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Web Searching Skills: Improving Cognitively Challenged Students’ Abilities through Accessible Training Lessons

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WEB SEARCHING SKILLS: IMPROVING COGNITIVELY CHALLENGED STUDENTS’ ABILITIES THROUGH ACCESSIBLE TRAINING LESSONS

by

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Web Searching Skills: Improving Cognitively Challenged Students’ Abilities through Accessible
Training Lessons
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has been approved for the Department of Computer Science

Prof. Clayton Lewis

Dr. Shaun Kane

The final copy of this thesis has been examined by the signatories, and we find that both the content and the form meet acceptable presentation standards of scholarly work in the above mentioned discipline.

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Nour, Redhwan Redha (Ph.D., Computer Science)

Web Searching Skills: Improving Cognitively Challenged Students’ Abilities through Accessible Training Lessons

Thesis directed by Professor Clayton Lewis

Worldwide, around 630 million individuals with cognitive disabilities have different challenges that can reduce the benefit of using the internet and searching for information. This dissertation developed and evaluated accessible web-searching training lessons to improve the web-searching skills of students with cognitive disabilities. The focus of the research was on improving the functional capabilities of the participants by providing supported search tools like voice searching and images in search results in addition to typing. A purposive sample of 19 volunteer students with a variety of cognitive disabilities were grouped into three functional groups (beginner, intermediate and advanced) by teachers from a special needs school. Pre- and post-web searching tasks along with a follow-up study after the training were conducted by the teachers, and grids from the Repertory Grids Technique (RGT) were collected. The lessons were created in collaboration with the teachers at the special needs school using the Google search Education Lessons as a basis, and consisted of teachers' instructions for group lessons and handouts for students. Significant differences between pre- and post-scores were found, and participants reported an improvement in their ability to search in their RGT grids. Additionally, a follow-up assessment showed a significant difference in pre- and post-scores and demonstrated that participants retained web searching skills.
Recommendations were created to guide researchers, teachers, web developers, and accessibility experts. The results of this research indicated that it was possible for students with cognitive disabilities to improve their web searching skills when they received training from their teachers with the use of accessible web searching handouts.
DEDICATION

To my parents’ souls and to my brother Waheeb, my biggest inspiration.
ACKNOWLEDGEMENTS

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CHAPTER I

BACKGROUND AND SIGNIFICANCE

I.1 Introduction

This chapter describes background information about the research project, and project motivation. The research problem including questions, hypothesis, and objectives to answer questions are presented. The project’s audience is described and the dissertation outline is presented.

I.2 Background

The ability to search the web and find relevant sources is an essential skill for everyone in the 21st Century. As web content increases, the amount of available information is multiplying exponentially. In 2016, Google’s search engine processed at least two trillion searches per year (which equals 167 billion searches per month, or 5.5 billion per day) (Sullivan, 2016). Some of the advantages of online searching include being able to find prices for products, problem solving for things like learning how to put together a chair, finding information rapidly, connecting people through social networks, and searching online to watch videos or listen to music (Bughin et al., 2011). Web searching also has the potential for reducing barriers to
information access and increasing new learning opportunities for people with cognitive disabilities.

Unfortunately, laws and guidelines do not fully support cognitively disabled individuals and their web usage needs because most of the technical focus is on either physical or sensory disabilities (Section 508, n.d., Richardson, 2011). These omissions in guidelines correspond to a gap in empirical research that examines how people with cognitive disabilities use the web. Borg, Lantz & Gulliksen (2014) highlighted the dearth of research about internet use by cognitively challenged individuals. Considering the plethora of different types of cognitive disabilities and variability even within a particular type of cognitive challenge, this scarcity in internet research may exist because of a gap in understanding cognitive disabilities. Furthermore, training that supports people with cognitive disabilities online and that supports different learning modalities for user interfaces have not been developed sufficiently in this area of focused research.

Most internet training materials are geared toward self-directed learners, causing challenges for some individuals with cognitive disabilities, considering their difficulties, varying needs, and inexperience (Egan, Worrall, & Oxenham, 2004). A paucity of literature exists focusing on internet training for cognitively disabled people, in spite of the possible value of such internet training. Kumin, Lazar, Feng, Wentz, & Ekedebe (2012) indicated that computer training is essential and can significantly affect the performance of people with Down syndrome. Furthermore, two other studies (Egan, et al., 2004; Egan, Worrall, & Oxenham, 2005) found that
individuals with Aphasia and Traumatic Brain Injury (TBI) became more independent in using the internet after receiving training and using accessible internet training material.

Although cognitively challenged individuals have a variety of limitations, their cognitive abilities may not create unbreakable barriers. Instead, support for different learning modalities and providing multiple formats may facilitate access to information and strengthen cognitive performance (Keates et al., 2007). Presenting information in multiple formats will help someone who has difficulty with a single style by using the alternatively accessible formats. User interfaces that incorporate spoken and visual presentations are valuable examples of such directions. Chu, Chen, & Li (2002) developed an adaptive web browser supported with voice assistance (text-to-speech) and image assistance (in which pictures appear when there is mouse movement over a text). The authors concluded that an adaptive browser was simple, easy to use, and improved performance of the cognitively disabled participants.

I.3 Motivation

Based on the previous literature-based viewpoints and findings from research, this project seeks to develop an effective web searching training program supported with a customizable user interface that addresses some of the cognitive and technological barriers cognitively challenged people face when they search. Providing a structure that supports accessibility and flexibility along with a customizable user interface should aid individuals in learning at their own pace.
based on their functional capabilities, using one-to-one sessions coupled with teachers’ support. Myriad reasons frame the logic in choosing this project:

- As just discussed, web searching is important, but there is limited research on web searching by people with cognitive disabilities.
- It may be possible to modify the user search interface to make it easier for individuals with cognitive disabilities to use.
- A project like this would be able to focus on the functional capabilities, i.e., “strengths and weakness” of cognitively challenged students, by using and evaluating the effectiveness of alternative formats and modalities, ultimately providing a “learning profile” for each individual.
- This project would be able to provide experience-based accessible training materials that fit students’ needs by using a strategy of strong collaboration with teachers who have experience working with cognitively challenged students.

1.4 Research Problem

Cognitively challenged individuals have limited access to information on the web due to inaccessible web interfaces and a lack of training in web searching skills. Thus, this project has a twofold purpose. First, this research seeks to create and employ a customizable web searching interface with features that may be helpful for individuals with cognitive disabilities by considering their functional capabilities. Second, this project explores the potential value of improving web
searching skills by adapting Google Search Education lessons to meet the needs of students with cognitive disabilities.

I.4.1 Research Questions and Hypotheses

This research seeks to answer the following two key research questions, and the research is guided by several hypotheses and objectives:

**Question 1**
What are the web searching features that can improve web searching skills in cognitively challenged students?

**Hypothesis 1**
Adapted web added search features will significantly improve cognitively challenged student’s web searching skills.

To answer Question 1, the following objectives have been established:

**Objective 1**

**What:** Include web searching tools to support different functionalities of students with cognitive disabilities.

**How:** By adding web searching features that include voice searching and images in search results.

**Why:** To support cognitively challenged individuals in their web searching based on their functional capabilities.
**Question 2**

How significant is the impact of an adapted version of Google Search Education lessons on web searching skills for students with cognitive disabilities?

**Hypothesis 2**

An adapted version of Google Search Education lessons will significantly improve web searching skills of cognitively challenged students.

To answer Question 2, the following objectives have been established:

**Objective 2**

**What:** Develop an adapted version of the Google Search Education lessons that focuses on students with cognitive disabilities completing web searching tasks.

**How:** By working collaboratively with teachers at a special needs school on how to use Google Search Education lessons with cognitively challenged students.

**Why:** To identify the lessons that can be adapted to help the cognitively challenged students.

**Objective 3**

**What:** Apply the adapted version of Google Search Education lessons to students with cognitive disabilities.
How: By guiding teachers in training students and administering pre- and post-assessments.

Why: To improve web searching skills of students with cognitive disabilities.

**Objective 4**

What: Evaluate the effectiveness of the adapted version of Google Search Education lessons as applied to students with cognitive disabilities.

How: By using pre- and post-assessment, with video and statistical analysis, and analyzing Repertory Grid Technique (RGT)-generated data on the training of students with cognitive disabilities.

Why: To propose training guidelines that can improve web searching skills for people with cognitive disabilities based on their functional capabilities.

I.5 Research Audience:

The following audiences have been identified as potential beneficiaries of this research:

- Researchers: Cognitive disabilities professionals, and accessibility and universal design researchers.
- Human Centered Computing (HCC) professionals: HCC groups who work on increasing access to computing systems for people with disabilities.
- The Web Accessibility Initiative (WAI): WAI develops web accessibility guidelines, in three main areas:
- Web Content Accessibility Guidelines (WCAG) are a technical standard developed to guide how to make web content more accessible to people with disabilities.

- Authoring Tool Accessibility Guidelines (ATAG) are administered by groups who support developers of authoring tools (software that generates web content).

- User Agent Accessibility Guidelines (UAAG) focus on supporting developers who develop web browsers, assistive technologies or any software that people with disabilities use to interact with the web.

- Google's Search Education Team: The team that creates materials for teaching people how to search.

- United States Department of Education: This department collects data on US schools, provides support and applies laws to protect civil rights, including those of people with cognitive disabilities.

- Disability Services Programs in Education Systems: Under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act, U.S. schools and universities must provide accommodation to people with disabilities. An example of an accommodation is alternate format texts and materials or any supported documents that aid disabled people with their learning.

- Schools: The school is usually responsible for planning the Individualized Education Program (IEP) for each student considering different needs.

- Curriculum Designers: Curriculum design specialists who are responsible for creating learning materials with articulated learning objectives that are based on learner needs.
• Librarians: People who assist library users with their enquiries and help them use computers to find resources.

• Web Users: Students, teachers, families or caregivers or others who want to use accessible web searching materials and learn about some web searching tools.

I.6 Dissertation Overview

This dissertation consists of eight chapters. Chapter I covers background information, project motivation, research questions as well as objectives and project audience. Chapter II is the literature review that describes cognitive disabilities, internet access, training, and web searching for cognitively challenged individuals. In addition, the RGT method is explained, and how it can be applied to people with cognitive disabilities is discussed. Chapter III focuses on answering the first research question by describing a study focused on developing added web searching features. Also, the chapter presents Google Search Education lessons and how they can be adapted to support people with cognitive disabilities and adapted to support the added web searching tools.

Chapter IV answers the second research question and focuses on how the accessible training program was created in collaboration with teachers from a special needs school. Chapter V describes the evaluation process and how the developed training lessons can be applied to students with cognitive disabilities and what data will be collected. Chapter VI highlights the results of applying the training program, including statistical analysis, RGT analysis, qualitative video
analysis and both teachers and students’ feedback about the training program.

Chapter VII discusses main observations, along with limitations and lists of recommendations. Chapter VIII presents the conclusion, main contributions, in addition to future directions and reflection. Figure 1 shows dissertation chapters.

Figure 1. Dissertation Overview
CHAPTER II

LITERATURE REVIEW

II.1 Introduction

This chapter provides the definitions of key terms and concepts such as cognitive disability, different types of cognitive disabilities, the medical and the functional model, accessible web content for people with cognitive disabilities, and studies focused on web searching and internet training for cognitively challenged individuals. In addition, the chapter highlights the importance of RGT and how it can be used to understand and support people with cognitive disabilities.

