

# Assessing Change In High School Student Information Literacy Using The Tool For Real-Time Assessment Of Information Literacy Skills

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## ABSTRACT

*Change in high school student information literacy (IL) knowledge and skills, from freshman year to senior year in high school was the focus of this quasi-experimental research project. Researchers used a free information literacy skills assessment tool entitled TRAILS (Tool for Real-time Assessment of Information Literacy Skills) to measure student IL skills. A total of 201 high school students participated in the study. Paired samples t-test results were mixed for specific TRAILS sub-categories, however, the senior mean for the total TRAILS assessment was significantly higher than the mean the participants earned on the total TRAILS assessment when they were freshman. Cohen's d effect size was 0.61. The significance of the information literacy curriculum is discussed in light of these findings.*

**Keywords:** Tool for Real-time Assessment of Information Literacy Skills; High School Student Information Literacy; Information Literacy Curriculum

## INTRODUCTION

A common factor in technology integration at all levels of education is the use of the Internet to acquire and use information. Whether the use of the Internet is limited to a Google search, or encompasses other strategies such as using online research databases, information literacy skills are critical for effective and efficient use of technology for learning. Thus, the growing importance of information literacy (IL) means educators need to understand the extent of information literacy skills that high school seniors possess as these students finish high school and plan to attend college or enter the work force. In addition, it is important for educators to understand how information literacy skills change throughout high school and why those changes occur.

Currently, little empirical research is available on the growth of IL skills throughout students' K-12 education (Latham & Gross, 2008; Maughan, 2001). One reason for the lack of research may be that few IL assessment tools were readily available until relatively recently. In addition, the inherent complexity of assessing IL skills (see, for example, Farmer, 2007) may make longitudinal assessment of the same set of students at different grade levels difficult. The researchers addressed this gap in the literature by investigating a group of students from one high school whose IL skills were assessed as they entered high school in 2006 and again as they completed high school in 2010.

Information literacy is defined in multiple ways. For this study, the definition of an information literate person provided by the Association of College and Research Libraries (ACRL) was used. In a White Paper released in 1989, ACRL identified an information literate person as one who is able to "recognize when information is needed" and who has "the ability to locate, evaluate, and use effectively the needed information" (Association of

College and Research Libraries, 1989, para. 3). Within the context of this definition, the researchers investigated change in the knowledge and skills of high school students in the area of information literacy, from when they were freshmen to when they were seniors. Researchers used a free information literacy skills assessment tool developed by Kent State University librarians entitled TRAILS (Tool for Real-time Assessment of Information Literacy Skills, <http://www.trails-9.org/>) to measure student IL skills. Currently, four TRAILS assessment instruments are available; TRAILS-3, TRAILS-6, TRAILS-9, and TRAILS-12, for third, sixth, ninth, and twelfth grade students, respectively. The researchers focused on differences in TRAILS results for one group of students who took both TRAILS-9 and TRAILS-12.

The particular group of high school seniors who participated in the study completed the TRAILS-9 online assessment in their freshman year of high school and completed the beta version of the TRAILS-12 online assessment during their senior year. This is a unique set of students because they may be one of the first and only groups of students across the nation who completed both TRAILS-9 and TRAILS-12 assessments because TRAILS-9 only became available in 2006 following two years of development and testing. Thus, 2010 was the first year the same set of students who completed TRAILS as freshmen (in 2006) were able to complete TRAILS as seniors (in 2010) allowing the two sets of scores to be analyzed from a longitudinal perspective.

### **RESEARCH QUESTIONS**

To investigate the change in information literacy knowledge and skills between freshmen and seniors in high school within the context of the information literacy curriculum, three research questions formed the basis of this research project:

- a) What is the level of information literacy skills for participants in this study when they were freshmen in high school as measured by TRAILS?
- b) What is the level of information literacy skills for participants in this study when they were high school seniors as measured by TRAILS?
- c) How do information literacy skills of participants as freshmen high school students compare to information literacy skills of the same participants as senior high school students as measured by TRAILS?

### **LITERATURE REVIEW**

In today's information-rich environment, students at all levels of the educational spectrum need information literacy (IL) skills. Students as young as kindergartners are exposed to information literacy skills through curriculum standards that specify the need for students to be able to ask questions about their areas of interest, use a variety of resources to gather information, and be able to share what they have learned (Todd & Kulthau, 2004). As each student progresses through elementary, middle, and high school, their exposure to and use of information literacy skills develop and grow; however, many graduating high school seniors may not have the information literacy skills they need to be successful in higher education (Burhanna & Jensen, 2006; Caspers & Bernhisel, 2005; Kolowich, 2011; O'Sullivan & Dallas, 2010; Seymour, 2007). While many high school students profess to be confident in at least some aspects of information literacy (Herring, 2009; Latham & Gross, 2008), in reality, when their IL skills are tested or otherwise assessed in college, the majority receive poor or failing scores (Maughan, 2001) or show deficits in their IL skills (Kolowich, 2011; Latham & Gross, 2008).

