IL instruction that was received did not cover online credibility evaluation, or if it did, that students simply did not retain what they learned from this instruction. In either case, these results suggest that students cannot be expected to have "picked up" how to evaluate the credibility of online information from their past experience with searching online or even from prior IL instruction. Explicit instruction in techniques of online credibility evaluation is needed in order for students to learn these important skills.

### 5.8.2. Self-reported evaluation strategies

As part of the post-test, students were asked to respond to the reflective prompt "What strategies did you use to evaluate credibility?" This question sought to elicit self-reported descriptions of subjects' behavioral strategies in evaluating credibility. Responses were open-ended and narrative, ranging in length from terse to descriptive, as with the responses discussed

above. The prompt was intended to elicit metacognitive reflection on the overall strategies that subjects employed. Instead, the subjects instead tended to respond with brief descriptions of particular actions or behaviors they employed.

Many responses mentioned checking the author's background and looking for links to other sources or citations, both in exploring the particular website for information on the author's background, or more generally performing background research. This was a common response among all three groups.

> T1: I looked online to find out about the credibility of the writer
> T2: I looked them up online and researched.
> CTRL: Internet research and website analyzing

Some responses characterized this specifically as using Google.

> T1: I would look the person up on google (sic), linked in (sic) or other sites to find their background information.
> T2: I googled (sic) both the people and researched into their backgrounds.

Performing background research on the author outside of the site itself is an effective strategy that was not specifically encouraged by the IC tool, but seemed to be a pre-existing skill employed by some subjects.

Many responses mentioned a reliance on the domain name as a primary indicator of credibility, which is often one of the primary criteria taught in K-12 library classes, and was also reinforced by the IC tool.

> T1: I determined whether the entire site was credible based on the domain name
> T1: I looked at whether the link ended in .edu, .org, or .com
> CTRL: My first criteria was to identify if the website was a .edu site of .com site.
> CTRL: I checked what kind of webpage it was (.org/.gov/.com, etc.)

Although relying on the domain name alone is problematic as the entire basis for credibility judgments, many subjects seemed to be aware of the importance of the domain name as a criteria.

One specific strategy that was mentioned by a few subjects was the practice of skimming or scanning a website for key evidence of criteria before making an evaluation.

> T1: I looked at/skimmed each website to see which one seemed to be the most professional or referred to the most outside sources.
> T2: Scanning all information and then deciding whether the website should be deemed credible and to what degree
> CTRL: I scanned the document first, looking at titles and section headers and graphs. This snap-judgment isn't perfect, but it's pretty effective in predicting the quality of content.

Employing scanning or skimming is an appropriate strategy when making evaluation judgments, although knowing which criteria to rely on is vitally important. The example comments seem to rely on a "snap judgment" heuristic, since they mention impressions of professionalism or organizational elements such as section headers rather than graphs. However, awareness of scanning and skimming as strategies is valuable for students.

As with the responses to the reflective prompts discussed under RQ2, some subjects simply responded that they employed the 5Ws as a strategy, without providing any more detail.

> T1: Look into who, what, when, what, why
> T2: I made sure each page I visited answered all five credibility questions. If it did not, I deemed that page not credible.
> CTRL: Went through the list of questions/criteria provided for the research activity, and checked how many times the answer to those questions was "yes."

While not providing much any specificity on the way that they applied this strategy, the fact that subjects may have learned the practice of applying a structured series of questions (and hopefully their sub-questions) may indicate that they learned a new strategy for systematically evaluating credibility.

While many of the responses mentioned similar basic criteria such as the author's background, some responses mentioned other criteria that were unexpected:

> T2: Identify publisher, research author, view comments as an indicator of how popular the company's or individual's popularity
> T2: I looked up some of the blogs, to see their popularity, what audiences tended to read them etc (sic)

These comments regarding "popularity" were a surprising finding. Online comments and popularity of posts are traditionally considered markers of credibility in IL instruction, and could even be considered the opposite since neither necessarily reflects the quality of the original content but rather the degree to which it is discussed or shared. However, this factor also was

mentioned in response to the reflective prompts to the prompts discussed under RQ2. In response to the "How did you decide" prompt, one subject responded: "(T)he buzz about this article is significant – 108 shares on Facebook, 413 Tweets, 200 Emails and 23 Google+ connections" (CTRL). In response to the "What criteria did you use" prompt, one subject responded "(W)ho shared this link on facebook or twitter?"(sic) (T2). Apparently, some students include social media popularity ("buzz") as part of their credibility evaluations. Relying on popularity as a measure of credibility may seem natural to today's students, but it would certainly surprise a librarian teaching IL skills. However, taking the devil's advocate position, it could be considered as a type of new gatekeeping function or endorsement, meaning that this information has been "approved" through comments, shares, and Tweets by other readers, rather than being vetted by editors, publishers, or the like. Interestingly, this type of metric is being adopted by scholarly databases such as Scopus and PLOS. Scopus includes an "Altmetric" feature, which tracks "the social or mainstream media mentions gathered for a particular paper as well as reader counts on popular reference managers" using social media sites (e.g. Twitter, Facebook, Pinterest, Google+), science blogs, and mainstream media outlets (Altmetric for Scopus, 2014). PLOS uses a feature called "Article-Level Metrics" which includes social bookmarking and dissemination activity, media and blog coverage, and discussion activity and ratings (Overview: Article-Level Metrics, 2014). This acceptance of altmetrics by scholarly databases suggests that new forms of gatekeeping and credibility criteria are emerging online.

While there were some surprises among the responses, overall, there was a great deal of similarity in the responses given between the groups. Coding the responses along the Evidence-based/Projection-based/Intuition-based rubric did not produce much difference between groups, as most responses included some type of evidence and none used Intuition-based evaluations. Thus, the content analysis of these open-ended responses to these reflective responses did not provide clear evidence of different strategies between groups, but instead provided an interesting view of the evaluation behaviors of the subjects as a whole.

### 5.8.3. Self-reported learning

As part of the post-test, students were also asked to respond to the reflective prompt "What have you learned about evaluating credibility on the web?" This question was intended to

elicit self-reported descriptions of what subjects had learned from their experience with the study. Responses were open-ended and narrative, ranging in length from terse to descriptive, as with the responses discussed above. Many subjects responded that they had learned that evaluating credibility is complex and involves multiple factors, and that making judgments requires exerting effort. This was a common response between all three groups.

> T1: I learned that it's important to take into consideration a lot of factors when evaluating credibility on the web. I came across websites that seemed credible but upon further investigation did not provide legitimate information.
> T2: That there are countless factors that play a part in determining credibility on the web, but by simply researching the author, citations, and host site you can determine the credibility much easier and confidently.
> CTRL: I learned that there is a lot that goes into the process of researching sources, and that the process should be systematic involving many steps to narrow down your choices.

Some subjects expressed their surprise that evaluating credibility was challenging.

> CTRL: It is a lot more difficult than I thought.
> CTRL: It's not always as straightforward as it seems!

Many responses indicated that subjects had learned a process of asking questions about the credibility of sources.

> T1: I have learned that there are many questions you must ask yourself before siting (sic) a website.
> T2: I have learned that it is important to ask yourself many questions before picking a source.

Along with asking questions, subjects also reported a more generalized awareness of critical thinking, being skeptical, and not relying on first impressions.

> T1: You cannot trust everything that is on the web despite how credible it may appear.
> T2: Not everything you see or read online is credible and should be read as true. Anyone can post something online and it may just be an opinion. You have to do a little bit of investigating to determine if you should trust what is on a particular page.
> CTRL: I have learned that not all websites are as credible as they may seem and to pick the right ones.

In particular, a few subjects reported an awareness that they cannot rely on the first results from a Google search.

> T1: If you only take an article at face value, especially if it one that popped up in a Google search, then you may be subjecting yourself to poor information.
> T2: There are many factors to look into when evaluating a source on the web. Also, just because it comes up on Google, doesnt mean its a legitimate and truthful source
> CTRL: Don't just click the first five links that come up on a google (sic) search! To find a good credible source you must narrow the search to exclude sources that are filled with bias and unsupported claims.

The last response is encouraging, especially in light of the fact that the search results overall seem to have come from the first sites listed in the Google search results.

Of course, not all subjects reported that they had learned anything. Some of the more experienced searchers among the study subjects commented negatively when asked "What have you learned?"

> T1: Not too much. Most of it was given knowledge that I've picked up from previous research experiences.
> T2: Nothing from this, I do it all the time already and am about to be published.

Given the percentage of prior IL experience in the subject pool, as described above, it is not surprising that a few of the subjects were already experience with evaluating online credibility.

Since many of the subjects commented on the unexpected complexity and difficulty of online credibility evaluation, their new awareness of the importance of critical thinking, and the types of questions they had learned to ask, there is qualitative evidence that at least some of these subjects learned new skills for credibility evaluation from the experience of this study. While there were not distinct differences between the responses of the three experimental groups, overall this content analysis of the open-ended responses provided a qualitative overview of the self-reported learning of the subjects as a whole.

### 5.8.4. Self-evaluation of skills

As part of the post-test, subjects were given the opportunities to self-evaluate their skill levels by rating their degree of confidence in their credibility evaluation skills and their metacognitive strategies. As discussed in Chapter 4, the post-test included the following questions:

- Rate how confident you feel about evaluating the credibility of online information
- Rate how well you feel you can evaluate the credibility of online information
- Rate how challenging you find evaluating the credibility of online information

Each of these questions was answered by moving a slider along a scale marked "Not at all" on the left end of the scale through "Somewhat" in the middle to "Very" on the right end of the scale. When the subject placed the slider along the scale, the Qualtrics survey software recorded the response on a scale of 0-100, with 0 meaning that the subject had placed the slider all the way to the left to indicate "Not At all" and 100 meaning that the subject had placed the slider all the way to the right to indicate "Very" in response to the statement. Note that this means for the "challenging" question the value of responses is reversed, since a response of "very challenging" is a negative response, as opposed to "very confident" being a positive response. Each subject responded to all three questions. The average scores for each question by experimental group are shown in Table 52 below.

**Table 51. Post-test average self-evaluation scores**

| Group | Confident | Well | Challenging |
|---|---|---|---|
| T1 | 68.97 | 73.09 | 44.70 |
| T2 | 75.60 | 73.24 | 39.96 |
| CTRL | 68.24 | 71.32 | 59.64 |
| Overall | 70.75 | 72.60 | 47.77 |

The average scores for both the confidence and well questions were over 70%, showing that overall the subjects rated themselves very highly. The T2 group rated themselves higher than both T1 and CTRL on both confidence and how well they feel they can evaluate the credibility of online information, and rated themselves as finding it less challenging than the other groups (a lower score meaning "not at all" challenging). The CTRL group was closer to the T2 group on their confidence and well self-ratings, but rated themselves much higher on how challenging they found it. This is interesting since it suggests that while the CTRL subjects, who did not use the IC tutorial or the IC tool and only used the online form in conducting their credibility evaluations, rated themselves as equally confident as the T1 group (T1 68.97 vs. CTRL 68.24)

they also rated the task as more challenging than the T1 group (T1 44.70 vs. CTRL 59.64). Using the IC tool may have helped the T1 subjects to find the task less challenging. However, the CTRL group reported equal levels of confidence, which clearly suggests that they over-estimated their own confidence.