II.2 Cognitive Disability

People with any cognitive disability usually have a variety of limitations when compared to others. They may have a lower capability to learn, and they may take a longer time to complete tasks. “Cognitive disability” has many definitions; in fact, there is no universal definition that fits all types. The Diagnostic and Statistical Manual of Mental Disorders- IV defines “someone with a cognitive disability as one who is significantly limited in at least two of the following areas:
self-care, communication, home living social/interpersonal skills, self-direction, use of community resources, functional academic skills, work, leisure, health, and safety” (American Psychiatric Association Task Force on DSM-IV, 2000). Another definition from the Coleman Institute for Cognitive Disabilities defines cognitive disability as – “a substantial limitation in one’s capacity to think, including conceptualizing, planning, and sequencing thoughts and actions, remembering, interpreting subtle social cues, and understanding numbers and symbols.” (Coleman Institute for Cognitive Disabilities, n.d.).

According to recent World Health Organization (WHO) estimations (2011), roughly 630 million individuals worldwide have cognitive disabilities and 28 million of these people live in the United States (Braddock, Hoehl, Tanis, Ablowitz, & Haffer, 2013). Figure 2 illustrates the prevalence of cognitive disability in the United States. Cognitive disability encompasses a wide spectrum of various cognitive impairments. This includes intellectual disability, Alzheimer’s disease (AD), Acquired Brain Injury (ABI) (traumatic brain injury [TBI]), stroke, as well as conditions like mental illness, autism, learning disability (dyslexia, dysgraphia, dyscalculia), attention deficit hyperactivity disorder (ADHD), and Down syndrome.

Cognitive impairments can arise in many ways such as through brain injury or stroke, aging, abnormal chromosomes (e.g. Down syndrome), severe mental illness or unknown causes. They can affect many aspects of cognitive function like memory and attention. Table 1 shows the summary of challenges that individuals with cognitive disabilities may have (Seeman, & Cooper, 2015).
Table 1. Summary of Possible Difficulties for Cognitively Challenged Individuals

<table>
<thead>
<tr>
<th>Area of Difficulty</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Memory</td>
<td>Working Memory, Short-Term Memory, Long-Term Memory, Visuospatial Memory, Auditory Memory (memory for sound patterns and others).</td>
</tr>
<tr>
<td>Executive Functions</td>
<td>Emotional Control and Self-Monitoring; Planning/Organization and Execution; and Judgment.</td>
</tr>
<tr>
<td>Reasoning</td>
<td>Fluid Reasoning (logical reasoning), Mathematical Intelligence, Seriation, Crystallized Intelligence, and Abstraction.</td>
</tr>
<tr>
<td>Attention</td>
<td>Selective Attention, and Sustained Attention.</td>
</tr>
<tr>
<td>Language</td>
<td>Speech Perception, Auditory Discrimination, Naming Skills, and Morphosyntax.</td>
</tr>
<tr>
<td>Understanding Figurative Language</td>
<td>Including: similes, personification, oxymorons, idioms, and puns.</td>
</tr>
<tr>
<td>Literacy - Depends upon functions</td>
<td>Speech Perception, Visual Perception, Phoneme Processing, and Cross-Modal Association (association of signs and concepts).</td>
</tr>
<tr>
<td>Other Perception</td>
<td>Motor Perception, Psychomotor Perception.</td>
</tr>
</tbody>
</table>

*Figure 2. Prevalence of Cognitive Disability in the U.S., 2012*
Many of the cognitive impairments coexist with additional physiological challenges such as motor, visual and other disabilities (Bodine, 2005). For example, people with Down syndrome often have visual and auditory disabilities (Hu, Feng, Lazar, & Kumin, 2013). However, it should be noted that living with a cognitive disability is not an indication that all cognitive functions are impaired.

Unfortunately, a different assumption can be clearly seen in the misconception that cognitive disability can be understood in terms of intelligence quotient (IQ) (Lewis, 2008). However, a person with lower IQ may perform effectively in some areas. On the other hand, someone with higher IQ may struggle with severe cognitive impairments (Sternberg & Grigorenko, 2004). For instance, individuals with mild learning disability may have difficulties in reading but perform very well with visual content (Johnson & Hegarty, 2003). Therefore, regardless of the condition, individuals with cognitive disabilities should be understood based on their functional capability while interacting with multiple environments (Lopresti, Bodine, & Lewis, 2008).

Conditions such Down syndrome and others can be represented to some extent in a medical model that focuses on an organic cause of a condition. The medical model views “disability as a problem of the person, directly caused by disease, trauma, or other health condition which therefore requires sustained
medical care provided in the form of individual treatment by professionals” (Langtree, 2010). However, as stated earlier, this medical definition is not useful as a functional classification. In many cases, the usefulness of the functional framework over the medical model is apparent. First, focusing on functional classification helps avoid confusion because of the overlap between various cognitive conditions (Bohman & Anderson, 2005). For example, both Down syndrome and learning disabled individuals may struggle with text processing. In addition to the previous point, capabilities also vary from person to person with the same condition, such that some individuals can be higher functioning while others are not. Second, explaining what a user can and cannot do may help designers to provide better support based on available guidelines and tools (Bohman & Anderson, 2005; Cognitive Introduction, 2013; Keates et al., 2007). Finally, many people dislike speaking in terms of user impairments because it focuses attention on disability rather than on an individual’s abilities (Keates et al., 2007).

II.3 Cognitive Disability and the World Wide Web

II.3.1 Web Accessibility and Laws

According to the World Wide Web Consortium (W3C), web accessibility means “people with disabilities can use the Web. More specifically, Web accessibility means that people with disabilities can perceive, understand, navigate, and interact with the Web, and that they can contribute to the Web. Web accessibility also benefits others, including older people with changing abilities due to aging” (Rutter et al., 2006).
Two domestic guidelines relate to web accessibility in the USA. First, the Americans with Disabilities Act (ADA) and the Rehabilitation Act of 1973 mandate guidelines to accommodate differently-abled individuals. The ADA focuses on providing equal opportunities to disabled individuals. Two sections of this Act deal with the web-related issues (United States Laws, 2013). The first one is Title II, which states that any “public entity shall take appropriate steps to ensure that communications with applicants, participants, members of the public, and companions with disabilities are as effective as communications with others” (The Americans with Disabilities Act of 1990, n.d.). The second is Title III, which focuses on public accommodation for disabled people (The Americans with Disabilities Act of 1990, n.d.). The second law is Section 508 that focuses on federal funding activities. Section 508 is considered the first web accessibility guideline. Receiving federal financial assistance as a state government under the Assistive Technology Act of 1998 forces the need for Section 508 compliance. Moreover, businesses that receive federal funds may have to meet the requirements of 508 (Section 508, n.d.).

International guidelines for accessibility also exist, but most are not considered laws or mandates. In other words, the international guidelines are not enforceable. However, these additional guidelines are recommended and are considered the first standards for accessible web content. The Web Content Accessibility Guidelines (WCAG) were created by the W3C's Web Accessibility Initiative (WAI). WCAG is a series of standards for web accessibility. WCAG (as international guidelines) have two versions. The first one was published in 1999
and improved the accessibility of the web. However, after advances in web technologies, some provisions and guidelines became outdated, and a second version was created. WCAG 2.0 (Caldwell et al., 2008) was published in 2008 and is also considered an International Organization for Standardization (ISO) International Standard (W3C Web Content Accessibility Guidelines 2.0 Approved as ISO/IEC standard, 2012).

WCAG 2.0 consists of 12 guidelines organized under each of four main principles: perceivability, reliability, understandability, and robustness. The guidelines are associated with success criteria ranked according to three priority levels. A web developer must fulfill requirements (priority A), and a developer should meet requirements (priority AA), or a developer may apply requirements if he or she chooses to (priority AAA). Only 25 out of a total of 61 success criteria must be applied (priority A). Sadly, most of the success criteria pertaining to cognitive disabilities are priority AAA (Richardson, 2011). Therefore, some organizations may choose to neglect them.

To provide more support for cognitive web accessibility, efforts have been made to endorse the advancing rights and awareness of technology access for people with cognitive disabilities. The Coleman Institute for Cognitive Disability presented a declaration entitled "The Rights of People with Cognitive Disabilities to Technology and Information Access". This declaration highlighted principles such as the right to access comprehensible information, usable communication technologies,
the value of universal design and standards, and the need to increase public and private funding (Braddock et al., 2013).

In January 2015, the W3C published the Cognitive Accessibility User Research working draft (Seeman, & Cooper, 2015). This document outlines challenges that face people with cognitive disabilities in areas such as memory, attention, and others. Moreover, this document organized user groups based on disabilities such as Autism, Down syndrome, and others. This document focused on improving accessibility for different user groups; thus, authors have asked for comments for continued improvement.

II.3.2 The Scarcity of Research

Often, assumptions are made that people with cognitive disabilities cannot use a computer and the internet. However, recent studies demonstrate the opposite. For instance, adults with Down syndrome were able to perform some computer and web tasks effectively (Kumin, Lazar, Feng, Wentz, & Ekedebe, 2012; Lazar, Loyola, & Feng, 2011). Another study shows that individuals with cognitive impairments can learn internet skills and use the internet as a learning tool by using customized training materials (Egan, Worrall, & Oxenham, 2005).

In a recent literature review that focused on evidence-based research about accessibility to electronic communication for people with cognitive disabilities, Borg et al. (2014) indicated the dearth of research in this area. The authors searched 13 databases and used a wide range of both specific and general search terms (e.g. computer*, intellectual*, accessib*). The authors used an adapted version of a
quality assessment tool developed by a health economist (Ekman, 2004) in order to select studies based on objectives, background, design, methods, data, discussions, and findings. Only nine studies from 29 selected studies highlighted using the internet. Only five studies included using websites, and the other four studies solely evaluated email usage.

The scarcity in research focusing on people with cognitive disabilities using the web was also highlighted in additional research (Cognitive Disabilities Part 1, 2015; Lewis, 2005; Petrides et al., 2013). Several reasons can be suggested for the paucity of research on this topic, including:

- Insufficient guidelines that focus on people with cognitive disabilities on the web (Richardson, 2011).
- Uneducated web developers lacking information about cognitive disability needs (Petrides et al., 2013).
- Web accessibility myths (Rutter et al., 2006) such as that textual information is sufficient, that accessibility is expensive and hard, that accessibility is mainly the web developer’s responsibility, and that accessibility only needs to focus on sightless users.

Additionally, other reasons exist related to difficulties with cognitive disabilities research in general, including:

- Variable cognitive needs that might call for variable solutions based on user context (Petrides et al., 2013).
• Conflicts between accessibility and usability (Mariger, 2006).
• Obstacles to implementing techniques and methods such as simple language (Writing Clearly and Simply, n.d.).
• Difficulties with recruitment and getting approval from Institutional Review Boards (IRB) (Lewis, 2005).