An interesting finding is that while many K-12 school districts have addressed library and information literacy curriculum standards through instruction and projects, many students indicate they are self-taught (Casters & Bernhisel, 2006; Latham & Gross, 2008) and often teachers at both K-12 and higher education institutions assume that because most students are proficient with technology and Internet searching, these students do not need formal IL instruction (Allen, 2007; Kolowich, 2011). Investigating information literacy instruction from the perspective of teachers, Probert (2009) found that not only did teachers have different understandings of the concept of information literacy, but some teachers indicated they did not explicitly teach information skills because they thought the research process was taught in other subjects and thus IL was not their responsibility. Similarly, Williams and Wavell (2007) found that teachers tended to view information literacy as a separate subject and as a consequence did little to incorporate IL skills and knowledge into the content areas they taught. While some teachers may lack IL

knowledge, it is promising that many teachers appear eager to learn more about information literacy in order to help their students develop and refine their IL skills (Probert, 2009).

Head and Eisenbert (2009) in a national research study called *Project Information Literacy* found that once students get to college, many consistently used “a small set of common information sources” (p. 3) and followed a research strategy “learned by rote” (p. 34), leading to a lack of deep learning and critical thinking. And while many librarians in both K-12 and higher education try to help students understand and use research resources efficiently and effectively, Hight (2010) reminded educators that today’s students have little to no experience with traditional organizational schemes and approaches to finding information, such as using subject headings. As a result, students may tend to approach research in a more random and personalized manner. In fact, it is not surprising that many students use Google or a similar search engine as a first step in any research process (Herring, 2009; O’Sullivan & Dallas, 2010). Understanding the research process from the perspective of high school students, as investigated by Kuhlthau (2004), may provide additional insight into student information literacy skills.

In Kuhlthau’s extensive work on the information seeking process by high school and college students, she identified and verified a model of the information search process that incorporates affective, cognitive, and physical aspects. The model includes six stages; task initiation, topic selection, prefocus exploration, focus formulation, information collection, and search closure. Each stage incorporates tasks, thoughts, feelings, actions, strategies, and mood. An example of a *task* in the first stage of task initiation is when a student first receives an assignment and realizes information is needed to complete it. When students move to stage two, topic selection, weighing different topic possibilities is an example of a *thought*. As students begin to identify a particular focus during stage three, they may feel confused or uncertain, examples of *feelings*. In stage four, focus formulation, one type of *action* is the process of reading notes taken on resources to help the student determine a specific focus. Stage five, information collection, is the process of gathering and evaluating information relevant to the focus. A *strategy* in this stage includes comprehensive searches for multiple types of resources. In the last stage, search closure, the *mood* is primarily indicative, defined by Kuhlthau as one leading to closure. Informed by Kuhlthau’s work, the researchers investigated the growth and development of information literacy skills among a particular group of high school students.

## **DESCRIPTION OF THE SCHOOL**

The high school that participants attended is a four-year comprehensive high school in an upper-middle class, suburban community located northwest of Columbus, Ohio. In 2010, the high school enrolled 1,925 students and graduated a class of 492. The school is fully accredited by the Ohio Department of Education. With 162 certificated/licensed professional staff, the high school was selected as an outstanding high school by the U.S. Department of Education in its Secondary School Program and is rated as “Excellent” (the highest designation) by the Ohio Department of Education.

## **DESCRIPTION OF THE STUDENTS**

The class of 2010 had 18 National Merit Semi-finalists and 17 Commended Scholars. The average ACT composite score for the class of 2010 was 25.7; the mean SAT score on the 1600 scale was 1175. Seventeen Advanced Placement courses are offered. In May 2010, a total of 885 Advanced Placement exams were taken with 84% of all tests taken receiving a score of 3 or higher. During the 2009-2010 school year, a total of 15 Standard Level (SL) and 14 Higher Level courses were offered as part of the International Baccalaureate (IB) Programme. In May 2010, 353 students took 590 IB exams in one or more of the 22 testing areas. Seventy-nine percent of the 389 SL tests taken received a score of 3 or higher. Two-hundred Higher Level tests were taken during the same time period with 96% of the tests taken receiving a score of 3 or higher. Twenty-four seniors received an IB Diploma in 2010, the year of the study.

## **METHODOLOGY**

The research project was a joint effort between the school librarians at a large upper-middle class suburban high school located northwest of Columbus, Ohio and a university faculty member from a large Midwestern

university. The university's Human Subjects Review Board and the school district's administration approved the study. Participants in this research study were high school seniors. On a pre-scheduled school day the researchers visited each senior language arts class and the university faculty member explained the study and what participation in the study would entail. Following this overview, students were asked to sign a consent form if they were willing to participate. For the study, students were asked to allow researchers to access their scores on the TRAILS assessments they took as ninth and twelfth graders. Seniors who were not yet 18 years of age also were asked to obtain their parents' permission in order to participate.

The assessment instrument used for the study was TRAILS (Tool for Real-time Assessment of Information Literacy Skills), a "freely available online tool designed to measure the information literacy skills of high school students. The assessment tool was" developed as part of the Institute of Library and Information Literacy Education (ILILE) ([www.ilile.org](http://www.ilile.org)), a federally-funded initiative through the Institute of Museum and Library Services (IMLS) and the U.S. Department of Education (Schloman & Gedeon, 2007). Based on information literacy skills from the Ohio academic standards, TRAILS consists of 30 items covering five sub-categories; "...develop topic; identify potential sources; develop, use, and revise search strategies; evaluate sources and information; recognize how to use information responsibly, ethically, and legally" (Schloman & Gedeon, 2007, p. 45). The TRAILS assessment consists of six questions in each of the five sub-categories. An example of a TRAILS question provided by Scholman and Gedeon (2007, p. 47) is for the category *develop, use, and revise search strategies*:

If you were using the Internet or a database, which of the following search phrases would find information on "hurricanes" in Florida? CHOOSE ONE ANSWER.