To investigate whether the student self-evaluations accurately reflected their actual performance, a Pearson's correlation test was performed on the self-report responses and the overall understanding scores described in section 5.5. The intent of this test was to determine whether the subjects were able to accurately self-evaluate their own skill levels by comparing the self-evaluations to the objectively measured scores of their understanding of the credibility criteria. For each subject, the self-reported score for each of the three self-evaluation questions was paired with their average understanding score. In all three cases, no correlation was found between the subjects' self-evaluation scores and the coder's understanding scores. Thus, the subjects' ratings of their own confidence in their ability to evaluate the credibility of online information, how well they feel they can evaluate the credibility of online information, and how challenging they find evaluating the credibility of online information had no statistical correlation to the actual scores for their understanding of the credibility criteria.

## 5.9. Summary of findings

The findings from this study are based on the results from three experimental groups with a total of 84 participants drawn from an introductory undergraduate course. Subjects were assigned to three experimental conditions: use of the IC tutorial and IC tool, use of only the IC tool and an online form, and use of only an online form. Assignment of the subjects to the three experimental conditions was stratified by year in college to control for prior experience level. The distribution of subjects by year in college and gender were roughly equivalent across the final group participants, although the CTRL group had a slightly higher level of prior IL instruction. Students in all three groups searched online for information on a common topic.

Both qualitative and quantitative data was collected from the experimental subjects to answer three research questions. The findings for Research Question 1 of this study are that significant improvement can be shown in the scores for understanding of the five credibility criteria for the T1 group compared to the T2 and CTRL groups. The findings for Research

Question 2 of this study are that no significant difference was shown and a conclusion cannot be made. On a purely descriptive basis, the T1 group gave a higher percentage of Evidence-based responses and a lower percentage of Projection-based responses than the T2 and CTRL groups. The findings for Research Question 3 of this study are that no significant difference was shown and a conclusion cannot be made. On a purely descriptive basis, the T1 group showed slightly greater metacognitive awareness than the T2 and CTRL groups.

Analysis of the search results show that subjects relied highly on blogs and research reports as information sources and frequently used first items in the list of Google search results on the exact phrasing of the research topic. Thus, students were shown to have satisficed in their searching behavior and settled for the easiest and first results. Scholarly sources were little used. Subjects also responded to reflective prompts that asked them about their strategies for evaluating online credibility and what they had learned from the study. Although the responses were not noticeably different between groups, both prompts provided interesting insights into the experiences of the experimental subjects, describing various search strategies that they used and the awareness that they gained about critical thinking and credibility evaluation online.

## 5.10. Limitations of the study

There were several limitations in this study that may limit the generalizability of its findings to broader populations of college students. Since Research Questions 2 and 3 did not produce statistically significant results, a larger sample size may be necessary to detect an effect. Although the study design relied upon random assignment to achieve comparability between groups, the final participants in the CNTRL group subjects had a somewhat higher percentage of prior IL training than did the T1 and T2 groups. Unintentionally, the experimental conditions varied by group in the amount of effort required, which impacted the length and thoughtfulness of some of the qualitative responses. Relying on self-report by subjects was a weakness of the study design, both in the expectation that students would be motivated to answer numerous questions about their evaluation strategies and to complete multiple tasks over the duration of the study. Students' responses to the metacognitive strategies survey were uniformly high and likely represent overestimation of their own skill level. Since this study was a separate extra credit activity not associated with a specific credit-bearing assignment, students may have put less than

usual effort into searching for and evaluating sources than they would for graded class assignment. Although they received extra credit for participating, this research may not have been viewed as a serious assignment. This may have affected the quality of the sources found and the evaluations the subjects completed. Potential solutions to the limitations have been discussed in the sections above.

# Chapter 6: Discussion

The purpose of this experimental study was to investigate the extent to which a custom-built online credibility evaluation learning tool incorporating scaffolding and metacognitive support called "InCredibility" positively impacted: 1) students' understanding of the expert criteria that constitute credibility evaluations, 2) their application of evidence-based source characteristics in making credibility evaluations, and 3) their metacognitive awareness of their own learning and of online information evaluation strategies. The study used both qualitative and quantitative data analysis methods (coding/scoring, statistical analysis, content analysis) to provide a multi-dimensional understanding of student behavior and answer the research questions regarding the impact of the learning tool. Subjects also provided open-ended responses to reflective prompts describing their evaluation strategies, self-evaluation of their skills, and what they learned from the study. In addition, the study analyzed the sources that students contributed in response to a common research topic to examine the subjects' search and evaluation strategies.

This chapter summarizes the findings for each research question, the analysis of the genres of sources that students contributed during the process of the study, and the subjects' self-evaluation of their skills. Implications for future improvements in both the study design and the design of the InCredibility tool itself are discussed, as well as for online IL instruction in general. This chapter concludes with comments on the contributions of this study, and discusses future directions for research.

## 6.1. Summary of Research Question findings

This study's first Research Question asked: "Do students who use the online credibility evaluation learning tool demonstrate greater understanding of expert credibility criteria in the process of evaluating online sources compared to groups of students who use a tutorial and an

online form, or those who use only an online form?" This research question was answered by coding the subject's open-ended responses to credibility criteria questions and performing a one-way ANOVA test on the between-group differences. In this study, "understanding" was defined as the subjects' ability to adequately define the credibility concepts of authority, relevance, reliability, currency, and purpose, and to describe why these criteria are important to evaluate. Understanding scores for each criteria were obtained by averaging coders' scores for two responses (definition and importance). Subject scores were then averaged for each experimental group. The results show that the T1 group had higher understanding scores for all of the criteria compared to both the T2 and CTRL groups, demonstrating that the use of the IC tool improved the T1 group's understanding of the each of the credibility criteria. The difference between the T2 group and the CTRL group was not significantly different, showing that the effect of the IC tutorial alone was not related to the difference in learning outcomes. These results demonstrate that use of the IC tool incorporating scaffolding and metacognitive support increased students' understanding of the expert criteria that they should use in making credibility evaluations. It also suggests that an online IL learning tool that integrates the process of credibility evaluation into the online research environment can be effective in helping students learn IL skills.

This study's second Research Question 2 asked: "Do students who use the online credibility evaluation learning tool demonstrate greater application of evidence-based source characteristics as the basis for their credibility evaluations compared to groups of students who use a tutorial and an online form, or those who use only an online form?" This research question was addressed by coding of the subjects' open-ended responses to reflective prompts in the post-test based on the categories from Markey et. al. (2014) of Evidence-based, Projection-based, and Intuition-based comments. An additional category for Description-based comments was added during the coding process, as well as combined codes for responses that included elements of two categories. The results showed no statistically significant difference between the experimental groups. On a purely descriptive basis, however, the T1 group gave a higher percentage of solely Evidence-based source characteristics and a lower percentage of Projection-based responses (or those that combined Projection) than the T2 group and the CTRL group. Specifically, in response to one prompt "How did you decide whether a webpage was credible or not?" the T1 group gave a higher percentage of Evidence-based responses (77%) than the T2 group (40%) and the CTRL group (65%), and in response to the second prompt "What criteria

did you use to help you evaluate credibility?" the T1 group gave a higher percentage of Evidence-based responses (87%) than the T2 group (68%) and the CTRL group (76%). The T2 group used 8% combined Evidence/Projection and 4% Description and the CTRL group used 8% Projection and 4% combined Evidence/Projection responses. These results suggest that the IC tool may have helped improve the T1 group's use of specific credibility criteria in making their credibility evaluations. This suggests that use of the IC tool incorporating scaffolding and metacognitive supports increased students' application of evidence-based source characteristics as the basis for their credibility evaluations.

This study's third Research Question asked: "Do students who use the online credibility evaluation learning tool demonstrate greater metacognitive awareness compared to groups of students who use a tutorial and an online form, or those who use only an online form?" To answer this question, a custom test of metacognitive skills was conducted as part of the post-test for all three groups and results were compared between groups to determine any differences in outcomes based on subject responses to a Likert-scale survey. The results showed that there was no significant difference between the experimental groups. On a purely descriptive basis, however, the T1 group reported more high scores for the metacognitive statements (6) than the T2 group (4) and the CTRL group (1), suggesting that the IC tool may have helped T1 become more aware of their own metacognition in relation to credibility evaluation, particularly in regard to reflective strategies. However, it is important to note that overall, subjects in this study consistently rated themselves very highly on all metacognition questions, which supports the literature showing that students tend to overestimate their own skills when self-reporting (Gross and Latham, 2007; Caspers & Bernhisel, 2007).

## 6.2. Additional findings

Along with the results for the three research questions described above, this study also produced additional findings of interest regarding the quality of the sources that subjects contributed, and their self-evaluation of their skills. These additional findings are discussed below.

### 6.2.1. Subjects' contributed sources

The online sources that were contributed by the study subjects were categorized by genre to analyze which types were most frequently used. Blogs and research reports were the most frequently contributed genres of sources across all groups. Blogs were 59.3% of T1's sources, 51.9% of T2's sources, and 29.6% of CTRL's sources. Research Reports were 12.4% of T1's sources, 29.6% of T2's sources and 40.7% of CTRL's sources. In the overall total of sources across all groups, Blog was the overwhelming majority of genres at 55.0%, followed by Research Report at 17.7% and Newspaper at 8.2%. Several of the most frequently used sources were found to be among the top results on the first page of results for a Google search on the exact phrasing of the research topic.

As discussed in section 5.3.1, four of the most frequently contributed sources show up in in the first page of Google search results for the query "what is the effect of social media on education." These results support themes of the LIS literature, which suggest that students often rely on the top items in a list of search results as recommendations of the best sources and barely go beyond the first few results pages (Lankes, 2008; Hargittai et al., 2010; Spink, Wolfram, Jansen & Saracevic, 2001). College students overwhelming rely on Google to the exclusion of many other academic search tools (Hargittai et al., 2010; Head & Eisenberg, 2011; Kim & Sin, 2011; Kolowich, 2011; Van Soyoc & Cason, 2006). The results also support the findings of the LIS literature that indicate students often rely on satisficing, the tendency of information seekers to accept the first satisfactory option vs. higher-quality alternatives, using the minimum amount of effort judged necessary (Simon, 1956; Agosto, 2002; Thomas, 2004; Gibson, 2008; Warwick et al., 2009). Research consistently finds that students rely on familiar sites and end searches as soon as an acceptable result is found (Rieh & Hilligoss, 2008; Warwick et al., 2009; Connaway et al., 2011). The fact that many subjects relied on the first search results found, and many contributed the same sources, suggests that the subjects in this study satisficed rather than expending effort to find sources that were of higher quality. However, the imposed nature of the query, and the fact that this study was an extra credit opportunity rather than a personal information need, may have affected the amount of effort that subjects invested in their search.