II.4 Cognitive Disability and Web Searching

The internet has the potential to reduce barriers to information access and increase new learning opportunities for people with cognitive disabilities. One of the most important uses of the internet is finding information. As mentioned earlier, in 2016, Google's search engine processed at least two trillion searches per year (which equals 167 billion searches per month, or 5.5 billion per day) (Sullivan, 2016). The ability to search the web and find relevant sources is an essential skill for everyone in the 21st Century.

In a recent report that focuses on the impact of web searching, the authors described the value of web searching in several ways (Bughin et al., 2011). One of the highlighted values was finding information relevant for individual needs. For instance, finding prices for products, time saving to find information quickly, people matching through social networks, and entertainment such as searching online to watch videos and listen to music. Chen, Jeon, & Kim (2014) compared online web searching and offline searching of non-web sources in terms of time-saving and improved matching of information. Significantly, the results show that participants were likely to find answers online (100%) in an average of nine minutes, as
compared to finding answers offline (between 87% and 90%) in an average of 19 minutes.

In analyzing studies from the review by Borg et al. (2014) and then conducting a further review focused on people with cognitive disabilities, eight studies are of particular importance. These studies featured the value of web searching as well as alternative formats and modalities by providing multiple input and output options (e.g., auditory, visual, icon) for cognitively challenged individuals. Table 2 presents a brief summary of the selected eight studies.

Table 2
Summary of Web Searching and User Interface Reviewed Studies

<table>
<thead>
<tr>
<th>Reference and Study Goal</th>
<th>Study Design</th>
<th>Participants</th>
<th>Tasks</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Hu and Feng, 2015)</td>
<td>Quantitative</td>
<td>23 participants with different cognitive disabilities</td>
<td>Under 3 conditions participants completed 15 search tasks: deep structure (4 × 4 × 4 × 4), broad structure (16 × 16), and use of Google custom search engine.</td>
<td>The search engine was preferred, as the failure rate for the deep structure was 29.3%, the broad structure was 46.7% and Google custom search was 18.5%.</td>
</tr>
<tr>
<td>(Kumin et al., 2012)</td>
<td>Qualitative and Quantitative</td>
<td>10 participants with Down syndrome (4 males and 6 females). Age range (19-29). Only one participant did not have experience with computers or the web.</td>
<td>1- Searching for the National Down syndrome Congress page on Facebook and “liking” the page. 2- Locating an event from a calendar</td>
<td>1- Participants needed less than 2 minutes on average to locate the page on Facebook. Some participants took longer...</td>
</tr>
<tr>
<td>Activity</td>
<td>Participants</td>
<td>Methodology</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Others had between 3-15 years' web experience.</td>
<td></td>
<td>Qualitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Finding and comparing a book’s prices on two different websites</td>
<td>3-</td>
<td>Bergmann et al., 2010</td>
<td></td>
<td></td>
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<tr>
<td>as they typed slowly.</td>
<td></td>
<td>Evaluate the effectiveness of simple UI “easy-to-search” that incorporates flexible selection of the numbers of auto complete suggestion with simplified search results “summary information of the results, and images to aid comprehension”</td>
<td></td>
<td></td>
</tr>
<tr>
<td>45 participants with learning disabilities</td>
<td>Searching a website and completing a task without assistance</td>
<td>Qualitative</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7 participants (3 with a moderate developmental disability and 4 with a mild one). The participants were 5 females and 2 males, with an age range of 15-44 years.</td>
<td>Finding images from Google Images search engine</td>
<td>Harrysson et al., 2004</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 students with mild to severe hearing impairments</td>
<td>Searching for websites in Graphic-based sites</td>
<td>Johnson et al., 2003</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Using Google Images search engine to complete tasks

The most observed problem was spelling the search words in search box. Another problem was choosing from a large selection in search results.
<table>
<thead>
<tr>
<th>Evaluating the effectiveness of using websites as educational resources</th>
<th>moderate learning disabilities. All had computer and internet access with support</th>
<th>line with interests that related to interest were preferred and more engaging over text-driven websites</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Chu et al., 2002) A comparison between an adaptive web browser that used multimedia (voice and picture assistance) and Internet Explorer</td>
<td>Quantitative</td>
<td>10 participants with cognitive disabilities (3 males and 7 females) Reading some web content Better performance when using the adaptive browser as reading comprehension was higher (p&lt;0.05)</td>
</tr>
<tr>
<td>(Davies et al., 2001) A comparison between accessible web browser “Web Trek” which utilized multimedia such as audio prompting and picture-based features and Internet Explorer</td>
<td>Quantitative</td>
<td>12 participants with cognitive disabilities (4 females and 8 males). Age range was 20-45 years. No internet experience but had knowledge about computers Searching for websites and saving them in a favorites list to be able to retrieve them Comparing the two browsers, &quot;Web Trek&quot; allowed the participants to perform better (p&lt;0.03), considering metrics like independence, accuracy and task completion.</td>
</tr>
<tr>
<td>(Overview of Steppingstones Cognitive Research, n.d) The ease of locating a web page in a site from search results</td>
<td>Qualitative</td>
<td>8 participants with cognitive disabilities. Age range 12-17 years. Each participant was indicated as a frequent user of the web Choosing a correct page from a search results list 1- Some students had difficulties spelling out search terms 2- Others were overwhelmed by choosing from many search results in the list</td>
</tr>
</tbody>
</table>
Hu and Feng (2015) found that people with cognitive disabilities are able to perform web searches in spite of some difficulties. Twenty-three participants with different cognitive disabilities completed 15 search tasks including deep structure (4 × 4 × 4 × 4), broad structure (16 × 16), and using the Google custom search engine. Four groups of tasks (easy, medium, difficult and most difficult) were related to finding some books from a website designed specifically for the study. Regarding task completion, no significant difference was found between the three conditions (X²(2) = 1.13, n.s.), but a significant difference among tasks with different difficulty levels was identified (X²(3) = 25.38, p < 0.001). The causes of failed browsing included issues linked to understanding the content structure or category and problems with recognizing the correct book. The study shows that people with cognitive disabilities have challenges with selecting correct links from results, entering correct spelling, and creating keywords. The author suggests adding an error tolerance technique for spelling in design to support cognitively challenged individuals.

Kumin et al., (2012) reported the value of using an “autocomplete” feature. Users with Down syndrome took advantage of the “autocomplete” Google search feature built into Safari on the iPad to find a site instead of typing the URL. Moreover, the “autocomplete” function increased the speed of completing tasks for the participants such as searching on Facebook or locating an event on a calendar, as well as searching and comparing prices from two consumers’ websites. When the “autocomplete” feature did not work on the selected website, one participant failed
to find the item. Additionally, the authors highlight the impact of the training on the participants’ performance. With the exception of one participant, those who did not have computing experience and took relevant classes performed below the group average across the tasks. The authors endorse a recommendation made in other publications, that formal computer training is significant and has an impact on performance for people with Down syndrome.

Bergmann and Erle (2010) developed a simple user interface called Easy-to-Web Search. The interface’s goal was to support people with cognitive disabilities searching the website of the German Institute for Human Rights. The interface was designed to aid misspelled search words and to provide a simple user interface to help find the correct word. The Easy-to-Web Search interface has modest control of the “autocomplete” function by offering a number of suggested similar words to choose from (three, five, or ten). Moreover, the interface included summary data for the search query and an icon image to support comprehension. The results of a pilot study using Easy-to-Web Search shows that only nine out of 45 participants with cognitive disabilities were able to complete tasks independently.

Harrysson, Svensk, & Johansson (2004) reported that people with mild to moderate developmental disabilities had common difficulties in entering correctly spelled words in the Google search box. Another cited problem was selecting from a large amount of text and copious links retrieved from search results. The authors recommended having some images in search results to aid comprehension and to introduce a new method for conducting web searches rather than depending only on
typing. Johnson and Hegarty (2003) found that individuals with mild to moderate learning disabilities who had access to needed support were able to search the web for things that interested them. The students’ search inquiries included music artists, actors, musical instruments, and a place of birth. The majority of participants in the study preferred websites that had more graphics compared to the text-only-driven websites.

Chu et al. (2002) highlighted the importance of pictures when they proposed an adaptive web browser with a simple interface to help people with cognitive disabilities comprehend the web content. The adaptive browser used a synthesized voice output (text-to-speech engine) that read sentences or words from websites. Additionally, another component, which was a database of 30,000 images, appeared based on mouse movement over the text. When the adaptive browser was compared with Internet Explorer in terms of task completion when reading content online, the results showed that the adaptive browser was simpler, easier to use, and showed significantly better performance for the participants because reading comprehension was higher (p<0.05).

Davies, Stock, & Wehmeyer (2001) found that individuals with cognitive disabilities made fewer errors and became more independent when they used a specialized web browser named “Web Trek” that incorporated a picture-based search approach, audio prompts, personalization and customization, reduced screen clutter, and error minimization functions.
Web Accessibility in Mind (WebAIM) team (Overview of Steppingstones Cognitive Research, n.d.) conducted a study to examine the ease of locating a web page within a site. Similar to the finding of Harrysson, et al. (2004), the results show that some students had difficulties with spelling search terms. Other students were overwhelmed and had problems with choosing "the best" result from many search results.

II.5 Internet Training for Cognitively Disabled Individuals

The reviewed studies in the previous section showed that individuals with cognitive disabilities are capable of using the internet and can benefit from information access despite some difficulties. Thus, addressing these barriers is important to enable easier web access. Therefore, an effective accessible internet training program is essential and can support cognitively challenged individuals as they develop the required skills to take advantage of online access.

Despite the possible value of accessible internet training for individuals with cognitive disability, there is limited research focused on this need. Few studies highlighted internet training for people with cognitive disabilities. Table 3 provides a summary of three selected studies of internet training.
<table>
<thead>
<tr>
<th>Reference and Study Goal</th>
<th>Study Design</th>
<th>Participants</th>
<th>Tasks</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Li-Tsang et al., 2004)</td>
<td>Quantitative</td>
<td>106 persons with intellectual disabilities (77 in the experimental and 29 in the control group). 42 were male and 35 were female participants in the experimental group, while 18 males and 11 females in the control group.</td>
<td>A pre- and post-training and one-month follow-up were used to assess ICT competence. Each participant was asked to complete 9 internet sub-tasks using Internet Explorer. The tasks included browsing specific web pages, using bookmarks and retrieving them, and typing in web addresses.</td>
<td>The experimental group achieved a higher level of computer competence after training and retained skills within one-month follow-up period, [F(75) = 70.06, ( p=.000 )], while there was no statistically significant difference for the control group.</td>
</tr>
<tr>
<td>(Egan et al., 2004)</td>
<td>Qualitative and Quantitative</td>
<td>20 participants with Aphasia (duration of aphasia with a mean of 3.1 years). Participants were 9 females and 11 males with an age range of 29-89 years and 20 tutors with an age range of 14-74 years. All had used the internet before and only 6 had no tutoring experience.</td>
<td>Tutor and student pairs met in “one-on-one sessions” for 6 lessons. The pre- and post-assessments measured the level of independence on a “5-point scale” for 12 internet tasks, like “go to web address and send email.”</td>
<td>Comparing the pre- and post-assessment, the Wilcoxon signed rank test showed that changes in independence level were significant (P&lt;0.05)</td>
</tr>
</tbody>
</table>
Li-Tsang et al. (2004) found that individuals with intellectual disability have the capacity to learn basic computer and internet skills using appropriate timing, learning technique (simplified step-by-step software) and support from teachers. Participants completed two sessions of three hours’ training and completed pre-and post-questions about mouse and keyboard usage and some web browsing using Internet Explorer. The comparison of pre-and post-results showed an improvement in the performance of participants in the experimental group. Moreover, a follow-up study (after one month) indicated that participants retained some of the skills from the training. Overall, a significant difference in improvement for the experimental group was noted [F (75) = 70.06, p = .000], while no significant difference was noted for the control group.