- Hurricanes not Florida
- Hurricanes and Florida
- Hurricanes or Florida
- Hurricanes but Florida

While in ninth grade, participants in this study completed the TRAILS-9 assessment. Because TRAILS-9 is an online assessment, students took it in the school library's computer lab. Each student was given a URL with a unique student code that enabled access to TRAILS. Students worked at their own pace with most completing the assessment within 20 minutes. During each administration, each student was asked to write his/her name on the Student Code form. The Student Code forms were collected by the school librarians as each student finished.

During the first term of the first quarter of 2009, 12th grade students in World Composition and Literature were given a beta version of TRAILS-12. As with TRAILS-9, each student was given a URL with a unique student code that enabled access to TRAILS. Students worked at their own pace with most completing the assessment in 20 minutes. Students took the beta version of TRAILS-12 in the school library's computer lab. During the administration of the assessment, each student was asked to write his/her name on the Student Code form. The Student Code forms were collected by the school librarians as each student finished.

Once TRAILS assessments were completed, results were available to the school librarians in a secure area of the TRAILS website. To access these results, the school librarians logged in with unique usernames and passwords. The students' scores appeared under the name of their respective teacher. Each of these class-based sessions were created previously by the school librarian (e.g., Smith Period 1 2006). In TRAILS, the student code and the respective scores are arrayed in a spreadsheet format. With the Student Code forms that were collected at the end of each administration of the assessment, the school librarian entered the name of the student next to his/her code in the spreadsheet. These scores were then entered into and stored in a secure database.

Initially, a total of 289 students agreed to participate in the study. The school librarians accessed scores from the administration of TRAILS-9 and beta TRAILS-12 and matched individual student scores from the Version Two of TRAILS-9 to results from TRAILS-12. Out of the 289 participants in the study, 201 matched pairs of scores were obtained. The difference between the number of initial participants in the study and the number of matched pairs is attributable to a number of factors including students who moved to or from the district over the four years from 2006 to 2010, or students who may have been absent on the days either of the TRAILS assessments were administered. Scores from TRAILS assessments serve as the dependent variables in this study.

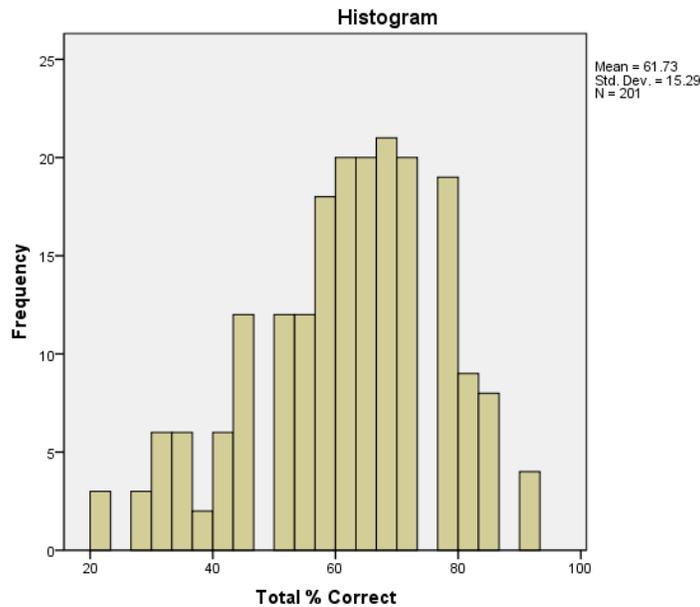
**RESULTS**

Student scores on the TRAILS assessment are returned as percentages. Because the TRAILS-9 assessment questions vary from the specific questions on the TRAILS-12 assessment, comparing percentages allowed the researchers to compare results. Normality was assessed by examining histograms on the dependent variable for 9<sup>th</sup> and 12<sup>th</sup> graders. The distributions were approximately normally distributed although slightly negatively skewed (see Tables 1 and 2).

**Table 1. Histogram of Test of Normality for TRAILS-9 assessment results**  
**Tests of Normality**

	Kolmogorov-Smirnov <sup>a</sup>			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Total % Correct	.109	201	.000	.969	201	.000
Total % Correct_A	.061	201	.070	.987	201	.064

a. Lilliefors Significance Correction

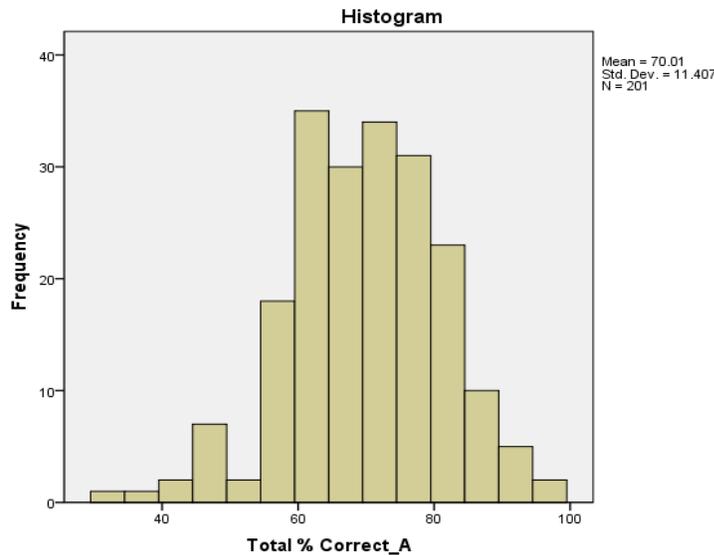


**What is the level of information literacy skills for participants in this study when they were freshmen in high school as measured by TRAILS?**

As freshmen, study participants scored just over 60% ( $M=61.73$ ,  $SD=15.290$ ,  $n=201$ ) on the TRAILS-9 assessment. Scores ranged from a low of 23 to a high of 92.