An unexpected finding of this research was that identifying the genre of the sources contributed turned out to be more difficult than expected even for the researcher. Determining

the intended purpose and credibility of many blogs was complicated by their hybrid nature that combined multiple existing information source categories (Herring et al., 2004; Scale & Quan-Haas, 2012). Even defining the nature of a popular site like the Huffington Post (HP), one of the most frequently used sources in this study, was difficult. The content of HP consists primarily of aggregated content from other sites and blog posts by Hollywood actors, retired politicians, and directors of charities, most of which would be classified as editorial in a traditional newspaper. The layout and visual design of the site echoes that of a newspaper, as does the title, although the site also prominently features social media sharing links and user commenting. HP does not give any definition of itself (the "About Us" link is a staff list) so this study's author relied on definitions by other sites, from journalism and industry, to determine how to define the HP website:

- Columbia Journalism Review: "an online newspaper filled with celebrity bloggers and virally disseminated aggregated content" (http://www.cjr.org/cover_story/six_degrees_of_aggregation.php)
- Crunchbase: "an online news aggregator and blog offering content that includes politics, entertainment, world news and technology." (http://www.crunchbase.com/organization/huffingtonpost)
- Mashable: "an American news website, content aggregator, and blog… featuring columnists and various news sources." (http://mashable.com/category/huffington-post)

These definitions point to the hybrid nature of this source. The genre of "news aggregator" is itself an example of a new genre that has emerged on the Internet; it is defined by PC Magazine as "A Web site that gathers news from different sources and other Web sites" (News Aggregator, 2014). This hybrid genre presents a challenge for students to judge the difference between an online newspaper, an online news aggregator, and a news website, as variously described in the definitions quoted above.

Other major news blogs pose similar evaluation challenges. Well-known media outlets such as NPR, the Wall Street Journal, and the Economist all include blogs. In the case of the Wall Street Journal, their blog titled "Digits" (http://blogs.wsj.com/digits) features coverage of "hot topics," user comments, and social media links. The content of these sites is similar to other news blogs, but the WSJ branding is very prominent and clearly meant to give the blog legitimacy. However, if these news blogs are considered equally credible to the traditional news

sites that host them, then alternative news blogs that feature similar content and format might be considered equally credible as well. Two sources cited by subjects in this study's experiment provide examples. Socialmediatoday.com describes itself as "an independent, online community for professionals in PR, marketing, advertising, or any other discipline where a thorough understanding of social media is mission-critical" which suggests a degree of professional credibility. InsideHigherEd.com describes itself as 'the online source for news, opinion and jobs for all of higher education… founded in 2004 by three executives with decades of expertise in higher education journalism and recruitment." These professionally-oriented blogs are hosted on dot-com sites, which students are often instructed to consider as not credible by traditional IL instruction. However, their professional experience may qualify them as experts on topics in their field, even if their expertise is not scholarly. The traditional concept of author expertise is challenged by the types of "experts" found on blogs: an AVP of Marketing at Pearson, a corporate marketing and product development officer. These individuals might be considered experts on their topics and thus have credibility, although perhaps not in the traditional sense of IL instructors. Another factor in evaluating blog authors is that their credentials or backgrounds may be difficult to locate on the site or completely absent. Thus, this discussion of specific blogs and blog authors demonstrates the challenges to traditional IL evaluation posed by the hybrid nature of new genres that have appeared on the Internet. The Internet is increasingly producing such hybrid information genres that can often defy traditional evaluation techniques (Crowston et al., 2010; Markey et al., 2014). This reality demonstrates the importance of IL instruction that is customized to the online information environment and the importance of students understanding what different genres consist of, their purpose, and how to critically evaluate their quality.

### 6.2.2. Subjects' self-evaluation of their skills

As part of the post-test, subjects were given the opportunities to self-evaluate their skill levels by rating their degree of confidence in their credibility evaluation skills and their metacognitive strategies on the post-test. Subjects used a slider on a scale of 0-100 to reply to questions asking them to rate themselves on how confident they feel about evaluating the credibility of online information, how well they feel they can evaluate the credibility of online information, and how challenging they find evaluating the credibility of online information. The

average scores for both the confidence and well questions were over 70%, showing that overall the subjects rated themselves very highly. A Pearson's correlation test was performed to investigate whether the student self-evaluations accurately reflected their actual performance on the overall scores for understanding of the credibility criteria. No correlation was found between the subjects' self-evaluation scores and the coder's understanding scores, demonstrating that the subjects' self-evaluation of their skills had no statistical correlation to the actual scores for their understanding of the credibility criteria.

These findings support the literature that shows students tend to overestimate their own skills when self-reporting, and do not realize their own need for instruction (Gross & Latham, 2007; Caspers & Bernhisel, 2007). Low-skilled students also hold inflated views of their own competence in information seeking, do not know their own weaknesses, and often overestimate their abilities to find and evaluate online information (Manuel, 2002). The IC tool was designed to address this issue by giving students repeated, structured practice in evaluating their own work as well as the evaluating the quality of other students' evaluations, and reflecting on their strategies. Through this tool's structured skills practice, students learned to evaluate their own skill level more realistically and compare their own skills to others based on shared performance.

## 6.3. Implications for the InCredibility tool

This study tested the effectiveness of the IC tool, and produced a number of implications for improving its design. The design of the IC tool was based on a synthesis of three related but disconnected fields of research: IL instruction, credibility evaluation, and Computer-Supported Collaborative Learning (CSCL). Underlying the online credibility evaluation learning tool's design is a 3-stage model that is the ACRL's definition of information literacy—"a set of abilities requiring individuals to 'recognize when information is needed and have the ability to locate, evaluate, and use effectively the needed information" (ALA, 2000). The tool represents each step of "locate, evaluate, and use" through a division into three stages identified as Investigate, Question, and Solve. The three stages of the tool give students repeated, structured practice in evaluating their own work (Investigate) as well as the evaluating the quality of other students' evaluations (Question). Through this structured skills practice, students learn to evaluate their own skill level more realistically and compare their own skills to others based on

shared performance. The tool provides scaffolding and metacognitive support through incorporating a process map of the overall task, progress monitors, and reflective prompts.

One possible enhancement to the IC tool based on the findings from the study would be the addition of rollover or pop-up texts to reinforce the definitions of the credibility criteria and their importance during the process of using IC to evaluate sources. The current rubric used for coding subject responses could be adapted as prompts in the Notebook and/or evaluation stages of InCredibility. These added prompts would help reinforce the definitions and importance of the criteria, and potentially increase student understanding of credibility criteria. Table 53 shows examples of these adapted rubric prompts.

**Table 52. Adapted rubric prompts**

| Criteria | Definition prompt | Importance prompt |
|---|---|---|
| Who/Authority | Decide if the author is qualified to write about the topic | Anyone can post to the Internet so you need to verify whether the author is qualified to write on this topic |
| What/Relevance | Decide if the information is useful for the research topic | There is a lot of information on the Internet so you need to choose relevant information for your research topic |
| Where/Reliability | Decide if the information is trustworthy | The sources of online information are not always apparent so you need to verify them |
| When/Currency | Decide if the information is up-to-date | Up-to-date information is often most accurate, (although not for every topic) so you need to verify the date of publication |
| Why/Purpose | Decide if the site shows bias | The intended purpose of online information is not always apparent and may influence its value so you need to check for possible bias |

These definition and importance prompts are currently included in the IC tool during the Question stage, but are not repeated throughout. In the form of rollover or pop-up texts integrated into the evaluation process, these added prompts would help reinforce the definitions and importance of the criteria, and potentially increase student understanding of the credibility criteria.

The IC tool could also be enhanced to further improve the learning outcome of greater understanding and application of expert credibility criteria while evaluating online sources. One

possible enhancement to a future version of the tool would be to expand the use of the current Tutorial tips about assessing evidence for credibility judgments throughout the InCredibility tool. These tips could be adapted to pop-ups or rollovers that would reinforce the specific types of evidence that students should look at for every source that they evaluate, potentially increasing student application of evidence-based credibility criteria in their evaluations. Table 54 shows examples of these adapted tip prompts.

**Table 53. Adapted tip prompts**

| Criteria | Evidence prompt |
|---|---|
| Who/Authority | Look for author's name, qualifications, and/or biography. Decide if the author is qualified to publish information on this topic. |
| What/Relevance | Look for specific facts, keywords or tags that relate to your topic. Decide what makes this source better than other sources for your question. |
| Where/Reliability | Look for the URL domain name that tells whether the site is commercial, educational or non-profit. Decide if the source emanates from a reliable source for your topic. |
| When/Currency | Look for dates at the top of an article or at the very bottom of the page. Decide how important having current is information to your topic. |
| Why/Purpose | Look for an "About" section that describes the site's purpose. Look for evidence of objectivity or possible bias. Decide if advertising might influence the content. |

While these tips are currently included in the IC tool's tutorial, they are not explicitly repeated in the subsequent stages of the tool (Question and Solve). In the form of rollover or pop-up texts integrated into the evaluation process, these added prompts would help reinforce the specific types of evidence that students should look for, and potentially increase student application of evidence-based credibility criteria in their evaluations.

Another enhancement to the IC tool would be adapt the current metacognitive post-test questions as question prompts integrated into the process of using the tool. Specific metacognitive prompts could be included to remind students to plan, monitor, and reflect on their tasks during the process of evaluation. These integrated metacognitive question prompts would prompt students to reflect on their own activities, increase their critical self-awareness, and

potentially increase in student awareness of their metacognitive strategies. Table 55 shows examples of these adapted metacognitive prompts.

**Table 54. Adapted metacognitive prompts**

| Category | Prompt |
|---|---|
| Planning | What information do you need to evaluate the credibility of this source? |
| | What questions about the topic should you ask before you begin evaluating the credibility of this source? |
| | What are several ways to find evidence for evaluating the credibility of this source? |
| Monitoring | What steps will you take to evaluate the credibility of this source? |
| | How effective are your strategies for evaluating this source? |
| | Did you compare information from different websites when evaluating this source? |
| | Did you periodically review the evidence you found while evaluating the credibility of this source? |
| Reflecting | What specific evidence did you find to justify and support your evaluation? |
| | Did you look at the evidence from different perspectives when evaluating this source? |
| | Was there a better way you could have found evidence when you evaluated this source? |
| | Did you find several different types of evidence when you evaluated this source? |

These integrated metacognitive questions would prompt students to focus on their own evaluation strategies and increase their critical self-awareness. This could result in an increase in student awareness of their metacognitive strategies. However, one potential drawback to this approach is that it would significantly increase the number of questions that students would need to answer when using the IC tool and thus increase the amount of effort required. Students might not want to answer so many questions. Perhaps the questions could be randomized and only one displayed for each source evaluated and saved.

Based on the overall low quality of subjects' sources, enhancements could be made to a future version of the IC tool to support students in finding higher quality sources. Displaying suggested search terms or keywords as alternatives to searching on the exact topic phrase might

encourage students to try different variations of searches. Displaying the keywords used by other students in their searches or even the results other students might help students realize how common the most frequently used sources are and might motivate them to find more unique sources. Rules could be added that an individual source can't be used more than X times, or that certain common search terms could not be used when searching. These enhancements would guide students towards doing more than natural language search, encouraging them to go beyond their inclination to satisfice by relying on the first few Google search results and help them become better online searchers.