The previous point was also highlighted by Egan et al. (2004), who found that people with aphasia could reach different levels of independence in using the internet by learning through specialized training materials along with support from
volunteer tutors in one-to-one sessions. The adaptive materials included simplified written instructions, formatting with bulleting and numbering, and pictures to support comprehension. Comparing pre- and post-assessments for 12 basic internet tasks, such as “email” or “save website to favorite”, the Wilcoxon signed rank analysis showed that significant changes occurred for the 20 participants (P<0.05).

In another study that used the same training material (Egan et al., 2005), the researchers found people with TBI could reach moderate-to-high levels of independence in using the internet and benefit from the aphasia training material without any modification. The tutors highlighted the value of sustaining interest and motivation during lessons. However, assessing 12 internet skills and moving between tasks in one session was too challenging, causing fatigue and confusion to students. Despite this challenge, using Wilcoxon signed rank analysis to compare pre- and post-assessments, six participants out of seven gained significant independence (z=-2.201, p=0.028).

Considering different types of cognitive challenges, we can observe why inaccessible internet training materials exist for individuals with cognitive disabilities (Egan et al., 2004). Most of the internet training materials, CDs, and online training lessons are geared toward self-directed learners. Usually these learning tools consist of computer terminologies and instructions that already require a certain level of computer proficiency. Thus, people with cognitive disabilities may be challenged to use these inaccessible materials, given their
inexperience with computers (hardware and software) and other possible limitations such as basic literacy (i.e., reading and writing skills).

Another problem with these training materials relates to enrolling a cognitively challenged person in a regular training classroom with non-disabled peers. Keeping up with the normal pace in the classroom and asking clarifying questions could lead to frustration and anxiety for those differently-abled students. In addition, private classes might be an option, but economic barriers often make this solution prohibitive (Egan et al., 2004). Another obstacle that may make internet training challenging is the limited empirical evidence that focuses on factors that affect the internet training, such as views, experiences, and skills of staff or teachers (Chadwick, Wesson, & Fullwood, 2013).

In addition to the previous problems, there are issues related to sampling access and size for cognitive disability research. It was reported in a recent literature review of accessible electronic access (Borg et al., 2014) that none of the included studies that focused on cognitively challenged individuals used a power calculation, and several studies used small sample sizes. This conclusion reflects the difficulties in recruitment of participants explained earlier.

II.6 Cognitive Disability and Repertory Grid Technique

Addressing sampling issues and other difficulties in research with participants who have cognitive disabilities can be accomplished by using the Repertory Grid Technique (RGT). When using RGT, sampling is handled quite differently for personal construct explorations. Size of sample is not as important as
in research that uses other quantitative methods of analysis; the depth of data
gathered per individual subject is the critical component, as is the interview
technique. RGT can explore a participant’s views on a selected topic deeply, and
each participant is treated as an entire data set. This generates a wealth of
information that can be analyzed qualitatively and quantitatively.

Personal Construct Theory (PCT) was developed by George Kelly (1955) to
explore how people construe the world they inhabit. More precisely, this theory
explains how people use their mental representations to create an idiographic
perspective of their surroundings which becomes their reality. Kelly uses the
metaphor of person-as-scientist to illustrate how an individual makes sense of the
environment and individual experiences. The key concept of Kelly’s theory is the
idea of *constructing*. In constructing, individuals use their experience along with
how they perceive the world in order to differentiate between objects, people, and
things. These differentiations are bipolar in nature and are called "bipolar
constructs" (e.g., hot vs. cold). The view of polar opposites does not imply that
constructs’ poles must logically be opposites in the way that antonyms are found in
a thesaurus (Caputi, Hunter, & Tan, 2009). For instance, the constructs dislike-like
and dislike-accept are both acceptable. In the second pair, “accept” does not
necessarily indicate that a person likes a thing.

In order to assess the process of constructing, RGT was developed by Kelly,
(1955) as a tool to explore personal constructs. The term repertory grid originates
from the word "repertoire" which refers to a range of constructs for each participant,
while the grid is related to the analysis of the generated data set per participant. RGT is an action research tool for discovering meaning about an individual’s focused constructs surrounding a chosen topic, through which researchers examine the simplicity or complexity of the construed reality in the grid while suggesting individualized actions for solving problems and creating change.

The main idea of RGT is that each person constructs reality individually so the idiographic (individual) perceptions permeate the data. Thus, the focus is on a person-centered approach. Examples of using RGT include discovering people’s perceptions of devices, systems, design perspective, websites, virtual environment, user interface, and concepts, and it also can establish comparisons between these concepts (Hinkle, 2009). An example of RGT in educational systems can be “a description of a set of ideas, techniques, examples, or illustrations by the pupils who are meant to be learning them, to discover what pupils have learnt, and, perhaps more valuably, how they have learnt them.” (Jankowicz, 2004).

The RGT’s grid is a blank matrix that has n constructs in rows, and m elements in columns. Elements can be "things or events" which are abstracted by a construct and are seen "as the formal aspects of a construct" (Kelly, 1955). In simpler terms, the elements frame the outside of the picture/puzzle of an individual’s reality. The elements are created by the researcher based on the chosen topic. The constructs “color in” the picture in the individual’s own words with weights for the hues and shades of each element.
Two phases are associated with completing a grid: construct elicitation and ratings. Note that these two phases can be completed by either a researcher or a participant. In the first approach, “participant creates construct”, the participant needs to compare three elements at a time (triads) by answering a question from the researcher, “What do two of these elements share in common that the third one lacks?” Once the construct is elicited, the researcher enters it into a matrix on the left side while the opposite pole (also elicited from the participant) will be placed on the right side. Construct elicitation and questioning continues until there is no significant difference in the generated constructs (Cook, & Krupar, 2011). In the rating phase, the subject will rate all elements across the grid using a one-to-five (most common) or one-to-10 scale. Note that the elicited side always represents the lower value of the scale and the opposite side always represents the higher value regardless of the valence of the elicited form of the construct (Fransella, Bell, & Bannister, 2004). Table 4 shows an example of a grid

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Element 1</th>
<th>Element 2</th>
<th>Element 3</th>
<th>Element... n</th>
<th>The Opposite Constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construct 1</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Opposite Construct 1</td>
</tr>
<tr>
<td>Construct 2</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Opposite Construct 2</td>
</tr>
<tr>
<td>Construct 3</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Opposite Construct 3</td>
</tr>
<tr>
<td>Construct... n</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Rank 1-5</td>
<td>Opposite Construct... n</td>
</tr>
</tbody>
</table>

Given this dissertation’s sample population and their challenges, the interview to elicit constructs was determined to be potentially too cognitively
intensive for these individuals. Thus, the second approach, “supplied constructs”, was considered more appropriate since a researcher can create the elements and the constructs based on the topic of interest. Sometimes research participants might not provide the constructs that would be significant to the goal of the study. An example of the selected constructs approach is found in the experimental studies focused on language by Fransella et al. (2004). In these studies, it might be essential for a researcher to compare relationships between certain words, and thus, the supplied constructs would be mandatory. Similarly, a grid could be constructed by an individual when considering which computer to purchase, using the basic features of each computer model, and then ranking each feature according to its value, use potential, cost, warranty, ease of learning, and so forth.

Several studies from the literature reported the value of using RGT with individuals with cognitive disabilities. In a review of psychological therapies for people with learning disabilities, Lindsay (1991) recommends using RGT as “more sensitive to individual differences and personal considerations.” Hare (1997) found that RGT aided in analyzing the interpersonal tensions of one woman who struggled to live within a small community home for people with learning disabilities. Rather than focusing on changing the woman's behavior and considering her “the problem”, RGT enabled the housing staff to identify possible changes in the housing policies. Additionally, RGT allowed the woman to express her opinion about the staff and residents in a non-aggressive and constructive
manner. Another feature of this study was the value of using visually-presented elements (photographs) to aid comprehension.

In work with four men with Asperger Syndrome, Hare, Jones, & Paine (1999) concluded that RGT is not only a feasible and practical approach to assess psychological problems, but it is also the most useful when other approaches do not work. The authors highlighted the value of the simplicity and the flexibility of the RGT structure compared to other assessment tools. Hare, Searson, & Knowles (2011) illustrated the effectiveness and richness of using RGT with two women with intellectual disabilities to discover their perception about their caregivers. The authors reported that both women were misunderstood by the caregivers as being considered cognitively disabled. The completed RGTs showed that one participant was acting aggressively because she was unfairly considered at risk of hurting others, and therefore was being isolated, although she wanted to be independent. Additionally, she was considered by caregivers to be rude but she was missing her grandfather who used to listen to her. The authors recommended sharing the RGT format for cognitively disabled individuals with families and caregivers as a way of avoiding mismatched perceptions and inadequate understanding.

II.7 Summary

This chapter shows that no universal definition of cognitive disabilities exists and that a variety of cognitive conditions and challenges may be caused by many reasons, some of which are unknown. In addition, any single cognitive disability may have more than one specific challenge, and it can overlap with other
physiological and psychological conditions as well. Therefore, people with cognitive disabilities should be represented by the functional model rather than the medical one.

The chapter also highlights the limited research in the area of web use and cognitive disabilities. Lack of sufficient guidelines and inclusion of cognitively challenged individuals are some of the reasons for the scarcity of research. The reviewed studies show participants with cognitive disabilities can benefit from alternative formats and modalities during web activities like web searching. Moreover, appropriately structured internet training can have significant impact on individuals’ performances.

Finally, the chapter describes the value of using RGT with people who have cognitive disabilities. RGT can explore a participant’s perception about a topic deeply as each participant will be treated as a data set that can generate a wealth of information qualitatively and quantitatively. Thus, RGT is a promising method for addressing the sampling issues that researchers encounter when studying participants with cognitive disabilities.
CHAPTER III

ADDING AND ADAPTING WEB SEARCH FEATURES

III.1 Introduction

This chapter describes a study that was conducted to answer the first research question and complete the first objective of this dissertation. The goal of the study was to identify how students with cognitive disabilities search the web using different input methods (text, voice searching by microphone, and hands-free voice searching). Moreover, this section explores how these features could be used with Google lessons, existing mainstream training materials, with appropriate adaptations.

III.2 Adding the Web Features

III.2.1 Background

Almost all the reviewed studies failed to concentrate on web searching for people with cognitive disabilities as a primary investigative objective. Additionally, they focused only on one input method for searching, which was typing. However, recent advances in technology have created new ways for people to perform web
searches. New features available for the Google search engine allow searching using speech input rather than typing. Additionally, visual images can be included in search results, potentially making it easier for people with cognitive disabilities to use search tools to find information, by reducing reliance on reading text. Google Knowledge Graph (KG), a feature that provides a summary of information in response to some searches, may also be helpful. As a first step in this research, therefore, a study was conducted (Nour, 2015) to assess the contributions of these Google search engine features and what value they have for users with cognitive disabilities.