Examining means for each sub-category, the lowest mean for freshmen occurred in the sub-category of *Develop Topic* ( $M=50.78$ ,  $SD=25.733$ ). For the sub-category of *Identify Potential Sources* the freshman mean was close to 65% ( $M=64.62$ ,  $SD= 25.162$ ) while the highest mean for freshman was in the sub-category of *Develop, Use, and Revise Search Strategies* ( $M=71.86$ ,  $SD=21.793$ ). In the sub-category of *Evaluate Sources and Information*, the freshmen mean was 57.55, with a standard deviation of 19.243. The freshmen mean in the fifth sub-category of *Recognize How to Use Information Responsibly, Ethically, and Legally* was almost 63% ( $M=62.99$ ,  $SD=21.796$ ).

Table 2. Histogram of Test of Normality for TRAILS-12 assessment results



### What is the level of information literacy skills for participants in this study when they were high school seniors as measured by TRAILS?

As seniors, study participants scored just over 70% ( $M=70.01$ ,  $SD=11.41-07$ ,  $n=201$ ) on the TRAILS-12 assessment. Scores ranged from a low of 32 to a high of 100.

For the five sub-categories, the lowest mean scores were in *Evaluate Sources and Information* ( $M=47.47$ ,  $SD=18.448$ ) and *Develop Topic* ( $M=54.57$ ,  $SD=26.377$ ). The highest mean scores were in *Recognize How to Use Information Responsibly, Ethically, and Legally* ( $M=73.51$ ,  $SD=22.145$ ) and *Identify Potential Sources* ( $M=75.64$ ,  $SD=17.306$ ). The remaining sub-category of *Develop, Use, and Revise Search Strategies* had a mean of just over 65% ( $M=65.97$ ,  $SD=17.713$ ).

### How do information literacy skills of participants as freshmen high school students compare to information literacy skills of the same participants as senior high school students as measured by TRAILS?

A paired sample t-test was used to compare student percentages from the freshman administration of TRAILS-9 to the senior administration of TRAILS-12. Significant differences were found between the means of the total score and in four of the five sub-categories. The mean significantly increased between the freshman mean ( $M=61.73$ ,  $SD=15.290$ ) and the senior mean ( $M=70.01$ ,  $SD=11.407$ ) in the total score ( $t(201)=-6.943$ ,  $p<.001$ ,  $df=200$ ) and in two of the five sub-categories. The two sub-categories with significant increases were *Identify Potential Sources* ( $t(201)=-5.351$ ,  $p<.001$ ,  $df=200$ ); and *Recognize How to Use Information Responsibly, Ethically, and Legally* ( $t(201)=-5.329$ ,  $p<.001$ ,  $df=200$ ). For total scores, Cohen's effect size value ( $d=0.61$ ) suggests a moderate to high practical significance. A moderate practical significance is indicated by Cohen's effect size value ( $d=0.51$  for *Identify Potential Sources*. Cohen's effect size value ( $d=0.48$ ) indicates a moderate practical significance for the sub-category *Recognize How to Use Information Responsibly, Ethically, and Legally*.

In two of the sub-categories, *Develop, Use, and Revise Search Strategies* and *Evaluate Sources and Information*, the senior mean was significantly lower than the freshman mean. For *Develop, Use, and Revise Search Strategies*, a significant difference between freshmen mean ( $M=71.86$ ,  $SD=21.793$ ) and senior mean ( $M=65.97$ ,  $SD=17.713$ ) was found ( $t(201)=3.300$ ,  $p\leq .001$ ,  $df=200$ ). Cohen's effect size value ( $d=0.296$ ) indicates a small practical significance. For the *Evaluate Sources and Information* sub-category, results indicate a significant difference ( $t(201)=5.662$ ,  $p\leq .000$ ,  $df=200$ ) between the freshman mean ( $M=57.55$ ,  $SD=19.243$ ) and the senior mean ( $M=47.47$ ,  $SD=18.448$ ). Cohen's effect size value ( $d=0.53$ ) indicates a moderate practical significance.

The sub-category of *Develop Topic* showed no significant difference ( $t(201)=-1.540, p \leq .125, df=200$ ) between the freshman mean ( $M=50.78, SD=25.733$ ) and the senior mean ( $M=54.57, SD=26.377$ ). Table 3 contains descriptive statistics and Table 4 shows results from the paired samples t-test. Table 5 is a bar chart comparing ninth grade TRAILS scores with twelfth grade TRAILS scores.