Another potential enhancement to the IC tool would be to increase the capabilities for collaborative evaluation activities to help motivate participation and stimulate peer learning. In today's online information environment, credibility is often not determined by the individual, but "within a community engaged in a larger conversation" (Lankes 2008, 114). Today's students often prefer a networked, participatory learning environment (Davidson & Goldberg, 2009; Halse & Mallinson, 2009; Thomas & Brown, 2011). Traditional IL instruction models such as one-shot classroom sessions may not connect effectively with today's students who are used to more social forms of learning (Costello et al., 2004; Manuel, 2002; Gibson, 2008; Leach & Sugarman, 2005). Social learning software tools support participatory knowledge creation through networking, socialization, communication and engagement with communities of learning and are "increasingly being recognized as essential scaffolds and learning tools" (McLoughlin & Lee, 2008, p. 649). Collaborative filtering and peer-review systems such as recommender or reputation systems allow users to pool their intellectual and experiential resources, transforming credibility evaluation into a collaborative rather than an individual effort (Metzger, 2007). Not only the criteria for evaluation but also the processes by which credibility evaluation is taught need to reflect the realities of online information seeking. For example, practices of collaborative inquiry can encourage students to participate in online verification strategies to assess author credentials (Metzger et al., 2003) or to share and compare sources through organized, collaborative online searches (Todd, 2000). To reinforce the real-world value of these practices, collaborative learning opportunities should be employed in the context of real classroom assignments (Harris, 2008) and embrace the Internet as "a means of creating communities and fostering collaboration" (Rieh & Danielson, 2007, p. 350). Social software tools are "increasingly being recognized as essential scaffolds and learning tools" (McLoughlin

& Lee, 2008, p. 649) because their affordances support participatory knowledge creation through networking, socialization, communication and engagement with communities of learning (McLoughlin & Lee, 2008).

Although students were able to comment on each other's evaluations in current the IC tool, participation in these activities was low. Expanding the opportunities for group participation in the information evaluation process might increase student engagement by enhancing social interaction. Originally, the IC tool was intended to provide a question asking-and-answering functionality that allowed the higher-skilled students (as based on tutorial performance) to answer questions from the lower-skilled through threaded discussions. This planned feature was eliminated during the development process due to time and budget constraints. Further exploration of the use of collaborative, social, and participatory methods for online credibility evaluation instruction is an intriguing possibility for future research.

## 6.4. Implications for study design

This study employed an experimental design with randomized assignment to heighten the statistical validity and generalizability of the results. Randomized assignment with stratification was used to assign subjects to the experimental groups by grade level, in order to ensure a comparable composition to the original distribution of grade levels in the entire class, making the study more ecologically valid. The stratified random assignment also equalized the distribution of year levels between groups, and thus helped control for the level of experience between groups. Subjects were randomly assigned to one of the three study groups: the Treatment 1 group (T1) used both the IC tool and the introductory tutorial, the Treatment 2 group (T2) used the tutorial and an online form to record their sources, and the control (CTRL) group used only the online form. Each group worked independently on the same research topic: "What is the impact of social media on education?" The timeline of the tasks was kept equal between the three groups, although the amount of effort required may have been unintentionally higher for the T1 group. After competing the study, all three groups responded to a post-test that included questions about the definition and importance of the credibility criteria, used to find the overall understanding score for each subject, as well as self-evaluation questions about the subjects' skills, and a Likert-scale survey of metacognitive strategies.

After conducting this study and analyzing the results, some issues with the study design became evident. These issues along with proposed study redesign suggestions to address the issues in any further iterations of the IC tool are described below:

**Issue 1:**

While the findings for Research Question 1 produced significant differences between the experimental groups, the findings for Research Questions 2 and 3 did not.

**Proposed Redesign:**

A larger sample size might produce statistically significant differences between the groups by producing greater variations in responses.

**Issue 2:**

The CNTRL group subjects had a somewhat higher percentage of prior IL training than did the T1 and T2 groups, which may have effected the study outcomes by providing those subjects with more prior experience and knowledge of the credibility evaluation criteria and process and increasing their understanding scores.

**Proposed Redesign:**

Stratify the random subject assignment not only by year in college but also by prior IL instruction, in order to ensure equal distribution of past experience across all the experimental groups, to increase the validity of the study results.

**Issue 3:**

The study relied on self-report by students of their behavior in seeking evidence and evaluating it. Students may have over-estimated how well they did, and the self-reported results may not necessarily correlate to better quality results.

**Proposed Redesign:**

The subjects' actual search outcomes could be qualitatively compared to an expert's search results, which would confirm or disconfirm the results of students' self-reports.

**Issue 4:**

Since the T2 and CTRL did not use the IC tool, logfile data was not collected for those experimental groups, which made it impossible to quantitatively compare their online behaviors to the T1 group

**Proposed Redesign:**

Collect log-file data on the T2 and CTRL groups, which could include sites visited, links clicked, time spent on sites, and the overall patterns of their searching and evaluation behavior, be able to compare patterns of user actions and time spent on tasks between the experimental groups

**Issue 5:**

It is likely that the experimental conditions varied in the amount of effort between the experimental groups, by requiring the T1 group to perform more detailed and repetitive tasks, and answer more questions, which is suggested by the dropoff in responses from the T1 groups answers on the open-ended prompts, as opposed to the greater participation in providing the open-ended responses from the T2 and CTRL groups

**Proposed Redesign:**

The amount of effort required across the experimental groups could be equalized, either by reducing the total number of questions asked to the T1group, by reducing the total quantity of tasks required for T1, or increasing the number of questions and tasks assigned to the T2 and CTRL groups

**Issue 6:**

The responses to the open-ended prompts from the T1 group were overall briefer and less thorough than the responses from the T2 and CTRL groups

**Proposed Redesign:**

The quality of participation while using the IC tool could increased by incentivizing more in-depth responses to the open-ended prompts, either through making the IC tool part of a graded in-class assignment, or by integrating the use of the tool into the syllabus instead of being an extra credit option, so that student participation was tied to an in-class grade

**Issue 7:**

Subjects' self-evaluations on the metacognitive test were overall very high, which meant that differences between the groups were quite small and statistical analysis was not possible, although the for RQ 3 showed a trend toward the T1 group's having greater metacognitive awareness

**Proposed Redesign:**

Instead of relying on a one-time test of metacognitive awareness at the end of the study, measures for tracking students' metacognitive strategies and skills could be integrated throughout the study design, perhaps by integrating prompts about planning, monitoring, and reflecting strategies into the IC tool's interface and into the online form at all three stages of the evaluation process (Investigate, Question, Solve)

A future study that employs the above proposed redesigns to addresses the issues described would (1) produce data with greater comparability between the experimental groups to allow greater confidence in comparisons of learning outcomes, (2) produce quantifiable data about subjects' behavior patterns that would allow for a comparison of metacognitive strategies, and (3) incentivize greater participation and contribution of more thoughtful, in-depth and complete answers to question prompts. These changes would produce new experimental results yielding more detailed quantitative data that would allow for additional statistical testing, and also yielding more extensive qualitative responses to help answer the research questions in greater depth.

In hindsight, a disproportionate amount of the researcher's time and effort was put into designing and developing the IC tool, working with multiple coders to direct its development, testing and bug-fixing, and pilot testing. Although this effort was necessary for the scale of the IC tool, it resulted in less time being spent on designing the control condition, working through details such as how to capture logfile data for T2 and CTRL groups, and pilot testing the T2 and CTRL conditions with test subjects. Spending more time and effort on these steps could have helped minimize some of the issues with the study design discussed above.

## 6.5. Implications for online IL instruction

Along with supporting effective online IL instruction, the IC tool addresses some of the challenges to teaching IL identified in the literature review:

1. The "faculty problem": Faculty may not view librarians as educational partners but may regard them as support staff and providers of support services (Owusu-Ansah 2004; Manuel, Beck & Molloy 2005; McGuiness 2006). Some librarians feel that faculty are either apathetic or outright obstructive towards efforts to collaborate on IL instruction (McCarthy 1985). Faculty may feel that librarians are not qualified to be teachers (Saunders 2012). They may also be unwilling to cede valuable in-class time to librarians (Hardesty 1995; Breivik & Jones 1993; Owusu-Ansah 2004; Hrycaj & Russo 2007). A tool that can be integrated into existing in-class assignments without requiring librarian instruction sessions might increase faculty receptivity to adding IL instruction to their course. Librarians could still be involved through supporting the assignments, and perhaps through incorporating chat reference functionality into the tool so that students could contact librarians with questions at the point of need during their research process.
2. Library Anxiety: Students may feel a sense of powerlessness when they begin an information search that requires using the library, involving feeling lost, fearful of library staff, and unable to navigate the library (Mellon, 1986). The IC tool addresses this barrier by situating library instruction in the online context where students normally do their research, rather than placing them physically in the library, or bringing a librarian physically to the classroom. By integrating the credibility process into the context of a real-life, in-class assignment, the IC tool situates credibility evaluation in a familiar setting where students feel comfortable. This issue could also be addressed by building on-demand chat reference into the structure of the IC tool, as mentioned above.
3. Lack of integrated IL curriculum: Only a small percentage of higher education institutions with first-year experience programs include a required IL component (Boff & Johnson 2002). Overall, IL is not a required component of most academic curriculum. Inclusion of IL instruction in the curriculum often relies on the advocacy of individual

librarians (Weiner 2012), although librarians often lack political leverage within the academic community, making it difficult for them to create change (McGuiness 2006). These difficult conditions mean that broad integration of IL into undergraduate education remains an aspiration rather than a fully realized ideal (McGuiness 2006). A tool that can be integrated into existing in-class assignments could help achieve greater reach of IL instruction to more students without requiring curricular changes and without relying on departmental or college-wide approval.

4. Outmoded IL teaching methods: Delivery of library instruction through the traditional lecture method is ineffective and does not engage today's students (Costello et al., 2004). One-shot instruction sessions cannot provide students with the sustained practice required to learn, apply and master IL competencies (Mokhtar et al. 2008, Mery et al. 2012). Information literacy needs to be reinforced over a longer period of time with appropriate scaffolding and guidance (Chu, et al., 2011). The traditional lecture-based course is ineffective for Gen Y students, who prefer more active learning environments (Manuel, 2002). Students consider required, for-credit IL classes as their least preferred means of getting library instruction, compared with individual instruction conducted at the point of need while students are actively seeking information (Davidson, 2001). These students prefer an online format for of IL instruction because it allows them to actually use the skills that they are learning about (Anderson & May, 2010). The IC tool integrates IL instruction into the real life context where students do their research, and makes instruction more relevant by connecting it to actual assignments and online research practices.

Based on the findings of this study and the review of the literature, several implications for effective IL instruction regarding credibility evaluation of online sources emerged:

- Subjects reported using appropriate information seeking skills such as skimming sources to get the main idea and conducting Internet searches (“Googling”) to investigate an author’s background. IL instruction should build on these types of pre-existing search strategies when teaching online credibility evaluation skills, in order to connect with students’ prior knowledge and scaffold them to more advanced skills such as techniques

for finding specific evidence to support their credibility evaluations (checking the "About" link, searching for information about the author, Google Scholar, limiting searches to scholarly sources). IL instruction today does not need to focus

- Subjects in the study showed a strong indication of relying only on the first results of a Google search. IL instructors should search with students on a class research topic, discussing how and why Google generates those results, and why the results are not an endorsement of credibility
- Subjects in the study demonstrated little ability to accurately identify the genre of hybrid online genres (such as identifying the Huffington Post as a newspaper because its layout looks like a newspaper). IL instruction should teach students strategies for how to evaluate the credibility of blogs and other hybrid Internet information sources, by demonstrating actual examples of typical search results rather than preselected examplars of traditional formats such as magazines and journal articles
- Subjects in the study showed little understanding of how to evaluate the "semi-academic" sources that are easily found online, such as independent research reports and non-peer reviewed online-only journals. IL instruction should teach ways to evaluate these types of sources, as well as understanding of how the scholarly research process works.
- Subjects in the study readily accepted claims of expertise from all types of online authors and content producers. IL instruction should address the varied forms of expertise that are often invoked online, and how to evaluate them as evidence of credibility including differentiating commercial content from educational content.
- Subjects in the study cited popularity measures of social media (likes, shares, comments or "buzz") as measures of credibility. IL instruction should address these types of popularity measures that students are familiar with and may interpret as measures of credibility, and discuss how to evaluate them, particularly in light of the growing acceptance of "altmetrics" in scholarly databases such as Scopus and PLOS.