III.2.2 Method

The features explored in the study included, first, voice searching with a manual microphone. The standard Google search box includes a microphone icon. By clicking that icon, the user can activate voice recognition, allowing them to speak their search terms. Second, hands-free voice searching was explored. The Google Chrome searching feature allows users to trigger voice recognition by saying “OK Google” rather than clicking the microphone icon. Third, the inclusion of images in search results was employed to enhance searching functions, using the Search Preview extension for Google Chrome. This adds thumbnail images to search results. The final innovative search feature is Google Knowledge Graph (KG). This relatively new feature (introduced in 2012) displays a summary of information in response to the user’s search terms, as a supplement to the search results for
selected searches. When either form of voice search is used, the KG summary is spoken. Figure 3 shows all the included features.

III.2.3 Participants

The six participants, who were recruited from a school for students with special needs, were five females and one male, ranging in age from 20 to 23. The medical diagnoses for the participants were Autism (two participants), ADHD, TBI, Down syndrome, and Turner syndrome. A Mini Mental State Examination (MMSE) was completed to measure the cognitive ability of the participants. The results of the MMSE show that all the participants are classified as “higher functioning”. However, the participants reported challenges with reading, listening, math, paying attention, and memory. All the six participants were frequent computer users, using "mainly desktop" computers either at school or at home. All of them used the
internet daily, and used Google to search for things like games, facts, applications and others.

### III.2.4 Procedure

The study was conducted at a special needs school in a large metropolitan area of Colorado. The researcher met with the students twice between 10 a.m. and 12 p.m. on different weekdays that fit their schedule. The first meeting was to complete consent forms, gather demographic data and conduct the cognitive measurement test. This meeting took around 15-20 minutes for each participant. The second meeting was to go through pre-test questions, perform the actual tasks and ask post-test questions to find participants’ preferences and understand their computer experience. The second meeting took around 25-35 minutes for each participant. Participants received $30 gift card from Target for their participation in the study. The participants performed the tasks using Google Chrome as the browser on an HP Windows touch tablet. All sessions were recorded using “Morae”, the usability software system.

### III.2.5 Search Tasks

Six search tasks were defined, two in each of three categories. First, the ‘specified source’ tasks were finding information about “cats” on Wikipedia and locating a rating for a movie called “Home Alone 2” from Internet Movie Database’s (IMDB) website. Second, the ‘free source, easy’ tasks were finding the year George Washington was born and finding the population of Omaha, Nebraska. Third, the...
‘free source, difficult’ tasks were identifying two things that Google Glass does and finding two ingredients in a recipe for onion soup. The information required for the ‘specified source’ and ‘free source, easy’ tasks could be found in the Google KG summary, while the information required for the ‘free source, difficult’ tasks did not appear there.

III.2.6 Experimental Design

Three input conditions were employed in the study design. Voice searching with manual control, hands-free voice searching, and searching by typing on the tablet’s on-screen keyboard as well as two output conditions including with and without images in search results. Each participant performed six tasks, one each in each combination of the three input conditions and two output conditions. A balanced Latin square was used to balance the occurrence of particular tasks with the input and output conditions and the order of tasks and conditions, as shown in Table 5.

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Order of Tasks</th>
</tr>
</thead>
<tbody>
<tr>
<td>P/T</td>
<td>Task 1 Wikipedia</td>
</tr>
<tr>
<td>1</td>
<td>Typing (image)</td>
</tr>
<tr>
<td>2</td>
<td>Typing (no image)</td>
</tr>
<tr>
<td>3</td>
<td>Microphone (image)</td>
</tr>
<tr>
<td>4</td>
<td>Microphone (no image)</td>
</tr>
<tr>
<td>5</td>
<td>OK Google (image)</td>
</tr>
</tbody>
</table>
After performing all six tasks, the participants were asked to use whatever search condition they preferred to look for any information that interested them. This final task sought to assess participants’ preferences indirectly when searching the web.

The researcher demonstrated to each participant how to use each method of searching when the method first appeared in the task order. The researcher showed what sample search results looked like, the first time images appeared in the task order, and the first time images did not appear. Each task’s question was read once, and a paper with the question was placed in front of the participant in case they forgot it.

The researcher followed a protocol that specified when to intervene and when to move to the next task. These included three scenarios. First, the researcher would intervene if the participants asked for help, e.g., if they did not understand the question. Second, if the participant said that he or she found the answer to the question, or said they could not find it, they were told to move to another task. Finally, if the participant was spending some time to find the answer, then the researcher would not intervene immediately, but would give between two to four additional minutes. This protocol sought to give adequate time to complete the tasks, without extending the testing period unduly.
III.2.7 Results

All tasks were successfully completed except Task 6 for Participant 1 and Task 3 for Participant 2. Generally, these two questions were the most difficult ones since the students were not familiar with the topics. When performing the final task with the method of their choice, three participants preferred typing over voice searching, likely since some of them encountered voice recognition issues. On the other hand, the other three participants favored hands-free voice searching as they pointed to the importance of overcoming spelling difficulties. None of the participants liked voice searching by clicking on the microphone; one of them claimed that it required too many steps. Three participants said having images in the search results was helpful and the others found no difference as they read the links.

The analysis of the video recordings showed that the easiest task was finding information on Wikipedia because all the participants were familiar with the site. On the opposite end, the most difficult task was searching for Google Glass, as it was something new to all of them. Moreover, the KG did not provide any information here. Therefore, most of the participants spent more time on this task. The KG was very useful to all the participants when it was available.

III.2.8 Conclusion

The results of this study answered the first question by underlining the importance of different learning modalities and the flexible design approach. Due to the variation in abilities and conditions among individuals with cognitive
disabilities, no one design fits all. When searching the web, some people preferred voice searching to overcome spelling hurdles, while others favored the traditional method of typing. Images in search results can be helpful for some individuals to have a better searching experience.

III.3 Adapting Google Lessons to Support Learners with Cognitive Disabilities

In 2012, Dan Russell and his team at Google introduced new search education lessons that aim to help teachers to educate students on web searching skills related to Google search engine (Google Search Education, n.d.). The lessons focused on a broad range of students from different grade levels and technological expertise. The lessons address five different topics: picking the right search query, understanding the search results, narrowing search results, finding evidence in search results, and evaluating the credibility of sources. Except for the final topic, each topic has three different levels: beginner, intermediate, and advanced.

The advanced lessons are directed toward more proficient users, while the beginner lessons are designed for those with no or limited knowledge of web searching. Each lesson includes recommended settings and techniques for working with students mostly in groups. Moreover, a learning method is provided with supported examples and PowerPoint slides showing how to teach the students the required skills. Google suggests that teachers have the option to peruse all lessons and adapt those that best serve their particular students. Also, important to note is that the Google search engine must be used while going through the training
lessons. Most of the features in the lessons are only supported by the Google search engine.

For the purpose of this dissertation, the Google Search Education lessons have been adapted to better meet the needs of learners with cognitive disabilities. Two forms of adaptation were needed; first, to accommodate the use of the added search features just described, and second, to change the form and presentation of the lessons to work for students with cognitive disabilities, based on input from experienced teachers who work with these students.

III.4 Adapting the Google Lessons to Support the Added Features

The structure of most of the Google lessons tends to support only those who can type. Therefore, using voice searching might be helpful for some lessons; it has limitations in some lesson areas. For example, in the lessons that focus on narrowing search results, operators such as “symbols or word” defined by Google exist to narrow the search results (Google Search Operators - Google Guide, n.d.). For instance, if a user wants to search for a phrase, using the phrase between two double quotation marks like “imagine all people” is necessary. However, if the same user tries to search the same query using voice searching, saying the word “quote”, the Google recognizer will not see the quote as “an operator” and will simply add the word “quote” instead of the symbol.

This search issue was solved by developing an enhanced voice searching feature using the Web Speech Application Programming Interface (API). The API, introduced by Glen Shires of Google in 2014, includes browser code built into the
“client side” to capture a user's input audio and “server side” code at Google servers that handles the actual speech recognition and return the results in a view box. This API only works on the Chrome browser. The current demo of this Web Speech API can be found here (Web Speech API Demonstration, n.d.).

Working on the open source code “client side”, the current Web Speech API was modified to develop a controlled voice search. The modification encompasses controlling the results that come back from Google’s server. That is, certain recognized words are converted to operators before the query is processed. For instance, in the previous example of the double quotation marks, the user needs to say the word “start” to open the quote following with the phrase then the word “end” to close the quote. Table 6 offers a supportive information sheet on how to use all the enhanced voice searching operators.

<table>
<thead>
<tr>
<th>Operators</th>
<th>Usage</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tag</td>
<td>Find social media tag</td>
<td>Tag Denver</td>
</tr>
<tr>
<td>Minus</td>
<td>Remove words. Use it before a word or site to exclude results that include that word or site.</td>
<td>Colorado minus Denver The result here will exclude anything that has Colorado and Denver together and retrieve anything else with Colorado</td>
</tr>
<tr>
<td>Site</td>
<td>Get results from specific sites or domains. For instance, you can find all mentions of “broncos” on Denver.com</td>
<td>broncos site denver.com</td>
</tr>
<tr>
<td>Link</td>
<td>Find pages that link to a specific page. It is important to track a specific link. For example, you can find all the pages that link to denver.com.</td>
<td>Link denver.com</td>
</tr>
<tr>
<td>Hashtag</td>
<td>To search for hashtags</td>
<td>Hashtag Denver</td>
</tr>
<tr>
<td><strong>Related</strong></td>
<td>Find sites that are similar to a URL you already know. If you search for related sites to the time.com, you'll find other sites of interest.</td>
<td><strong>Related</strong></td>
</tr>
<tr>
<td><strong>OR</strong></td>
<td>To combine searches for pages by including OR between the words. Without the OR, results will be only the pages that match both terms.</td>
<td></td>
</tr>
<tr>
<td><strong>File Type</strong></td>
<td>To search for documents with a specific file type like PDF or PowerPoint</td>
<td></td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>To get all pages that have the search term in the title</td>
<td></td>
</tr>
<tr>
<td><strong>URL</strong></td>
<td>Google restricts results to those containing all the query terms you specify in the URL</td>
<td></td>
</tr>
<tr>
<td><strong>Range</strong></td>
<td>Searching between range of numbers</td>
<td></td>
</tr>
<tr>
<td><strong>Start</strong></td>
<td>Search for a phrase or quote</td>
<td></td>
</tr>
<tr>
<td><strong>End</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Star</strong></td>
<td>You can use it with quote. The star will work as a placeholder for any unknown or wildcard terms. Use within the quotation to find variations of that exact phrase or to remember words in the middle of a phrase.</td>
<td></td>
</tr>
<tr>
<td><strong>Underscore</strong></td>
<td>To search for connected or hyphenated words like Evidence-based research</td>
<td></td>
</tr>
<tr>
<td><strong>Text</strong></td>
<td>If you start your query with text, Google restricts results to those containing all the query terms you specify in the text of the page</td>
<td></td>
</tr>
</tbody>
</table>

The images in search results were added to search returns using the Search Preview Chrome extension to aid comprehension. The extension can be installed freely from the Google store. As indicated earlier in section III.2, incorporating
pictures in search results might be helpful to some people with cognitive disabilities to understand search results. Each lesson can support this feature, as it works on the presentation of the search results.