Table 3. Paired Samples Mean Scores and Standard Deviation

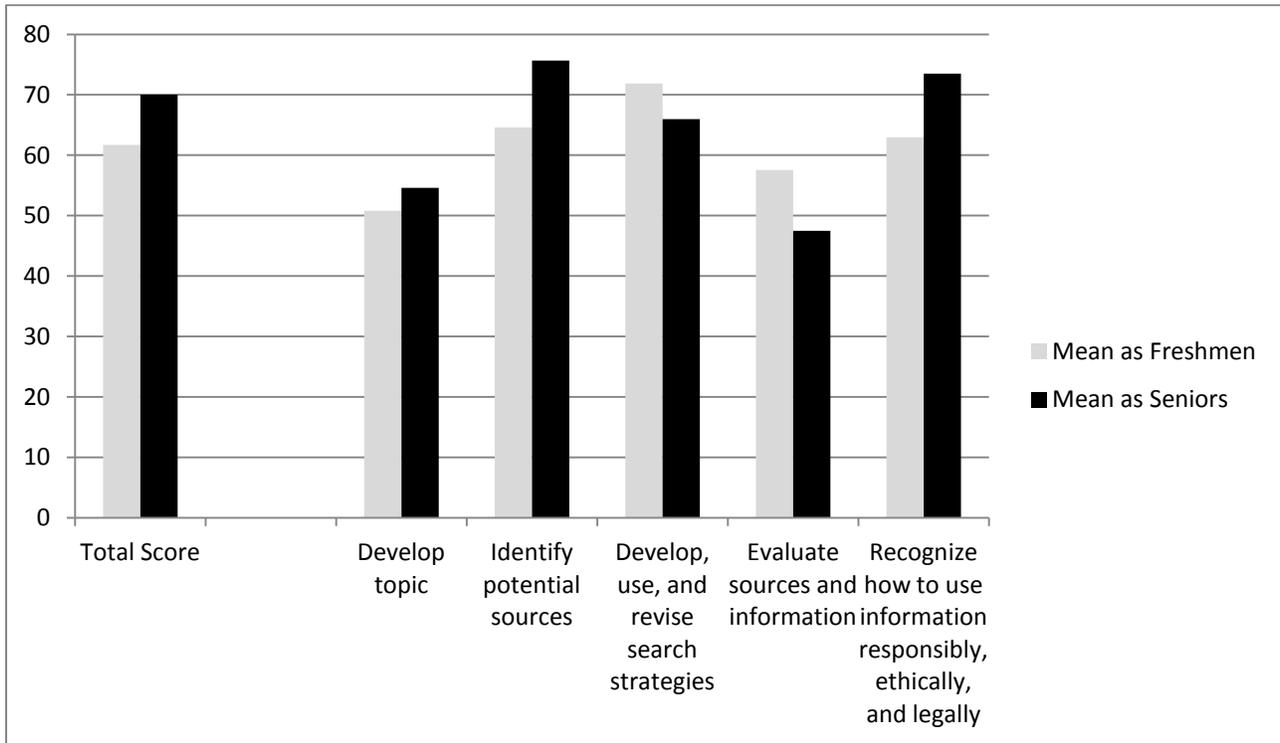
	Mean (n=201)	Standard Deviation
<b>Total score</b>		
Freshmen – TRAILS-9	61.73	15.290
Seniors – beta TRAILS-12	70.01	11.407
<b>Develop topic</b>		
Freshmen – TRAILS-9	50.78	25.733
Seniors – beta TRAILS-12	54.57	26.377
<b>Identify potential sources</b>		
Freshmen – TRAILS-9	64.62	25.162
Seniors – beta TRAILS-12	75.64	17.306
<b>Develop, use, and revise search strategies</b>		
Freshmen – TRAILS-9	71.86	21.793
Seniors – beta TRAILS-12	65.97	17.713
<b>Evaluate sources and information</b>		
Freshmen – TRAILS-9	57.55	19.243
Seniors – beta TRAILS-12	47.47	18.448
<b>Recognize how to use information responsibly, ethically, and legally</b>		
Freshmen – TRAILS-9	62.99	21.796
Seniors – beta TRAILS-12	73.51	22.145

Table 4. Paired-samples t-test results

	Mean	Standard Deviation	Standard Error of the Mean	95% Confidence Interval Lower	95% Confidence Interval Higher	t-value	Degrees of Freedom	Significance (2-tailed)
Total Score	-8.284	16.914	1.193	-10.636	-5.931	-6.943	200	.000*
Develop topic	-3.791	34.891	2.461	-8.644	1.062	-1.540	200	.125
Identify potential sources	-11.015	29.186	2.059	-15.074	-6.956	-5.351	200	.000*
Develop, use, and revise search strategies	5.891	25.308	1.785	2.370	9.411	3.300	200	.001*
Evaluate sources and information	10.080	25.239	1.780	6.569	13.590	5.662	200	.000*
Recognize how to use information responsibly, ethically, and legally	-10.522	27.994	1.975	-14.416	-6.629	-5.329	200	.000*

\* $p < .01$

Table 5. Comparison of TRAILS mean scores between 9th and 12th grade high school students



**DISCUSSION**

Information literacy knowledge and skills for the high school students in this study showed a significant overall increase between the freshmen mean score and the senior mean score. Sub-categories of the TRAILS assessments indicated mixed results, with two sub-categories indicating significant increases, two sub-categories indicating significant decreases, and one sub-category with no significant difference. These results are discussed based on the research questions and in the context of the information literacy curriculum.

**What is the level of information literacy skills for participants in this study when they were freshmen in high school as measured by TRAILS?**

In 2006, the 9th grade information literacy curriculum was integrated primarily into the language arts curriculum. The school 1 and the 9th grade language arts teachers collaborated extensively in the creation and teaching of mini research projects throughout the year. Thus, freshmen students were exposed to a wide range of activities throughout the school year that required them to locate and evaluate resources, determine the accuracy, authority, currency, and objectivity of a resource, identify a research question, and properly use and cite resources in an appropriate format for each resulting project. With an overall mean score of just over 60% ( $M=61.73$ ,  $SD=15.290$ ), freshmen students in this study performed at a respectable level, but have room to grow and improve. Examining each sub-category may yield a more thorough understanding of these ninth graders’ IL skills.