These implications for online credibility evaluation instruction demonstrate the many challenges that traditional IL instruction faces in the new online information environment. Given the time and scheduling constraints often placed on IL instructors, and the difficulty of adding more content to already limited instruction sessions, it is much more likely that these goals could be

met through integrating an online credibility evaluation tool into already existing classroom assignments, rather than trying to cover all these topics as a stand-alone instruction session divorced from students' practical online research experience. Addressing these challenges through the use of an online IL instruction and credibility evaluation learning tool offers a new approach to traditional IL instruction that meets the needs of students faced with the difficulties of evaluating online information, as well as the goals of IL instructors who seek to use teaching methods and content that are relevant to today's students, and to overcome the challenges to integrate IL instruction into the classroom and reach greater numbers of students

## 6.6. Contributions

In today's online information environment with its new hybrid genres and lack of traditional credibility markers, IL and credibility evaluation skills cannot be taught effectively using traditional library-based methods, or in an isolated, one-shot approach that does not support repeated real-life practice and reflection. Although today's students are fluent with and reliant upon the Internet as their primary source of information, IL instruction is primarily conducted in one-shot sessions or library-based classroom instruction that focuses on vetted, authorized information sources. It is also divorced from the in-class context of students' actual research assignments. These traditional instructional approaches cannot provide students with the engagement and sustained practice required to learn, apply and master IL competencies (Mokhtar et al. 2008, Mery et al. 2012). Customizing credibility instruction to the *online* information environment is particularly important because of the lack of conventional quality control mechanisms and indicators of authority from traditional *print-based* formats (Rieh, 2002; Gasser et al., 2012; Metzger et al., 2010). The markers of credibility in the print-based paradigm that were traditionally maintained by professional gatekeepers such as editors and reviewers are often lacking on the Internet, and web pages typically offer few reliable cues to credibility that students can use in their evaluations (Burbules, 2001; Iding et al., 2008; Mackey & Jacobsen, 2011; Rieh & Danielson, 2007). Learning and practicing the techniques of online credibility evaluation in the real-life context of academic research is important to make IL instruction relevant to today's students.

This research investigated the integration of IL instruction directly into the online information environment where students actually do their research through the use of a browser plugin (the Notebook) that allows students to evaluate sources and capture specific evidence for their credibility judgments at the time of need. An important contribution of this research is the demonstration of scaffolding and metacognitive support incorporated into the IC tool. To support effective student learning, the IC tool employs scaffolding that decomposes a complex, high-level task into simpler, easy-to-understand units (Quintana, et al. 2004). This scaffolded structure breaks down the complex task of making credibility evaluations about online information sources into a systematic process. The browser-based Notebook presents basic questions to be answered, organized into a familiar visual format of a notebook with a "tab" for each of the five questions to be answered. The student gains mastery over the process by completing each of the smaller question-answering steps first, gathering together the evidence that will be later required for making a credibility evaluation. At first, however, the student is only required to enter answers to straightforward questions (Who is the author? What are their qualifications?). Completing the questions in the Notebook for each source gives students practice in completing the steps of a systematic process of gathering specific evidence to support credibility evaluations.

To support students in building cognitive links between prior knowledge (experience using Google and Wikipedia to find answers) and new knowledge (the critical evaluation of online information using evidence-based judgment), the IC tool scaffolds students from simple concepts in a familiar context (questions about Who, What, Where, When, and Why) to the higher-level concepts of Authority, Relevance, Reliability, Currency, and Purpose. The 5Ws questions employ non-expert language that presumes no prior knowledge of credibility evaluation. In the later stages, the 5Ws are mapped to more sophisticated credibility criteria language, providing scaffolding to bridge the gap between students' unsophisticated understanding of online information evaluation and the more sophisticated models of evaluation criteria used by experts.

The Notebook also scaffolds learning by automating routine tasks such as recording URLs and taking notes into a single tool that is available at the point of need (while searching online) and automatically gathers all the needed information into an easily-accessed format on the IC website. Students can save and return to their notes about saved websites, and later will

use these notes as basis for their credibility evaluations. Automating these routine tasks saves cognitive effort and allows students to focus on the important learning tasks.

To help students monitor their progress while completing their credibility evaluations, a process map on the IC Headquarters page visually represents the three stages of the process (Investigate, Question, and Solve) as a conceptual organizer. As students complete each stage, these bars progressively fill in with a new color to indicate completion of the tasks. Time-based reminders show students their progress and remind them of their goals. These features decompose the complex task of evaluating online information into more manageable steps, help students schedule and manage their time rather than waiting until the last minute, and help students understand that credibility evaluation is a systematic process, not a one-time action.

To support articulation and reflection, the IC tool employs scaffolding that guides students in reviewing their own understanding and making it explicit (Quintana, et al. 2004). During the Investigate stage, students are prompted to enter comments on each source they evaluate, explaining why they rated it as they did. At the end of the stage, they are prompted to review their work and make any changes they feel necessary. A prompt asks "How confident in your answers?" to encourage self-reflection. During the Question stage, other students can see these comments and respond to them. Students receive comments on their own sources and make comments on others. During the Solve stage, students are prompted to choose between two sources and explain their rationale for choosing which is better, and then articulate their own understanding of the credibility criteria that they used. These scaffolds help students make explicit the steps they take in making credibility evaluations, and to review their own understanding.

Scaffolds also support students in developing their metacognitive skills. The IC tool provided metacognitive support through the use of process maps, progress monitors, and reflective prompt, which helped subjects plan, monitor and reflect on their learning. Through introducing explicit systematic structure to what had previously been a simplistic action, a student's self-regulation and self-evaluation processes are enhanced (Ge & Land, 2004; Pifarre & Cobos, 2010). The IC tool supports students in the important metacognitive skills of planning their tasks, monitoring their progress toward meeting goals, taking appropriate steps to solve problems, and reflecting on past performance (Quintana et al., 2005, p. 2360). At each stage of the IC tool, the unfamiliar and challenging process of evaluating the credibility of online

information is structured as a systematic process requiring planning, monitoring, and reflection. As students complete each stage of the learning tool and gain repeated practice in each activity, they learn how to regulate their online searching behavior and reflect on their own skills and understanding and to reflect on their own thinking. By giving student repeated practice in reviewing and commenting on the evaluations of others, the IC tool supports students in externalizing and comparing their knowledge and beliefs with those of their peers (Sharma & Hannafin, 2007).

The incorporation of scaffolding and metacognitive support into an online IL instruction and credibility evaluation learning tool offers a new approach to traditional IL instruction that meets the needs of students faced with the challenges of evaluating online information, as well as the goals of IL instructors who seek to use teaching methods and content that are relevant to today's students, and to integrate IL instruction into the classroom and reach greater numbers of students. The IC tool supports the ongoing movement in IL teaching philosophy and pedagogy away from the concept of the traditional "sage on the stage" model and toward the contemporary model of "guide on the side" (Doyle, 1994), embracing cognitive, constructivist and inquiry-based models of learning (Stripling, 2010). Librarians have shifted their educational goals from teaching students how to locate materials using specific library tools to teaching students how to deal with information in any format located anywhere (Thompson, 2002), and the IC tool supports integration of IL instruction and practice into the online information environment where students do the majority of their research. The use of the IC tool supports the expansion of the librarian's role from simply teaching retrieval skills to incorporating "a more total research environment in the course of finding and using information/knowledge" (Owusu-Ansah, 2004, p. 5). The explicit modeling and support of metacognitive strategies and exploring how these techniques can support IL instruction is also a significant contribution to the field.

This study is unique in its application of metacognitive measurement to IL instruction. No similar work was found in the IL literature, although scaffolding and metacognition have been studied in other fields, e.g. science (Quintana, et al., 2004; Azevedo, 2005; Quintana, Zhang & Krajick, 2005; Raes, 2012; Tanner, 2012), education and psychology (Kauffman, 2004; Iding, 2008; Pifarre & Cobos, 2010), educational media (Bannert, Hildebrand & Mengelkamp, 2009), pharmacy (Ge, Planas & Er, 2010; Ge, 2013), and specific domains such as reading comprehension and writing skills (Lin, 2011). However, there has been little research on the

application of scaffolding and metacognitive support to teaching students IL and credibility evaluation skills (Gorrell et al., 2009; Bannert & Mengelkamp, 2013). This lack of attention to metacognition is a significant gap in IL instruction, because IL can be seen as inherently metacognitive in that it encourages individuals to become aware of their search and evaluation skills and apply them to specific information needs (Booth, 2011). Both the *Information Literacy Competency Standards for Higher Education* and the *Guidelines for Information Literacy in the Curriculum* describe IL as essentially metacognitive (ACRL, 2000; MSCHE, 2003). Any training in IL skills should not only equip students with guidelines to help them assess the credibility of websites, but should also encourage them to reflect on the process of evaluation (Madden et al., 2011). Since students do not spontaneously engage in metacognitive thinking unless they are specifically encouraged to do so, it is important to include metacognitive support in learning environments (Lin, 2001). Effective searching of the web is a complex process of reasoning and decision-making (Todd, 2000), and strong self-regulation ability and metacognitive awareness are necessary in order to be successful in web-based learning (Raes et al., 2012). The use of metacognitive scaffolds can help students to develop strategies to be more critical in their evaluation of the credibility of online information sources (Iding et al. 2008). Online learning tools like IC can incorporate metacognitive scaffolding and explicit strategies for planning, monitoring, and reflection into the process of learning IL skills. This research explores integrating IL and metacognition instruction, and the results suggest the potential for greater metacognitive awareness and skill development through the use of a scaffolded online learning tool.

## 6.7. Significance

The Internet has transformed the nature of information literacy and credibility evaluation. The new hybrid genres and forms of expertise that are emerging online no longer conform to the traditional instructional model of print-based IL instruction. The checklist-based approach to evaluating sources often employed by librarians does not simply transfer to the online information environment, which requires more complex and challenging strategies. IL instruction needs to be adapted to better suit the specific context of online information sources. Since students tend to be fluent with finding information online and consider themselves to be

skilled searchers (regardless of their actual ability), they often do not see the relevance of IL instruction that appears to be library-based and focused on traditional genres of information (magazines, books). However, IL skills are even more important and necessary in the online information environment than they have been before. To effectively reach these students and help them understand the importance and value of IL skills in the inline information environment, this dissertation's research developed an innovative strategy for providing a new kind of information literacy education customized for the needs of today's students (Gross and Latham, 2007). It explores the opportunity for IL instruction to incorporate the use of new information technology and social media features to help students assess the credibility of online information. This research sought to investigate how to teach IL in a way that supports how "young people think and work" (Harris, 2008, p. 172) while taking into account the "newer behaviors emerging in digital environments" (Rieh & Hilligoss, 2008, p. 50).