With the features provided, a person with cognitive challenges can choose any of the following techniques when they search:

- Typing without images in search results.
- Typing with images in search results.
- Voice searching without images in search results.
- Voice searching with images in search results.
- Typing and using the microphone without images in search results. For example, a user who searched by typing but did not find the answer could search again using the microphone to find it.
- Typing and using voice searching with images in search results. For instance, a user who does not find an answer when using voice searching could change the searching method to typing.

III.5 Summary

This chapter answers the first research question by showing the value of different search tools such as voice searching and images in search results. The chapters describe the added search tools and how they can support people with cognitive disabilities. Including images in search results in addition to using voice searching may aid cognitively-disabled individuals when they search on the web.
The chapter shows that the Google Search Education lessons are great examples of training material that can be adapted to support learners with cognitive disabilities. Additionally, adapting these lessons to support added features like images in results, voice searching and enhanced voice searching tools can also help people with cognitive challenges to use other Google search engine features, including operators.
CHAPTER IV

CREATING WEB SEARCHING TRAINING PROGRAM

IV.1 Introduction

This chapter outlines the research plan for answering the second research question, including adapting lessons for cognitively disabled individuals. The chapter focuses on how the researcher worked with teachers at a special needs school to create adapted web search training lessons that fit students with cognitive disabilities.

IV.2 Developing Accessible Training Lessons for Web Searching

IV.2.1 Setting

The meetings with the teachers occurred at their school, a special needs school that supports a variety of cognitively challenged students. A conference room at the school was used for meetings. A projector in the room was used to help the researcher present information and to facilitate discussion.

IV.2.2 Participants

Four teachers (three females and one male) with an age range of 27-33 years participated in developing the accessible web searching training materials and,
later, in training the students. All the teachers had between two and ten years’ experience working with cognitively challenged students. All reported teaching their students using computers and the internet on a daily basis at the school to search for information. This included finding definitions of words, downloading templates of papers for writing assignments, finding information from specific websites, and looking at newspapers and current events. Table 7 shows background information on the teachers.

Table 7

<table>
<thead>
<tr>
<th>P</th>
<th>Gender</th>
<th>Age</th>
<th>Educational Background</th>
<th>Experience with cognitively challenged students</th>
<th>Work time with the current school</th>
<th>Use of the internet with the students</th>
<th>Examples of search topics used with students</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>M</td>
<td>28</td>
<td>Masters in Education (Human Growth and Development)</td>
<td>2 years</td>
<td>1 year</td>
<td>Daily</td>
<td>Specific word searches and definitions, order of words, and keywords</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>28</td>
<td>B.S. in Special Education and Colorado Teaching License</td>
<td>4 years</td>
<td>1 year</td>
<td>Weekly</td>
<td>Templates for writing papers for assignments</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>33</td>
<td>B.S. in History/Secondary Social Studies Education and Colorado Teacher License for Special Education</td>
<td>10 years</td>
<td>10 years</td>
<td>Daily</td>
<td>Research, finding, and understanding information from specific websites</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>27</td>
<td>B.S. in Sociology with counselling focus and masters in clinical mental health</td>
<td>3 years</td>
<td>3 years</td>
<td>Daily</td>
<td>Newspaper, art posters, videos and current events</td>
</tr>
</tbody>
</table>
IV.2.3 Materials

The starting points for the lessons were the Google Search Education Lessons, described earlier in Chapter III, section III.3. The researcher provided notes on using the additional search features to be included in the study, since these were not covered in the Google training materials.

IV.2.4 Procedure

The teachers participated in eight meetings to work on the materials. To accommodate teachers’ duties and different scheduling during school hours, the meetings were arranged after school hours between 3:30 p.m. and 4:30 p.m. The researcher used two methods to record the results of these meetings. First, for each meeting with the teachers, the researcher wrote comments and notes. Second, the teachers were requested to send search tasks, questions or any comments by email to the researcher.

The first meeting with the teachers was to collect background information about the participating teachers. The second meeting introduced the Google lessons and the added web features. After that, the teachers took two weeks to go through the materials to discuss them. In the third meeting, the teachers gave their feedback about the Google lessons and how to use these with the students. Moreover, they highlighted the importance of using the added features to support many students. At the end of this meeting, the teachers were asked to draft example search tasks for all lessons within two weeks.
For the following meetings, the researcher and the teachers agreed to meet weekly. Moreover, teachers would send their searching tasks or any comments a day before each meeting to help the researcher prepare answers in order to have an effective meeting within the one-hour limit. In the fourth meeting, the researcher and the teachers discussed the draft search tasks. In the fifth meeting, an agreement was made on the search tasks to be used and another discussion focused on developing a worksheet to present the search tasks to the students. In addition, the teachers discussed an appropriate format for students’ handouts to help them find the answers to the search tasks during the training. Moreover, the teachers requested their own manual to use when training the students.

The sixth meeting focused on discussing another set of search tasks for the students, to be used as a post test at the end of the study. The seventh meeting was devoted to developing the RGT materials to be used for assessment. The researcher presented an example of an RGT grid, using the idea of buying a laptop by comparing specifications from different brands. Table 8 shows the grid explained to the teachers.

<table>
<thead>
<tr>
<th></th>
<th>Mac</th>
<th>HP</th>
<th>Dell</th>
<th>Sony</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>The looks are to die for</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>2</td>
<td>Looks boxy and standard</td>
</tr>
<tr>
<td>Many software options</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>Limited software</td>
</tr>
<tr>
<td>Fast performance</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>Slow performance</td>
</tr>
<tr>
<td>Easy to upgrade</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>Upgrade is a dealer job</td>
</tr>
</tbody>
</table>
In the final meeting, the eighth, the researchers and the teachers reviewed and agreed on the training plan.

**IV.2.5 Results**

As mentioned earlier, the researcher collected notes from each meeting with the teachers in addition to teachers’ suggestions sent by email. The notes included the following subjects:

- Feedback on Google lessons and how to adapt them to support students.
- A teacher’s instructions to use in the training.
- Recommendations for added web features to support students in the training.
- A worksheet with suggested search tasks to be used by the students.
- Draft student handouts to use during the training.
- Suggestions for developing RGT grids for student use that would focus on searching abilities, training and handouts.
- Suggestions and lessons learned from working with the teachers.

Note that the first two subjects from the previous list are explained in this section while all the others are presented in the next **Chapter V** which focuses on the work with the students.
IV.2.5.1 Feedback on Google Search Lessons

Considering the teachers' searching skills, the teachers were familiar with the process of creating keywords and choosing reliable sources. However, they did not know some ideas related to understanding search results. For example, they did not know that words used in a search query are highlighted in "Bold" in the snippets from the search results. Additionally, the teachers did not know most of the Google search options (e.g., choosing picture size, video length, news article from a specific date, filetype, site, and double quotes operators). All the teachers indicated that they themselves learned these features in the study, and some of them said that they might have learned more than the students had.

The process of developing the lessons with the teachers was valuable for them. However, this does not mean that future studies need to provide teachers with training. Google Search Education lessons are comprehensive and well designed in terms of explaining search skills, and teachers only need to follow the instructions on their own. In fact, for this study, no training was provided to the teachers. The researcher only introduced them to the Google lessons briefly, and then they spent two weeks learning about the lessons by themselves. After that, the teachers met with the researcher to discuss and decide which lessons and searching skills were important to teach the students.

These experienced teachers had many suggestions for improving the Google lessons for their students. The following are the main points teachers highlighted:
• Google lessons with different levels are “great” to support the differences in the abilities between students with cognitive disabilities.

• All lessons are suitable for the training except for Lesson 5, which focuses more on reading content and evaluating authors tone and bias.

• Each Google lesson is very lengthy.

• The structure of each Google lesson is “overwhelming” when used. For instance, each lesson document has main points along with examples. Additionally, some links to Power Point slides are offered, which contain screenshots for answers, or more explanation. Thus, considering the many words within the document, it will be difficult to move between the document and the Power Point slides to teach. Instead, “ideally it would be great to have the screenshots placed immediately after the main points for easier use.”

• For each Google lesson, instead of looking at different examples for the same topic, only choose one.

• Some of the Google lessons highlight points that can only be presented to the students instead of letting them search. However, this process will not work for students with cognitive disabilities, as some of them might get lost or not pay attention. Instead, a better approach is to let them search during the training lessons to facilitate engagement.
• Designing the training lessons should be presented in the form of “why would I use this?” by letting students search for things they are interested in or with which they are familiar.

• The training and the search tasks should be organized into goals and objectives. Most of the students learn effectively using a Today my goal is…” approach. Thus, it is important to inform the students, for example, that the day’s goal is to find a PDF file instead of searching for an hour looking for different pages.

• The training lessons should have clear and summarized action sequences "step-by-step" to achieve the goal.

IV.2.5.2 Teachers’ Instructions

A second category of notes focused on developing instruction sheets for the teachers during training. These are guidelines organized in chronological order on what to do in each meeting with the students. For example, guidelines focused on how many tasks to complete per meeting, which task should be presented first, when the training would occur, and others. Appendix A shows the instructions that resulted

IV.2.5.3 Suggestions and Lessons Learned from Working with the Teachers

Generally, the discussions with the teachers worked well. The process used evolved over the course of the project, and there are some lessons learned that may
be useful in undertaking similar design work in future. Here is a description of the key points about the process that emerged:

- Teachers have a lot of responsibilities; thus, the researcher should schedule meetings with them in advance, at least a week before the desired date. However, meeting cancellations should also be expected.
- A teacher point person should be recruited who can contact the researcher in case a meeting needs to be cancelled at the last minute or if other questions or issues arise.
- Meetings should be scheduled for no more than one hour.
- Considering teacher’s duties, it is recommended to let them choose the best time that works for all of them. In this study, after school hours were most convenient.
- Meeting agendas should be prepared and shared in advance. However, the researcher should not assume that all teachers will read or review it. Therefore, the full agenda should be reviewed during each meeting.
- Researchers should meet with the teachers and explain the structure of the lessons, allowing them to ask questions and to establish prior knowledge.
- Researchers should give the teachers a link to access the lessons and send the link by email.
- Teachers should be allowed to have adequate time to go through the lessons. In this study, at least two weeks was required.
• To avoid confusion, researchers should start with one lesson per meeting and consider concepts, the questions that need to be created, examples ...etc.

• Researchers should be specific about what they require teachers to do. For example, researchers might ask teachers to look at what concepts or topics can benefit the students with cognitive disabilities. It is helpful to send full details of the required tasks by email.

• Researchers should not assume that the teachers understand what is said or not said. Thus, all the search tasks and their answers should be reviewed with teachers.

• Some teachers are not tech-savvy so researchers need to be prepared to explain concepts in more detail with examples. For example, none of the teachers in this study knew how to install and enable or disable an extension in Chrome browser.

• All the teachers should be asked to share their opinions and ideas. This was very valuable in this study as the developed questions changed several times. For example, two teachers suggested changing the related questions in Lesson 4 from table presentation to a multiple choice format.