The lowest mean score for freshmen in this study was in the sub-category of *Develop Topic* with a mean score of 50.78 percent ( $SD=25.733$ ); meaning students answered approximately half of the questions correctly. Because freshmen in high school may have limited experience with the research process, these students may be apprehensive or somewhat unsure of themselves when starting research projects, making it difficult for them to understand how to best develop a topic for further research. The uncertainty or confusion students feel about how to identify a question worthy of research may be reflected in the relatively low score for this sub-category. In light of

this result, educators may need to be especially mindful of how they design and structure projects where students need to identify individualized topics. Students may need specific guidance and direction in the beginning stages of a project to ensure they are on the right track.

Freshmen in this study achieved close to 65% in the sub-category of *Identify Potential Sources* ( $M=64.62$ ,  $SD=25.162$ ), indicating a good level of understanding about appropriate resources to use for research. As freshmen, students in this study had their first exposure to free and fee-based online research databases at the high school level and received guidance and direction from school librarians in how to use these resources to gather specific types of information. Multiple research projects, careful scaffolding by the school librarians and language arts teachers, and the creation of a paper-based list of research databases available at the school may have provided the foundation that enabled students to learn which databases best align with different types of research questions. Success in finding appropriate information may also positively impact student retention of how well a specific resource answers a question. Success in finding appropriate and relevant information is often a result of well-developed search strategies.

The highest mean score obtained by participants as freshmen in 2006 was in the sub-category of *Develop, Use, and Revise Search Strategies*. The mean score of approximately 72% ( $M=71.86$ ,  $SD=21.793$ ) indicates a high level of understanding of research strategies. These research strategies include the ability to identify and revise keywords and to create appropriate Boolean search statements. The variety of mini-research projects interspersed throughout the school year that are aligned with the freshman language arts curriculum, coupled with the active involvement of the language arts teachers and the school librarians, may have helped increase student skills in this area. For example, explaining and providing examples of the use of Boolean operators such as “not,” “and,” and “or” provided concrete examples that students were then able to use to structure their own search statements.

Although the ninth grade IL curriculum is prescribed, specific, and intense, with high levels of collaboration between the school librarians and the language arts teachers, in the sub-category of *Evaluate Sources and Information*, the freshmen mean score only reached 58 percent correct ( $SD=19.243$ ). Ninth grade students are exposed to multiple instances where they are able to engage in evaluating sources as well as searching a variety of resources (including books and subscription online databases) with ongoing feedback from the school librarians, however, these skills may need time to develop and students may not be motivated to devote the time necessary to hone these skills, especially in light of other commitments and activities that high school students must juggle with their academics.

In the final sub-category of *Recognize How to Use Information Responsibly, Ethically, and Legally*, the freshmen mean score was in the range of 60% ( $M=62.99$ ). This result indicates a good rudimentary understanding of responsible use and may be the result of the requirement that all resources needed to be cited correctly in the mini-projects freshmen completed throughout the school year coupled with ongoing classroom discussions about plagiarism and copyright.

### **What is the level of information literacy skills for participants in this study when they were high school seniors as measured by TRAILS?**

By 2010, students in this study were high school seniors. The overall mean score on the TRAILS-12 assessment for these students was 70 percent, indicating a fairly high level of IL skills. The IL curriculum for seniors is much less structured than it is for freshmen and the mixture of relatively high and low scores in the sub-categories may be a reflection of a reduced emphasis on IL throughout the senior curriculum.

Twelfth grade students are required to complete a Capstone project that incorporates a persuasive essay on a problem of interest to the student as well as a service component that in some way connects to the problem identified in the persuasive essay. Because the Capstone project is part of the language arts and government curricula, most of the instruction by the school librarians concentrated on search strategies, credibility of sources, construction of works cited with annotations that spoke to the credibility of the source; and refinement of the research question. Instruction was, however, not uniform across all language arts classes even though the school librarians collaborated with the language arts teachers to develop lessons on the above-mentioned benchmarks,

paying particular attention to those areas of perceived need as revealed in the TRAILS-12 assessment. In other words, some language arts teachers did not have the school librarians work with their students in a classroom setting to prepare for the Capstone project.

Senior high school students in this study may struggle with the beginning phases of a research project in much the same way they did as freshmen. A mean score of approximately 54% for the sub-category *Develop Topic* suggests these high school students may lack some skills related to how to develop a topic for research. Because the Capstone project has two components, namely a service component and a research component, some students may have focused on identifying what they wanted to do for their service component without much regard to the research component. Once the service component was completed, these students may struggle to identify a worthwhile problem that links their service to required research for their respective persuasive essay.

The highest mean score for senior students in this study was in the sub-category *Identify Potential Sources* ( $M=75.64$ ,  $SD=17.306$ ), indicating a high level of skills. Twelfth grade students' comfort with identifying potential sources may be attributable to their overall comfort with the subscription online databases that are provided by the school district and, in Ohio, by INFOhio (<http://www.infohio.org/>), a free collection of databases for Ohio's K-12 students and teachers. These resources are continually emphasized by the school librarians and teachers throughout all four years of high school. Thus, continued and repeated use of the same resources increases familiarity and ease of use and may help students resist an initial reliance on generic search engines such as Google.