Not only the criteria for evaluation but also the processes by which credibility evaluation is taught need to reflect the realities of online information seeking. Employing collaborative learning opportunities in the context of real classroom assignments helps to reinforce the real-world value of these practices (Harris, 2008), embraces the Internet as "a means of creating communities and fostering collaboration" (Rieh & Danielson, 2007, p. 350), and helps today's learners "use new technologies to participate in virtual communities where they share ideas, comment on one another's projects, and plan, design, implement, advance, or simply discuss their practices, goals, and ideas together" (Davidson & Goldberg, 2009, p. 12). This study explored a novel pedagogical technique for teaching online credibility evaluation to today's students, and showed that the custom-built online credibility evaluation tool improved students' learning outcomes in their understanding of expert credibility criteria in the online information environment. It has also contributed practical implications for IL study design, IL tool building, and online IL instruction.

This research synthesized work from three distinct fields: IL instruction, online credibility evaluation and Computer-Supported Collaborative Learning. Each of these fields has a well-established research tradition but they are often segregated into disciplinary silos and do not interconnect. This research explores areas of overlap and synergy between these fields, while also producing an empirically tested learning tool. This tool embeds IL training in the online information environment, links online credibility evaluation research with IL practice, employs

scaffolding and metacognitive support for learning, and incorporates interactivity and participatory engagement. One significant contribution of this research is the development of a new pedagogical approach to teach effective online IL skills to today's students through integrating these disparate approaches into a unified design. Thus, this research makes a theoretical contribution to the field of IL research by suggesting that related findings and perspectives from online credibility evaluation research and Computer-Supported Collaborative Learning be synthesized with IL to explore the online information environment experienced by today's students.

The students in this study explained in their own words what they learned from the use of the IC tool with its scaffolding and metacognitive support. Many subjects responded that they had learned that evaluating credibility is complex and involves multiple factors, and that making judgments requires exerting effort. One student stated: "I learned that it's important to take into consideration a lot of factors when evaluating credibility on the web. I came across websites that seemed credible but upon further investigation did not provide legitimate information." Another student said: "I learned that there is a lot that goes into the process of researching sources, and that the process should be systematic involving many steps to narrow down your choices." This awareness of the challenges of online credibility evaluation also extends to a greater awareness and appreciation of critical thinking skills: "You cannot trust everything that is on the web despite how credible it may appear." Some students reported learning the important lesson that they should not rely on thirst results from a Google search: "just because it comes up on Google, doesnt mean its a legitimate and truthful source." Overall, students indicated that credibility evaluation is challenging and requires effort: "It is a lot more difficult than I thought" and "It's not always as straightforward as it seems!" These statements by students demonstrate that they learned important IL concepts from using the IC tool, and that they gained knowledge about credibility evaluation strategies that they can continue to use throughout their academic and professional careers.

This research explored the question of how IL instructors, educators, and instructional designers can help students think critically about online information. Given the easy availability of unreliable and non-credible information on the Internet, it is crucial that we support critical thinking in the online information environment for today's students. IL instruction cannot rely on older models of print-based formats and clearly identifiable exemplars of genres. The new hybrid

genres that are emerging on the Internet require unique approaches to credibility evaluation that are specific to the types of evidence available online. Since traditional gatekeepers and indicators of credibility are often not available in the online environment, IL instruction needs to be customized to support new critical thinking practices. Overcoming students' ingrained tendencies to expect easy results from Web searching, to rely on the first results of a Google search, and to employ only superficial evaluation of credibility, is a key challenge to IL instruction today.

Overall, this research demonstrates that IL instruction needs to address the specific challenges of online credibility evaluation, and that scaffolding and metacognitive support in the form of an online learning tool can effectively integrate IL instruction into the online information environment where students actually do their research.

## 6.8. Future research

There are several possible directions for further research based on the findings of this study. The proposed improvements to the study design discussed in Section 6.6 provide possibilities for interesting future work, for example, capturing detailed log-file data for all three experimental groups to enable greater comparative analysis of potential differences in their searching and evaluation behaviors. In particular, it would be interesting to empirically measure the difference in subject behaviors based on metacognitive prompts. Recording detailed data on the search behaviors, time on task, and patterns of evaluation for all the experimental groups in the study would produce quantifiable data about subject behavior patterns that would allow comparison of metacognitive strategies as a result of different metacognitive interventions. This research could produce valuable insights into the effectiveness of metacognitive supports supported by empirical data.

Another possible direction for future research would be through implementing the design implications discussed in section 6.7. An expanded IC tool that supported greater collaborative commenting and peer-review functionalities would address the current trend of student research behavior in which credibility evaluation is a collaborative rather than an individual effort. One example would be to incorporate the question asking-and-answering

functionality that was originally planned for the IC tool, allowing higher-skilled students (as based on tutorial performance) to answer questions about sources from lower-skilled students through threaded discussions. This social, participatory learning capability would scaffold the interactivity that students are accustomed to in social media with learning opportunities tied directly to the credibility evaluation tasks and integrated into the online learning environment.

Additional avenues for further research would involve exploring the implications for effective IL instruction regarding online sources discussed in section 6.8, particularly focusing on the critically evaluating the hybrid genres of information that currently exist and continue to evolve online. Examples include teaching students strategies for evaluating (1) the credibility of blogs and other hybrid Internet information sources, (2) the quality of "semi-academic" sources such as independent research reports and non-peer reviewed online-only journals, (3) the varied forms of professional expertise that are often invoked online, and (4) the popularity measures of social media that students may interpret as measures of credibility (likes, shares, comments or "buzz").

Building on the implications from this study, further possible future research could involve testing the IC tool with different subject populations in different in different academic environments, such as high school or community college students. These different populations might have different levels of prior IL instruction and levels of experience with searching the Internet, and thus might provide different and potentially greater learning outcomes. Subject populations from different socio-economic statuses other than an elite public university might provide different outcomes. The IC tool could also be implemented in other public information-seeking settings such as public libraries where the emphasis is not on academic research but on personal interests. Studying the use of the IC tool in these environments would likely produce new insights into the online research practices of different populations and approaches to supporting diverse information seeking practices.

The IC tool could also be applied to other types of scaffolded online learning tools in areas other than credibility evaluation, such as collaborative online learning environments like MOOCS or in collaborative research practices in libraries. The IC tool could also be integrated into an existing LMS system such as U-M's CTools or other systems such as Blackboard or Moodle. This type of integration is made possible through employing the Learning Tools Interoperability (LTI) specification. Doing so would make InCredibility instantly implementable

in any UM classroom that uses CTools, and potentially to any other LMS that employs the LTI framework. Integrating the tool into an LMS would make it easily accessible to students through a resource that they already use, and would connect it to the assignments and resources that they already use as part of their class. Since online chat reference with librarians is also available through CTools and other LMS systems, this would provide a complementary resource that also supports academic research at the point it is most useful and relevant to students, when they are doing actual online research for academic assignments.

While the IC tool was designed to be specific to online information sources and credibility evaluation by college students, it could also be modified and extended to other potential use cases and populations. Since identifying and evaluating the types of hybrid genres that are emerging online has proven to be challenging, an IC-like tool could be customized to the process of identifying and evaluating the quality of information sources such as blogs, non-peer reviewed online journals, or "educational" sources such as TV documentaries. The process of evaluating these types of genres would involve learning to identify specific evidence that should be used in evaluating their reliability and credibility, such as what is the purpose of the site, who owns the site, is it commercially motivated, to what degree is there editorial vetting of the site, and what criteria the site has for who can write or post content. A genre-identification tool such as this could help students overcome their natural instinct to accept websites at face value and make simplistic, superficial judgments that are often influenced by visual layout and design. Instead, they would learn how to critically evaluate genre as an important part of understanding and using online information.

Another potential application of the IC tool design would be to identifying the nature of expertise as it is invoked online. Sources such as the Huffington Post, the Discovery channel, and social media blogs present a wide array of contributors as experts, but determining the degree to which these contributors are actual experts in the subject area is challenging. The process of evaluating expertise is more difficult than evaluating credibility, but it could involve searching online to find evidence about the author's background and qualifications, their other writing or posting online, critical evaluations of the authors themselves from other online sources, and even their scholarly output and academic citations. An expertise-identification tool such as this could help students to understand that expertise is complicated and situational, and that they should not

automatically accept claims of expertise that are made online, but use critical thinking about who is an acceptable expert for their information need.

Overall, there is great potential for future research to study the application of IL skills in the online information environment where today's students do their academic research and personal information seeking. Learning effective IL skills is critical to success in today's economy and society, and online learning tools offer a unique opportunity to teach the "skills, knowledge and expertise students should master to succeed in work and life in the 21st century" (Partnership for 21st Century Skills, 2011). The online information environment presents many challenges to IL instruction, but also offers opportunities. Utilizing the affordances of social software tools in online learning presents opportunities to support participatory knowledge creation through networking, socialization, communication and engagement with communities of learning (McLoughlin & Lee, 2008). IL instruction must embrace the practices and skills of today's students and their reliance on the Internet as a primary source of information, and must embrace the new hybrid genres of information and the resulting strategies for effective credibility evaluation. New pedagogical methods are needed to teach these effective online IL skills. This study investigated one potential avenue for online IL pedagogy, and there are many more to explore. Insights gained from this study will be useful for IL instructors, librarians, instructional designers, and researchers interested in promoting online information credibility evaluation skills.

## Appendix 1: Kapoun's five criteria for evaluating Web pages (1998)

| Evaluation of Web documents | How to interpret the basics |
|---|---|
| 1. Accuracy of Web Documents<br>• Who wrote the page and can you contact him or her?<br>• What is the purpose of the document and why was it produced?<br>• Is this person qualified to write this document? | Accuracy<br>• Make sure author provides e-mail or a contact address/phone number.<br>• Know the distinction between author and Webmaster. |
| 2. Authority of Web Documents<br>• Who published the document and is it separate from the "Webmaster?"<br>• Check the domain of the document, what institution publishes this document?<br>• Does the publisher list his or her qualifications? | Authority<br>• What credentials are listed for the authors)?<br>• Where is the document published? Check URL domain. |
| 3. Objectivity of Web Documents<br>• What goals/objectives does this page meet?<br>• How detailed is the information?<br>• What opinions (if any) are expressed by the author? | Objectivity<br>• Determine if page is a mask for advertising; if so information might be biased.<br>• View any Web page as you would an infommercial on television. Ask yourself: why was this written and for whom? |
| 4. Currency of Web Documents<br>• When was it produced?<br>• When was it updated?<br>• How up-to-date are the links (if any)? | Currency<br>• How many dead links are on the page?<br>• Are the links current or updated regularly?<br>• Is the information on the page outdated? |
| 5. Coverage of the Web Documents | Coverage |

- Are the links (if any) evaluated and do they complement the documents' themes?
- Is it all images or a balance of text and images?
- Is the information presented cited correctly?

- If page requires special software to view the information, how much are you missing if you don't have the software?
- Is it free or is there a fee to obtain the information?
- Is there an option for text only, or frames, or a suggested browser for better viewing?