• Researchers should provide email and contact information in case teachers have questions during the research process.
CHAPTER V

APPLYING TRAINING LESSONS TO STUDENTS WITH COGNITIVE DISABILITIES

V.1 Introduction

This chapter describes the evaluation process for answering the second research question, including using the developed lessons and materials, data collection and data analysis.

V.2 Setting

This study was conducted at a special needs school in a large metropolitan area on the Front Range of Colorado. The school supports a variety of students with learning disabilities, autism, Asperger's Syndrome, ADHD, and others through different programs and services. These services are in the areas of academics, independent living, and social skills. The school is a middle and high school for students 6th -12th grade. The age range for the students is between 14 and 21 years. The school has eight teachers and 50 students. The school has 8 classrooms, each of them with computers where students learn and study different topics using the computers and internet on daily basis. Each classroom has between 5-6 computers.
V.3 Participants

19 students with cognitive disabilities from the school described in Section V.2 above participated in the study. Inclusion criteria for selection purposively included students with any type of cognitive challenge with no restriction on age. Exclusion criteria included any physically-grounded disabilities such as visual or hearing deficits that affect the ability to see or hear instructions. An additional exclusion criterion included those who could not speak or understand English. The students gave informed consent regarding participation, in addition to having their parents or guardian sign a consent form before the student participated. Each student was informed that they would get a $30 gift card from Target for every hour of their participation. Demographic information for the 19 participants is shown in Table 9.

<table>
<thead>
<tr>
<th>P</th>
<th>Gender</th>
<th>Age</th>
<th>Education</th>
<th>Academic Accommodation</th>
<th>Disability Information/Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1 F</td>
<td>16</td>
<td>High School</td>
<td>- Extended time</td>
<td>-Reading and comprehension</td>
<td></td>
</tr>
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<td>- Use of calculator</td>
<td>-Listening</td>
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<td>- Scribe to assist with writing</td>
<td>- Easily distracted by others</td>
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<td></td>
<td>- Reader to assist with reading</td>
<td>- Remembering/Memory</td>
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<td>- Executive function</td>
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<td></td>
<td>- Paying attention</td>
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<tr>
<td>P2 F</td>
<td>15</td>
<td>Middle School</td>
<td>- Extended time</td>
<td>-Reading and comprehension</td>
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<td></td>
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<td></td>
<td>- Scribe to assist with writing</td>
<td>-Writing</td>
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<td></td>
<td></td>
<td></td>
<td>- Reader to assist with reading</td>
<td>-Listening</td>
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<td>- Easily distracted by others</td>
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<td>- Remembering/Memory</td>
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<td>- Executive function</td>
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<td>- Paying attention</td>
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<td></td>
<td>- Speech is difficult to understand</td>
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<td></td>
<td>High School</td>
<td>-Extended time</td>
<td>-Reading and comprehension</td>
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<td>----------------</td>
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<tr>
<td>P3</td>
<td>M</td>
<td>16</td>
<td></td>
<td>-Use of calculator</td>
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<td></td>
<td></td>
<td>-Scribe to assist with writing</td>
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<td></td>
<td></td>
<td></td>
<td>-Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P4</td>
<td>M</td>
<td>10</td>
<td>Middle School</td>
<td>-Extended time</td>
<td>-Listening</td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>-Use of calculator</td>
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</tr>
<tr>
<td>P5</td>
<td>M</td>
<td>16</td>
<td>High School</td>
<td>-Extended time</td>
<td>-Reading and comprehension</td>
</tr>
<tr>
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<td></td>
<td></td>
<td>-Scribe to assist with writing</td>
<td></td>
</tr>
<tr>
<td>P6</td>
<td>M</td>
<td>15</td>
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<td>-Extended time</td>
<td>-Reading and comprehension</td>
</tr>
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<td></td>
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<td></td>
<td>-Use of calculator</td>
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<td></td>
<td></td>
<td>-Scribe to assist with writing</td>
<td></td>
</tr>
<tr>
<td>P7</td>
<td>M</td>
<td>14</td>
<td>Middle School</td>
<td>-Extended time</td>
<td>-Writing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Scribe to assist with writing</td>
<td></td>
</tr>
<tr>
<td>P8</td>
<td>M</td>
<td>15</td>
<td>Middle School</td>
<td>-Extended time</td>
<td>-Writing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Use of calculator</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Scribe to assist with writing</td>
<td></td>
</tr>
<tr>
<td>P9</td>
<td>M</td>
<td>15</td>
<td>High School</td>
<td>-Extended time</td>
<td>-Reading and comprehension</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Use of calculator</td>
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<td></td>
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<td>-Scribe to assist with writing</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>-Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>ID</td>
<td>Gender</td>
<td>Age</td>
<td>School</td>
<td>Accommodations</td>
<td>Other Issues</td>
</tr>
<tr>
<td>-----</td>
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<td>-------------</td>
</tr>
<tr>
<td>P10</td>
<td>M</td>
<td>18</td>
<td>High</td>
<td>Extended time</td>
<td>Reading and comprehension, Easily distracted by others, Paying attention</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P11</td>
<td>M</td>
<td>17</td>
<td>High</td>
<td>Extended time</td>
<td>Reading and comprehension, Writing, Listening, Easily distracted by others, Remembering/Memory, Executive function, Paying attention</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P12</td>
<td>F</td>
<td>16</td>
<td>Middle</td>
<td>Extended time</td>
<td>Writing, Listening, Easily distracted by others, Executive function, Paying attention, Motor challenges (eating or personal care)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P13</td>
<td>F</td>
<td>17</td>
<td>High</td>
<td>Extended time</td>
<td>Easily distracted by others, Remembering/Memory, Executive function, Paying attention, Wears Glasses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P14</td>
<td>F</td>
<td>13</td>
<td>Middle</td>
<td>Extended time</td>
<td>Reading and comprehension, Writing, Listening, Easily distracted by others, Remembering/Memory, Executive function, Paying attention</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P15</td>
<td>M</td>
<td>15</td>
<td>High</td>
<td>Extended time</td>
<td>Writing difficulty, Easily distracted by others, Executive function, Paying attention, Wears glasses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P16</td>
<td>F</td>
<td>15</td>
<td>High</td>
<td>None</td>
<td>Easily distracted by others, Remembering/Memory, Executive function, Paying attention, Wears glasses</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P17</td>
<td>M</td>
<td>15</td>
<td>Middle</td>
<td>-Scribe to assist with writing</td>
<td>Dysgraphia, Easily distracted by others, Executive function</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
<tr>
<td>P18</td>
<td>M</td>
<td>17</td>
<td>High</td>
<td>Extended time</td>
<td>Comprehension, Writing</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>School</td>
<td>-Use of calculator Reader to assist with reading</td>
<td></td>
</tr>
</tbody>
</table>
Table 10 lists the internet experience for the 19 participants. Only four of the participants use laptops while the others use desktop computers. The experience with web usage ranged between 2-8 years, and the average number of hours per day spent on the web ranged from 1-7 hours per day. Two participants preferred Internet Explorer as their browser while the others used Google Chrome. The interviews with the students indicated that some examples of things students search included video games, science projects, and pictures.

Table 10

<table>
<thead>
<tr>
<th>Students’ Web Usage and Experience</th>
</tr>
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<tbody>
<tr>
<td><strong>P</strong></td>
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</tr>
<tr>
<td>P1</td>
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<td>P2</td>
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<td>P3</td>
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<td>P10</td>
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<td>P11</td>
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<td>P15</td>
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<td>P16</td>
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<tr>
<td>P17</td>
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<td>P18</td>
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<tr>
<td>P19</td>
</tr>
</tbody>
</table>
The teachers arranged the students in three groups, using the Group Reading Assessment and Diagnostic Evaluation (GRADE) exam. The GRADE is “a normative diagnostic reading assessment that determines what developmental skills students have mastered and where they need instruction or intervention” (Group Reading Assessment and Diagnostic Evaluation, n.d.). Every year, the school administers the GRADE reading test to their students at the beginning of the year, and then again at the end of the year. This standardized test assesses reading comprehension and vocabulary and gives the “Grade Equivalency” of the students’ reading ability. Using this assessment, the teachers categorized the students into three groups as the following:

- Beginner Level: < 4th grade reading ability.
- Intermediate Level: 5th - 8th grade reading ability.
- Advanced Level: > 9th grade reading ability.

Using GRADE scores, three students were placed in the beginner group (P1, P2, and P3) while 11 students were placed in the intermediate group (P4-P14). The intermediate group was subdivided into two groups. This was because no classroom at the school had 11 computers, since the maximum was six computers per classroom. Thus, five students (P4-P8) were treated as the first intermediate group while the other six students (P9-P14) were the second. Finally, five students were placed in the advanced group (P15-P19).
Note that instead of focusing on the medical diagnosis in grouping the students, the teachers focused on the functional capabilities of the students. The focus was on the reading and comprehension abilities of the students. Based on that, the teachers placed students with the same medical diagnosis but different functional abilities in different groups.

V.4 Materials

The students used six sets of materials during the training process. These were: a web features manual; a worksheet for each lesson which described the search tasks; handouts that provided step-by-step answers to search tasks and summary notes for each lesson; an RGT grid to assess students’ searching abilities before and after the training, a grid for evaluating each training lesson, and a grid to assess the handouts for future use. Table 11 shows a summary of these student materials; each set is described more fully below.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Added Web Features Manual</td>
<td>A customizable voice searching and images in search results</td>
</tr>
<tr>
<td>Student Worksheet</td>
<td>The search tasks that the students will answer</td>
</tr>
<tr>
<td></td>
<td>Consist of two types:</td>
</tr>
<tr>
<td>Student Handouts</td>
<td>1- Step-by-Step answer to search task</td>
</tr>
<tr>
<td></td>
<td>2- Summary notes of each lesson</td>
</tr>
<tr>
<td>Searching Ability Grid</td>
<td>A student perception of his/her ability to search before and after the training</td>
</tr>
<tr>
<td>Training Grid</td>
<td>A student perception of each training lesson</td>
</tr>
<tr>
<td>Handouts Grid</td>
<td>A student perception of training handouts</td>
</tr>
</tbody>
</table>
V.4.1 Added Web Features Manual

Although the teachers reported that the majority of their students could type, they suggested that voice searching could be a useful tool to support some students that struggled with typing, as well as those who were nervous about their capabilities. In addition, adding the images to search results was also favored, and teachers felt it could help some students comprehend the results. However, it might have been overwhelming to some students to have images as these items can easily distract a student. The teachers suggested that these added features should not be mandatory but that they be offered as an option. The manual describing these features can be found in Appendix B.

V.4.2 Students’ Worksheets

The teachers suggested developing search tasks in the format of a worksheet. The developed search tasks were created based on the students’ abilities and familiarities with topics. Moreover, the tasks highlight what teachers teach students on a daily basis. This includes specific topics like history, the animal world, foods and restaurants, and movies and documentaries. The search tasks were created to support the three levels of user groups (beginner, intermediate and advanced), with tasks provided for pre- and post-tests for each lesson. Table 12 shows the number of search tasks for the entire training.
The goal of the pre- and post-questions was to evaluate the effectiveness of the search lessons. The pre- and post-questions were similar, but not identical, in order to minimize the practice effect. However, the steps required to complete the tasks were the same. For instance, the beginner group who needed to answer a pre-question for Lesson 3 would go through three steps to find PowerPoint slides about a book titled “20,000 Leagues Under The Sea” by Jules Verne (i.e., open Google.com, write the search query supported with the search operator, and select the answer). The same group needed the same three steps to answer the post-question which was finding PowerPoint slides about a different book titled “The Adventures of Huckleberry Finn” by Mark Twain.