In the sub-category *Develop, Use and Revise Search Strategies*, senior high school students in this study scored almost 66 percent correct, indicating a good understanding of how to structure and conduct searches ( $M=65.97$ ,  $SD=17.713$ ). However, teachers and librarians may assume that high school students would continually improve in this area due to the pervasive nature of Internet searching that occurs in daily life and therefore score much higher. From a curricular perspective, students may need continued guidance and direction related to search strategies, especially as their projects and inquiries become increasingly complex as they progress through high school.

The lowest score for both ninth grade results and twelfth grade results was the twelfth grade students' mean score in the sub-category *Evaluate Sources and Information* ( $M=47.47$ ,  $SD=18.448$ ). This score may indicate that these twelfth grade students have relatively weak skills in how to evaluate the information they find for accuracy, relevance, and currency, or it may mean that they do not pay much attention to these characteristics in relation to resources they use for research.

The second-highest mean score for the high school seniors in this study was in the sub-category *Recognize How to Use Information Responsibly, Ethically, and Legally*. With a mean score approaching 75% ( $M=73.51$ ,  $SD=22.145$ ) these students appear to have a solid understanding of what it means to use and cite information appropriately. One reason that may account for this high level of understanding is that teachers and school librarians frequently jointly grade student research projects, with the school librarians focusing on appropriate citations and well-developed annotations of resources. Because joint grading efforts occur from ninth through twelfth grades, students have consistent and regular feedback on the proper use of information.

### **How do information literacy skills of participants as freshmen high school students compare to information literacy skills of the same participants as senior high school students as measured by TRAILS?**

Overall, high school seniors in this study scored significantly better in information literacy skills than they did as freshmen. This finding suggests that high school students gain information literacy skills as they progress from ninth to twelfth grade. While results from this study cannot definitively explain why this growth occurred, it is reasonable to suggest that the information literacy curriculum had some impact on student IL skills because it is through the IL curriculum that students are instructed about information literacy, are taught IL skills, and complete research-related projects that require the use of IL skills to complete. Comparisons in each sub-category in the context of the IL curriculum may provide a more thorough understanding of the growth, decline, or lack of change in IL skills for students in this study.

The mean scores in the sub-category of *Develop Topic* were close to 50% in both 2006 and 2010. These mid-range mean scores may indicate that even as these students gained knowledge and maturity during their high school years, they remained somewhat unsure of themselves when starting research projects. As these students move to higher education or to working environments, it is important to remember that they may continue to need help in structuring research efforts and identifying how to get started.

In the category of *Identify Potential Sources*, the mean score from TRAILS-12 was significantly higher than the mean score from TRAILS-9. As mentioned previously, these high school students are exposed to multiple online resources throughout high school and are trained by the school librarians in how to access and use them efficiently. Having easy access to these high quality subscription research databases highlights the importance of having full-time licensed school librarians who work closely with teachers to select those databases that best meet the needs of the curriculum. This careful selection of resources aligns with the collection development aspects of Ohio's Library Guidelines (Ohio Department of Education, 2010) and may contribute to the ability of the students in this study to identify resources that best meet specified criteria.

The highest mean score obtained by participants as freshmen in 2006 was in the category of *Develop, Use, and Revise Search Strategies*, reaching almost 72 percent. In the aggregate, these students possessed strong skills in determining how to search for and find needed information. It may be the case that the work done by language arts teachers in conjunction with the school librarians in planning, designing, and implementing meaningful projects throughout the freshman year helped these students better understand and apply search strategies. As educational researchers have found (see, for example, Anderson, 1995), repetition contributes to retention, so the continued emphasis on IL skills over multiple projects may have provided repeated practice and refinement of these skills resulting in strong test results.

It is, therefore, interesting to note that as seniors, study participants tended to score lower in this category. Surprisingly, a significant difference exists between the freshman mean ( $M=71.86$ ,  $SD=21.793$ ) and the senior mean ( $M=65.97$ ,  $SD=17.713$ ) for this category. One explanation of these results is the decreased emphasis on the IL curriculum during the intervening years (sophomore and junior years in high school). During their sophomore and junior years, these high school students are not continuously, systematically, or uniformly required to use their learned search strategies to complete assignments or projects. In fact, the pressure to teach content in subjects such as science, mathematics, and history often means that students acquire information literacy and research experiences primarily in language arts. Hence, these IL experiences may not be reinforced nor transferred to other disciplines.

In addition, teachers may not use the same language when assigning work that requires students to find and use information outside of the traditional textbook. Differences in terminology may cause confusion and uncertainty in students, causing them to abandon learned search strategies in order to "follow directions." For example, teachers in this high school generally do not require students to plan their searches in advance by identifying keywords and phrases germane to their topic before "hopping on a computer." This lack of direction from teachers may be due to their own lack of familiarity with even the most common advanced search strategies that will return robust and targeted information. Another difference between these high school teachers is that they often have different names for their research assignments such as "Spotlights," or "Research Memos" causing confusion among students as to how to approach completing these types of assignments, especially with limited direction or if directions conflict with a student's still-developing personal research process. Even traditional terminology is changing, as the *scientific method* is transitioning to *the design cycle* in new curriculum standards.