**Putting it all together**

- **Accuracy.** If your page lists the author and institution that published the page and provides a way of contacting him/her and . . .
- **Authority.** If your page lists the author credentials and its domain is preferred (.edu, .gov, .org, or .net), and, . .
- **Objectivity.** If your page provides accurate information with limited advertising and it is objective in presenting the information, and . . .
- **Currency.** If your page is current and updated regularly (as stated on the page) and the links (if any) are also up-to-date, and . . .
- **Coverage.** If you can view the information properly--not limited to fees, browser technology, or software requirement, then . . .

You may have a Web page that could be of value to your research!

FROM: Kapoun, Jim. "Teaching undergrads WEB evaluation: A guide for library instruction." C&RL News (July/August 1998): 522-523.

Converted to HTML by Paul McMillin, September 18, 1998
Minor textual corrections: 10 May 2010 [MOE]

Retrieved from**:** http://olinuris.library.cornell.edu/ref/research/webcrit.html

## Appendix 2: CRAAP Test

**Evaluating Information – Applying the CRAAP Test**
**Meriam Library & California State University, Chico**

When you search for information, you're going to find lots of it . . . but is it good information? You will have to determine that for yourself, and the CRAAP Test can help. The CRAAP Test is a list of questions to help you evaluate the information you find. Different criteria will be more or less important depending on your situation or need.

**Currency**: the timeliness of the information

- When was the information published or posted?
- Has the information been revised or updated?
- Is the information current or out-of date for your topic?
    - Are the links functional? (For the Web)

**Relevance**: the importance of the information for your needs

- Does the information relate to your topic or answer your question?
- Who is the intended audience?
- Is the information at an appropriate level (i.e. not too elementary or advanced for your needs)?
- Have you looked at a variety of sources before determining this is one you will use?
- Would you be comfortable using this source for a research paper?

**Authority**: the source of the information

- Who is the author/publisher/source/sponsor?
- Are the author's credentials or organizational affiliations given?
- What are the author's credentials or organizational affiliations given?
- What are the author's qualifications to write on the topic?
- Is there contact information, such as a publisher or e-mail address?
- Does the URL reveal anything about the author or source?
    - examples: .com (commercial), .edu (educational), .gov (U.S. government), .org (nonprofit organization), or .net (network) (For the Web)

**Accuracy**: the reliability, truthfulness, and correctness of the content, and

- Where does the information come from?

- Is the information supported by evidence?
- Has the information been reviewed or refereed?
- Can you verify any of the information in another source or from personal knowledge?
- Does the language or tone seem biased and free of emotion?
- Are there spelling, grammar, or other typographical errors?

**Purpose**: the reason the information exists

- What is the purpose of the information? to inform? teach? sell? entertain? persuade?
- Do the authors/sponsors make their intentions or purpose clear?
- Is the information fact? opinion? propaganda?
- Does the point of view appear objective and impartial?
- Are there political, ideological, cultural, religious, institutional, or personal biases?

Retrieved from: http://www.csuchico.edu/lins/handouts/eval_websites.pdf

## Appendix 3: Kathy Schrock's 5Ws

**THE FIVE W'S OF WEB SITE EVALUATION**

**WHO**

**Who** wrote the pages and are they an expert? Is a biography of the author included? How can I find out more about the author?

**WHAT**

**What** does the author say is the purpose of the site? What else might the author have in mind for the site? What makes the site easy to use? What information is included and does this information differ from other sites?

**WHEN**

**When** was the site created? When was the site last updated?

**WHERE**

**Where** does the information come from? Where can I look to find out more about the sponsor of the site?

**WHY**

**Why** is this information useful for my purpose? Why should I use this information? Why is this page better than another?



Retrieved from: http://kathyschrock.net/abceval/5ws.htm

## Appendix 4: University of Michigan Library 5Ws

### University of Michigan
### Evaluating Information on the Web

The 5 Ws – Who, What, Where, When, and Why

| Criteria | What to Look for |
|---|---|
| Who?<br><br>Who wrote the information? What are the author's credentials? Who sponsors/publishes the site? Can I learn more about the sponsor of the site? | Author's name, credentials, a biography and resume; phone or mailing address or means to contact the author (not just email); Look at the URL (.com, .edu, etc), and an "About" page |
| What?<br><br>What information in presented? What is the purpose of the site? Is the information objective, complete? | An "About/Purpose" section to see the author's stated purpose of the page; is the information presented objectively, can you detect any bias? Find out if other web sites refer to this site. |
| Where?<br><br>Where does the information come from? Are there links to reliable external web sites? Can I verify the source of the information? | Bibliographies, notes, or references; verify that links go to credible web sites. You should be able confirm info you find elsewhere too. |
| When?<br><br>Is the information presented actually current for the topic at hand? Has it been updated recently? | Last updated dates; whether the information presented seems outdated compared to other sources. |
| Why?<br><br>Why would you use this information over other information available? Does it fit your research goals? | Articulate what makes it better than other sources of information on the web for your purposes |

| | |
|---|---|

Based on Kathy Schrock's 5 Five Ws of Web Site Evaluation http://kathyschrock.net/abceval/5ws.htm

Retrieved from: http://www.lib.umich.edu/shapiro-undergraduate-library/diy-toolkit-modules-teaching-research-concepts#Module_Four

## Appendix 5: Prototype Tutorial Questions, Tips and Answers

The tutorial page shows a static screenshot of a page. A question displays at the top of the screen. Each question begins "Look for clues about (question) and click on the evidence." Clicking on the correct area shows a highlight around the answer and displays "Right!" and the answer. A "Tip" button shows a popup box with the first tip. Clicking on a wrong area shows a popup box with "Try again" and the second tip. Clicking on a second wrong area shows the answer.

| Question | Tip #1 | Tip#2 ("Try again.") | Answer ("Right!") |
|---|---|---|---|
| WHO wrote this information? | Is an author's name listed? Is there information about the author's expertise? | Look for an author's name or biography. If the author is not named, is there an editor or group name? | Always look for author's name, qualifications, and/or biography. Decide if they are qualified to publish this information. |
| WHAT kind of information is it? | What topics does this source cover? Is the information useful for your research? | Look for words and topics in the text that relate to your topic. Is the information useful? | Always look for specific facts, keywords or tags that relate to your topic. Decide what makes this source better than other sources for your question. |
| WHERE does this information come from? | Who hosts or publishes the site? Is there contact info for the host or publisher? | Look for the URL domain name (.com, .edu, .org). Is there a "Contact" link? Are there links to credible sources? | Always look for the URL domain name that tells whether the site is commercial, educational or non-profit. Decide if the source is reliable for your topic. |
| WHEN was information written? | Is the information presented current? Has it been updated recently? | Look for a date when the information was posted or updated. Are there references in the text to current events? | Always look for dates at the top of an article or at the very bottom of the page. Decide how important having current is information to your topic. |

| | | | |
|---|---|---|---|
| WHY was this information written? | What is the purpose of the site? Is there evidence of bias? | Look for an “About” link. Do any statements seem to be opinion? Does it seem objective or biased? Is there advertising related to the content? | Always look for an “About” section that describes the site’s purpose. Look for evidence of objectivity or possible bias. Decide if advertising might influence the content. |

## Appendix 6: Pilot study metacognition test results

Response options and numerical values:

Strongly Disagree = 1
Disagree = 2
Neither Agree nor Disagree = 3
Agree = 4
Strongly Agree = 5

| Question | SD | D | NAD | A | SA | Mean |
|---|---|---|---|---|---|---|
| I learn more information when I am interested in the topic | 1 | 0 | 1 | 13 | 40 | 4.65 |
| I try to use strategies that have worked well in the past | 0 | 1 | 1 | 19 | 34 | 4.56 |
| I think about what I really need to evaluate before I begin | 0 | 3 | 11 | 27 | 13 | 3.93 |
| I consciously focus my attention on important information | 0 | 3 | 12 | 30 | 10 | 3.85 |
| I ask others for help when I don't understand something | 2 | 7 | 6 | 23 | 17 | 3.84 |
| I try to translate new information into my own words | 0 | 7 | 10 | 23 | 15 | 3.84 |
| I ask myself questions about the subject before I begin | 1 | 6 | 9 | 29 | 10 | 3.75 |
| I can motivate myself to learn when I need to | 1 | 7 | 10 | 24 | 13 | 3.75 |
| I ask myself periodically if I am meeting my goals | 0 | 6 | 9 | 34 | 6 | 3.73 |
| I am a good judge of how well I understand something | 0 | 7 | 9 | 31 | 8 | 3.73 |
| I ask myself how well I accomplished my goals once I'm finished | 1 | 6 | 11 | 28 | 9 | 3.69 |
| I know what kind of information is most important to evaluate | 0 | 4 | 15 | 31 | 5 | 3.67 |
| I am good at organizing information | 2 | 6 | 12 | 23 | 12 | 3.67 |
| I focus on the meaning and significance of new information | 1 | 3 | 12 | 36 | 3 | 3.67 |
| I ask myself if there was an easier way to do things after I finish | 0 | 8 | 15 | 22 | 10 | 3.62 |
| I consider several alternatives strategies before I begin | 0 | 8 | 11 | 31 | 5 | 3.6 |
| I find myself using helpful strategies automatically | 0 | 8 | 15 | 27 | 5 | 3.53 |
| I find myself pausing regularly to check my comprehension | 0 | 9 | 15 | 24 | 7 | 3.53 |
| I organize my time to best accomplish my goals | 3 | 9 | 13 | 18 | 12 | 3.49 |
| I find myself analyzing the usefulness of strategies | 2 | 9 | 13 | 23 | 8 | 3.47 |
| I ask myself questions about how well I am doing while I'm evaluating | 1 | 9 | 13 | 27 | 5 | 3.47 |
| I am good at remembering information | 1 | 10 | 13 | 25 | 6 | 3.45 |

| | | | | | | |
|---|---|---|---|---|---|---|
| I periodically review information to help me evaluate important criteria | 2 | 7 | 15 | 27 | 4 | 3.44 |
| I ask myself if I have considered all the options while I'm evaluating | 1 | 11 | 14 | 23 | 6 | 3.4 |
| I have a specific purpose for each strategy I use | 0 | 10 | 16 | 26 | 3 | 3.4 |
| I think of several strategies and choose the best one | 0 | 14 | 13 | 22 | 6 | 3.36 |
| I know how well I did after I finish | 0 | 15 | 11 | 26 | 3 | 3.31 |
| I ask myself if I have considered all options after I finish | 2 | 14 | 16 | 19 | 4 | 3.16 |
| I know when each strategy I use will be most effective | 1 | 16 | 17 | 20 | 1 | 3.07 |
| I ask myself if I have learned as much as I could have once I finish | 4 | 16 | 15 | 17 | 3 | 2.98 |

## Appendix 7: Online Form for Control Groups

This online form was used by the Control Group subjects. It provides the same credibility questions and criteria as the Notebook, without the prompts and tips.

| **PART ONE** |
| --- |
| Enter the URL of the website: |
| Who is/are the author(s)?<br>What are the author's qualifications?<br>What can you find out about their background? |
| What are the main topics?<br>What type of site is it? (commercial/educational/governmental/news/opinion/scholarly)<br>How useful is this information for your topic? (A little/Somewhat/Very) |
| Where is this site hosted or published?<br>What is the site's domain name? (.com, .edu, .gov)<br>Are there links to supporting evidence? |
| When was this webpage published or copyrighted?<br>Has it been updated?<br>How important is having current information for your topic? (A little/Somewhat/Very) |
| Why do you think this site was created? (to educate/inform/ persuade/sell)<br>Do you see evidence of bias? (Yes/No/Not sure)<br>If yes, what is the evidence? |

This section provides the conceptual scaffolding used in the tool.

| **PART TWO** |
| --- |
| The questions you've been asking about your sources are very important. Clues about "Who, What, Where, When, and Why" answer questions which experts call Authority, |

| |
|---|
| Relevance. Reliability, Currency, and Purpose |
| Clues about WHO wrote this information tell you about AUTHORITY, or if the author is qualified to write about the topic |
| Clues about WHAT kind of information it is tell you about RELEVANCE, or if the information is useful for your topic |
| Clues about WHERE this information comes from tells you about RELIABILITY, or if the information is trustworthy |
| Clues about WHEN this information was written tells you about CURRENCY, or if information is current, and whether currency is important |
| Clues about WHY this information was written tells you about PURPOSE, or if the site shows bias that may influence the information |

This section provides the reflective prompts used in the tool.

| **PART THREE** |
|---|
| Looking back on the process of evaluating the credibility of online information.... |
| 1. How did you decide whether a webpage was credible or not? |
| 2. What specific criteria did you use to help you evaluate credibility? |
| 3. What strategies did you use to evaluate credibility? |
| 4. How confident were you in your evaluations of credibility? |
| 5. What have you learned about evaluating credibility on the web? |

## Appendix 8: Schraw and Dennison Metacognitive Awareness Inventory (1994)

Knowledge of Cognition

- Declarative knowledge (DK)
- Procedural knowledge (PC)
- Conditional knowledge (CK)

Regulation of Cognition

- Planning (P)
- Information management skills (IMS)
- Monitoring (M)
- Debugging strategies (DS)
- Evaluation (E)

| |
|---|
| I ask myself periodically if I am meeting my goals. (M) |
| I consider several alternative to a problem before I answer. (M) |
| I try to use strategies that have worked in the past. (PK) |
| I pace myself while learning in order to have enough time. (P) |
| I understand my intellectual strengths and weaknesses. (DK) |
| I think about what I really need to learn before I begin a task. (P) |
| I know how well I did once I finish a test. (E) |
| I set specific goals before I begin a task. (P) |
| I slow down when I encounter important information. (IMS) |
| I know what kind of information is most important to learn. (DK) |
| I ask myself if I have considered all options when solving a problem. (M) |
| I am good at organizing information. (DK) |
| I consciously focus my attention on important information. (IMS) |
| I have a specific purpose for each strategy I use. (PK) |
| I learn best when I know something about the topic. (CK) |
| I know what the teacher expects me to learn. (DK) |
| I am good at remembering information. (DK) |
| I use different learning strategies depending on the situation. (CK) |
| I ask myself if there was an easier way to do things after I finish a task. (E) |
| I have control over how well I learn. (DK) |
| I periodically review to help me understand important relationships. (M) |
| I ask myself questions about the material before I begin. (P) |
| I think of several ways to solve a problem and choose the best one. (P) |
| I summarize what I've learned after I finish. (E) |
| I ask others for help when I don't understand something. (DS) |

| |
|---|
| I can motivate myself to learn when I need to. (CK) |
| I am aware of what strategies I use when I study. (PK) |
| I find myself analyzing the usefulness of strategies while I study. (M) |
| I use my intellectual strength to compensate for my weaknesses. (CK) |
| I focus on the meaning and significance of new information. (IMS) |
| I create my own examples to make information more meaningful. (IMS) |
| I am a good judge of how well I understand something. (DK) |
| I find myself using helpful learning strategies automatically. (PK) |
| I find myself pausing regularly to check my comprehension. (M) |
| I know when each strategy I use will be most effective. (CK) |
| I ask myself how well I accomplished my goals once I'm finished. (E) |
| I draw pictures or diagrams to help me understand while learning. (IMS) |
| I ask myself if I have considered all options after I solve a problem. (E) |
| I try to translate new information into my own words. (IMS) |
| I change strategies when I fail to understand. (DS) |
| I use the organizational structure of the text to help me learn. (?) |
| I read instructions carefully before I begin a task. (P) |
| I ask myself if what I'm reading is related to what I already know. (IMS) |
| I reevaluate my assumptions when I get confused. (DS) |
| I organize my time to best accomplish my goals. (P) |
| I learn more when I am interested in the topic. (DK) |
| I try to break studying down into smaller steps. (IMS) |
| I focus on overall meaning rather than specifics. (IMS) |
| I ask myself questions about how well I am doing while learning something new. (M) |
| I ask myself if I have learned as much as I could have once I finish a task. (E) |
| I stop and go back over new information that is not clear. (DS) |
| I stop and reread when I get confused. (DS) |

## Appendix 9: Raes et al. adapted Metacognitive Awareness Inventory (2012)

(Adapted from Schraw & Dennison, 1994)
(NOTE: The complete inventory of questions was provided courtesy of Annelies Raes (translated from Dutch)

| |
|---|
| **Knowledge of cognition** |
| I try to use strategies that have worked in the past when searching the Internet for information |
| I am good at organizing the information I find on the Internet. |
| I know what kind of information is most important to find |
| I have a specific purpose for each strategy I use when searching for information on the Internet |
| I am good at remembering the information I found on the Internet |
| I can motivate myself to understand information I find on the Internet when I need to |
| I am a good judge of how well I understand the information that I find on the Internet |
| I find myself automatically using helpful strategies to find information on the Internet |
| I know when each strategy I use for finding information on the Internet will be most effective |
| I understand the information I find on the Internet better if I am interested in the topic (I learn more if I am interested in the topic) |
| I use different learning strategies depending on the situation |
| I am aware of what strategies I use when I study |
| **Regulation of cognition** |
| I ask myself questions about the subject before I begin searching for information on the Internet |
| I think about what information I really need to find before I begin searching on the Internet |
| I think of several ways to find information on the Internet and choose the best one |
| I organize my time to best accomplish finding good information |
| I find myself analyzing the effectiveness of my searching strategies |
| I compare information from different Websites before I choose one |
| I periodically review to help me understand information I find online |
| I ask myself periodically if I am finding the best information |
| I ask myself questions about how well I am doing while searching for information on the Internet. |
| I ask myself how well I accomplished my goals (answered my research question?) once I finish searching the Internet |
| I ask myself if I have considered all options when searching for information |
| I find myself pausing regularly to check my comprehension when searching on the Internet |
| I know how well I did at finding information once I am done searching the Internet |
| I ask myself if there was a better way to find information after I finish searching the Internet |
| I ask myself if I have considered all options after I finish searching the Internet |

I ask myself if I found as much information as I could once I finish searching

# Appendix 10: Demographics Chi Square Tests

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Group * Year | 82 | 100.0% | 0 | 0.0% | 82 | 100.0% |

**Group * Year Crosstabulation**

Count

| | | Year | | | | Total |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | |
| Group | CTRL | 7 | 10 | 4 | 3 | 24 |
| | T1 | 9 | 12 | 6 | 6 | 33 |
| | T2 | 7 | 11 | 3 | 4 | 25 |
| Total | | 23 | 33 | 13 | 13 | 82 |

**Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | .881[a] | 6 | .990 |
| Likelihood Ratio | .907 | 6 | .989 |
| N of Valid Cases | 82 | | |

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Group * Gender | 82 | 100.0% | 0 | 0.0% | 82 | 100.0% |

**Group * Gender Crosstabulation**

Count

| | | Gender | | Total |
|---|---|---|---|---|
| | | 1 | 2 | |
| Group | CTRL | 11 | 13 | 24 |
| | T1 | 16 | 17 | 33 |
| | T2 | 19 | 6 | 25 |
| Total | | 46 | 36 | 82 |

**Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | 5.824[a] | 2 | .054 |
| Likelihood Ratio | 6.078 | 2 | .048 |
| N of Valid Cases | 82 | | |

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Group * Experience | 82 | 100.0% | 0 | 0.0% | 82 | 100.0% |

**Group * Experience Crosstabulation**

Count

| | | Experience | | | Total |
|---|---|---|---|---|---|
| | | 2 | 3 | 4 | |
| Group | CTRL | 3 | 13 | 8 | 24 |
| | T1 | 4 | 16 | 13 | 33 |
| | T2 | 4 | 12 | 9 | 25 |
| Total | | 11 | 41 | 30 | 82 |

**Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | .442[a] | 4 | .979 |
| Likelihood Ratio | .435 | 4 | .980 |
| N of Valid Cases | 82 | | |

**Case Processing Summary**

| | Cases | | | | | |
|---|---|---|---|---|---|---|
| | Valid | | Missing | | Total | |
| | N | Percent | N | Percent | N | Percent |
| Group * PriorIL | 82 | 100.0% | 0 | 0.0% | 82 | 100.0% |

**Group * PriorIL Crosstabulation**

Count

| | | PriorIL | | Total |
|---|---|---|---|---|
| | | 1 | 2 | |
| Group | CTRL | 14 | 10 | 24 |
| | T1 | 18 | 15 | 33 |
| | T2 | 14 | 11 | 25 |
| Total | | 46 | 36 | 82 |

**Chi-Square Tests**

| | Value | df | Asymp. Sig. (2-sided) |
|---|---|---|---|
| Pearson Chi-Square | .081[a] | 2 | .960 |
| Likelihood Ratio | .081 | 2 | .960 |
| N of Valid Cases | 82 | | |

# Appendix 11: RQ1 Chi Square Tests

**Descriptives**

Score

| | N | Mean | Std. Deviation | Std. Error | 95% Confidence Interval for Mean | | Minimum | Maximum |
|---|---|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound | | |
| 1 | 33 | 1.2288 | .32429 | .05645 | 1.1138 | 1.3438 | .25 | 1.70 |
| 2 | 25 | 1.0252 | .21323 | .04265 | .9372 | 1.1132 | .62 | 1.33 |
| 3 | 24 | .9963 | .34211 | .06983 | .8518 | 1.1407 | .38 | 1.57 |
| Total | 82 | 1.0987 | .31611 | .03491 | 1.0292 | 1.1681 | .25 | 1.70 |

**ANOVA**

Score

| | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|
| Between Groups | .945 | 2 | .473 | 5.224 | .007 |
| Within Groups | 7.148 | 79 | .090 | | |
| Total | 8.094 | 81 | | | |

**Post Hoc Tests**

**Multiple Comparisons**

Dependent Variable: Score

Tukey HSD

| (I) Group | (J) Group | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| 1 | 2 | .20359* | .07976 | .033 | .0131 | .3941 |
| | 3 | .23254* | .08070 | .014 | .0398 | .4253 |
| 2 | 1 | -.20359* | .07976 | .033 | -.3941 | -.0131 |
| | 3 | .02895 | .08596 | .939 | -.1764 | .2343 |
| 3 | 1 | -.23254* | .08070 | .014 | -.4253 | -.0398 |
| | 2 | -.02895 | .08596 | .939 | -.2343 | .1764 |

*. The mean difference is significant at the 0.05 level.

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