A second category that resulted in a significant difference between the freshman mean and the senior mean was *Evaluate Sources and Information*. In this category, the freshman mean ( $M=57.55$ ,  $SD=19.243$ ) was significantly higher than the senior mean ( $M=47.47$ ,  $SD=18.448$ ). Unfortunately, as students move up through the high school grades, the IL curriculum is less prescribed, therefore student skills and ability in this area may decline. For some students in this study, however, the projects in their freshman year may have helped build a level of comfort with the school librarians and these students may tend to seek out the librarians in their sophomore, junior, and senior years for one-on-one consultation, conversation, or help. While these students may not be in the majority, their continued effort to seek assistance in evaluating information may indicate that the evaluation process is difficult to master and may benefit from sustained and easy access to professional school librarians.

In the last category, *Recognize How to Use Information Responsibly, Ethically, and Legally*, the mean from seniors in 2010 was significantly higher than the mean from these same students as freshmen in 2006. Twelfth grade student growth in this area may be the result of district-wide use of a subscription to an interactive suite of online tools that enables students to track their sources and information from the beginning of a project to its conclusion. These online tools provide easy and continuous access to the specific resources used, facilitating the process of accurately citing and attributing information to meet copyright guidelines. Additionally, teachers and librarians jointly reinforce the importance of protecting intellectual property throughout a student's high school years. Normal human growth and development also may contribute to a greater understanding and recognition of the need to use information responsibly. Seniors tend to be more mature than freshmen; consequently their greater adherence to rules and guidelines related to intellectual property may simply be a result of their overall maturity.

## LIMITATIONS

The specific participants for this study were students from an upper middle-class high school with an established library curriculum, full-time school library professionals, and school-financed access to numerous research databases. Due to these characteristics, this population tends to be somewhat narrow in scope because of a relatively high student academic achievement record coupled with high quality and multiple school resources. As such, it cannot be considered as representative of all high schools or all high school students. Additionally, the school environment where the study took place consists of teachers who are willing to provide class time for efforts such as this research study and who regularly engage in planning, implementing, and assessing student projects in collaboration with the schools' librarians, which may not be typical of some high schools.

Four limitations are related to TRAILS. First, the nature of TRAILS as an assessment instrument is not intended to measure change. Rather, the score is a relative indicator of how a student performs in relation to others who have taken the same assessment. Second, the small number of assessment items (approximately 6 questions in 5 sub-categories, for a total of 30 questions) may impact the reliability of the instrument. Because, statistically, the more items included in a scale to measure a particular concept, the more reliable the scale. Third, the relatively large standard deviations for the TRAILS assessment instrument indicate a somewhat flat and broad distribution curve, meaning a large range of scores, with many scores not too close to the mean. Fourth, the TRAILS-12 assessment used in the study was the beta version. The current TRAILS-12 assessment differs from the beta version because a small number of question items were replaced when overall results from the beta testing were analyzed. The current TRAILS-12 assessment also may have items arranged differently than they appeared in the beta version.

## CONCLUSION

Collectively, results from this study demonstrate overall student growth in information literacy skills with slight weaknesses in the areas of developing topics and evaluation of resources and information. The differences in student performance and the relatively wide range of scores (as indicated by high standard deviations in all sub-categories) are evidence that student information literacy skills need a continuous and consistent approach. And while standard deviations were high for both freshman scores and senior scores, the range of scores within three standard deviations of the mean tended to be lower for seniors indicating scores were more closely clustered for seniors.

A district-wide K-12 research model, with sample lesson plans and resources that teachers can learn about, access, and use prior to implementing the model with students may provide a means to provide students with ongoing models of successful application of IL skills. Collaboration among teachers and between teachers and school librarians to develop a K-12 model may benefit students by increasing the confidence levels of all teachers in their own information literacy skills. A district-wide plan also helps standardize information literacy vocabulary such that students will hear consistent terminology whether they are in first grade, seventh grade, or seniors in high school. In addition, a district-wide plan should also include measures to ensure a common set of expectations so that students understand that information literacy skills are necessary for learning in any discipline. The Common Core in Language Arts (<http://www.corestandards.org/>), recently adopted in Ohio and other states, includes *Research to Build and Present Knowledge* as a component in its College and Career Readiness standard. The Common Core may therefore be an impetus in favor of a district-wide K-12 research model.

The TRAILS assessment results suggest that while many high school seniors purport to know how to do online research, their comfort and confidence in using search engines such as Google may portend a somewhat masked uneasiness with being able to identify research topics and use effective search strategies on their own. Scores on TRAILS also indicate students struggle with evaluating resources even as they complete their senior Capstone projects. Kolowich (2011), in reporting on an upcoming publication from the American Library Association, states that researchers found that college students “exhibited significant difficulties that ranged across every aspect of the search process” (para. 8). Thus, the results from the TRAILS assessments is mirrored in what researchers are finding as high school seniors graduate and transition to college. With multiple studies reporting that students at all levels of education have difficulty in mastering information literacy skills (Allen, 2007; Caspers & Bernhisel, 2007; Knight, 2006; Kolowich, 2011; Latham & Gross, 2008; Morrison, 1997; Nutefall, 2005; O’Sullivan & Dallas, 2010), school librarians may be in the best position to take the lead in reversing these findings. For example, by offering staff development in multiple formats (i.e., online, one-on-one, traditional class sessions) school librarians may make a positive contribution by helping teachers increase their own IL skills, thereby paving the way for a collaborative effort in building a K-12 research model that provides students with the information literacy skills they need to be successful as lifelong learners.

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