The search tasks were developed with general prompts or scenarios to focus the student’s efforts online, rather than specific questions. The motivation behind this technique was to let them practice working on problem solving. Avoiding giving them a clearly stated question was critical sometimes, as some students might have used a specific question as a search query with no change. Moreover, some of these
questions could lead to answers by Google KG, which would not allow us observe how the students looked for answers in more open-ended situations.

There were two criteria that were used to create the search tasks with the teachers; the readability and comprehensibility of the selected topics and the availability of the likely search results.

**Topic readability and comprehensibility:** Topics were chosen based on the assumption that the students would be able to understand the question and read most of the related search results easily considering their GRADE reading score. Additionally, the selected topics were things students were familiar with, considering the vocabulary they were likely to see in the questions and in the search results. For example, in their classrooms at their school, the intermediate students had learned some information about animals. Thus, students could have some questions related to animals. However, the teachers made sure that none of the questions developed for this study had been pre-taught in the curriculum or practiced at the school with the students.

**Google search results availability:** After the question was created, the next step was to test that question and see what search results would be available. Most importantly, the goal was to make the search challenging enough that students would not find answers immediately from search results. This included predicting and testing the likely queries that the students might use. Once the question was selected for a test, each of the four teachers came with a search query that was created based on their experience with the level of the students in the group. If
there was a similarity between the created queries (3 similar queries), then that
query was tested. If there was an immediate answer in the results, then the
question was changed. One limitation to this approach was that the students used
the autocomplete feature which helped them to find popular search predictions from
Google and led them to find the answers immediately from the KG.

Note that the teachers used an unbalanced combination of the two previous
criteria to create the questions when one criteria seemed to be more suitable than
the other. For example, in Lesson 3, almost all the questions for all groups had a
similar readability level. However, since the goal of the lesson was to focus on
learning the filters and operators, the teachers decided that the readability here
was less important since many of the Google results could not be found without
using Google’s search tools (e.g. news articles using “News” filter). Thus, the focus
was mostly on what search filters and operators were appropriate for each group.
For instance, the intermediate group had to learn the “filetype” operator while the
advanced used “site:” to search for information on a specific web domain.

In the same lesson, there was an opposite case which involved learning the
same tool but required different groups of students to look more at the results. For
example, the beginner students learned using the “Images” filter to search for
George Washington. On the other hand, the advanced students were asked to use
the “Images” filter and search for a map of Colorado from 1860s that had to have
enough detail to complete a task. This was because the teachers felt that the
advanced group would easily find the answer if they were given a similar question as the beginner students had.

Working closely with the teachers in this way perhaps resulted in criteria for question development that were less clear and less specific than might been used if the researcher alone had created the questions for each level. In a researcher-developed model, a clearer, more rigid system for designing items could have defined. However, the way in which questions were developed did present some advantages, including the assurance that questions would make sense to the students and that cooperation from the teachers in the research would be maximized.

The goal of the worksheet was to help the students focus on the tasks. The format of the worksheet consisted of a description of a search task with spaces where the student could record answers. Figure 4 shows an example of a worksheet for a beginner group working on Lesson 1. Appendix C contains the worksheets and search tasks for all lessons.
V.4.3 Students’ Handouts

The handouts consisted of two components: a step-by-step answer to each search task presented in the lesson, and summary notes for the lesson. The step-by-step answer showed the steps needed to complete the search task, with screen shots labeled with red boxes to indicate where to type or click. Figure 5 is an example of a step-by-step answer to Lesson 3 for the intermediate group. The summary notes include instructions and main goals for each lesson, supported with examples and screen shots. Figure 6 illustrates the summary notes of Lesson 1 for the beginner group. Appendix D includes the students’ handouts for all lessons. The recommendations for constructing the handouts, derived from the meetings with the teachers, included the following:

- Use as little text as possible.
- Use numbers to indicate the ordered steps required to complete the tasks.
- Use simple phrases.
- Use headings to highlight lesson goals.
- Use labeled screen shots to focus attention on where to click as an example.
- Have one page that has the answer to the search task and another one as a summary of the lesson.
Lesson 3: Pre 4 (Intermediate)

1- Open Google.com
2- Type in the search box: The Grapes of Wrath filetype:doc
3- You will see [DOC] before any results. This means that the file is a word document. Now, all Google results will be word documents. You can open the file or save directly to your computer
4- Choose any link with the title of your search for the answer

Figure 5. Step-by-Step Answer to Lesson 3 Intermediate Search Task

Lesson 1 Beginner: Picking the right search terms

Goal 1: Parse a question to arrive at a query

- Circle keywords – keywords are essential words you can make a list of it
- Underline “maybe” words, offer synonyms or replacement terms
- Add missing words
- Ignore unnecessary words
- Identify unique words
- Do not have too many words
- Use mostly nouns

Example:

What [food] does Tyson [like] best?

Percy Jackson

favorite

Goal 2: Use graphic organizer to develop your query

Example:

Figure 6. Summary Notes of Lesson 1 Beginner
V.4.4 Teachers’ Feedback on the Grids

All the teachers felt that RGT would be a great method to understand a student’s perception. However, they had a concern that it would be difficult for the students to work with the grid’s format, as shown in the example provided by the researcher. Instead, using a more familiar format would help to gather their feedback. Fortunately, the RGT method has a lot of flexibility, and a researcher can shape it to support research needs.

To respond to the teachers’ suggestions, the researcher collected a word pool and phrases from the teachers, and created grids by following these teacher suggestions:

- Each grid consisted of six elements and 12 constructs.
- The grid should have a five-point scale, with corresponding smiling/frowning emoticons as a picture cue for cognitively challenged students. Moreover, arrow indicators should be included to present the negative and positive poles.
- Have phrases to explain the elements for evaluation.
- Have the constructs opposite each other to enhance comprehension.
- Avoid sophisticated words or phrases.
- The grid needed to be very basic and uniform across the levels.

Three sets of grids were created, following these suggestions, to assess students’ impressions of their searching ability, their impressions of the training lessons, and their impressions of the handouts.
V.4.4.1 Grid Construction for Perceptions of Searching Ability

The six proposed elements for these grids were: creating keywords, understanding search results, narrowing search results, finding relevant information, independent use and need addressed. The elements were simplified by changing each element with a phrase suggested by the teachers, as shown in Table 13. The 12 developed constructs for these grids are presented in Table 14.

Table 13
<table>
<thead>
<tr>
<th>Element</th>
<th>Corresponding Phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creating keywords</td>
<td>Creating search words or statements on Google is</td>
</tr>
<tr>
<td>Understanding search results</td>
<td>Understanding search results is</td>
</tr>
<tr>
<td>Narrowing search results</td>
<td>When I try to narrow search results to find information, it is</td>
</tr>
<tr>
<td>Finding relevant information</td>
<td>Finding information for my search is</td>
</tr>
<tr>
<td>Independent use</td>
<td>Searching by myself is</td>
</tr>
<tr>
<td>Need addressed</td>
<td>Searching can meet my needs and is</td>
</tr>
</tbody>
</table>

Table 14
<table>
<thead>
<tr>
<th>Positive Constructs</th>
<th>Negative Constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyable</td>
<td>Frustrating</td>
</tr>
<tr>
<td>Simple</td>
<td>Difficult</td>
</tr>
<tr>
<td>Fast</td>
<td>Slow</td>
</tr>
<tr>
<td>Obvious</td>
<td>Confusion</td>
</tr>
<tr>
<td>Useful</td>
<td>Useless</td>
</tr>
<tr>
<td>Provides a sense of achievement for me</td>
<td>Provides a sense of failure for me</td>
</tr>
</tbody>
</table>

Instead of using numbers to respond, corresponding smiling/frowning emoticons were created to aid comprehension while ranking. Figure 7 shows Rating Element 3 within the simplified version of the searching ability grid. Each single grid is broken down into separate pieces, one for each element where
students rank each element with the available constructs. Once all the elements are ranked and completed, the results are combined into a single grid.

Figure 7. Rating Element 3 within Simplified Searching Ability Grid

V.4.4.2 Grid Construction for Perceptions of Training

The researcher worked with the teachers using the previous approach to develop the grid and then created the simplified ones for use by the students and teachers. The goal of this grid was to gather each student’s perception about the training lessons. The six proposed elements for this grid were: need addressed, communication with the teachers, amount of information, participation, time allotment, and training experience. The elements were simplified by changing each element with a phrase suggested by the teachers, as shown in Table 15. The 12 developed constructs for these grids are presented in Table 16. Figure 8 shows an example of Rating Element 2 of the training grid.
Table 15
*Simplified Phrases for the Training Grid*

<table>
<thead>
<tr>
<th>Element</th>
<th>Corresponding Phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need addressed</td>
<td>This training lesson met my needs and was</td>
</tr>
<tr>
<td>Participation</td>
<td>My participation in this training lesson was</td>
</tr>
<tr>
<td>Communication with teachers</td>
<td>The communication between my teacher and me in this lesson was</td>
</tr>
<tr>
<td>Amount of information</td>
<td>The amount of the training information was</td>
</tr>
<tr>
<td>Time allotment</td>
<td>The time given for this training lesson was</td>
</tr>
<tr>
<td>Training experience</td>
<td>The whole experience of this training lesson was</td>
</tr>
</tbody>
</table>

Table 16
*Constructs for Training Grid*

<table>
<thead>
<tr>
<th>Positive Constructs</th>
<th>Negative Constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyable</td>
<td>Frustrating</td>
</tr>
<tr>
<td>Useful</td>
<td>Useless</td>
</tr>
<tr>
<td>Provides a sense of achievement for me</td>
<td>Provides a sense of failure for me</td>
</tr>
<tr>
<td>Enough</td>
<td>Not enough</td>
</tr>
<tr>
<td>Motivating</td>
<td>Not motivating</td>
</tr>
<tr>
<td>Helped me concentrate</td>
<td>Distracting</td>
</tr>
</tbody>
</table>

2- My participation in this training lesson was

![Rating Scale](image)

*Figure 8. Rating Element 2 of the Simplified Training Grid*
V.4.4.3 Grid Construction for Perceptions of the Handouts

The six proposed elements were: everyday use, independent use, language (readability), visual format, handout organization, and content quantity. The elements were simplified by changing each element to a phrase suggested by the teachers, as shown in Table 17. Table 18 shows the 12 constructs that were developed. Figure 9 shows the rating of the first element using the simplified version of the handouts grid.

Table 17

<table>
<thead>
<tr>
<th>Element</th>
<th>Corresponding Phrase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Everyday use</td>
<td>The handouts are something I would use in my everyday life as a student and an individual and it is</td>
</tr>
<tr>
<td>Independent use</td>
<td>Using the handouts by myself is</td>
</tr>
<tr>
<td>Language</td>
<td>The wording of the handouts is</td>
</tr>
<tr>
<td>Visual format</td>
<td>The visual appearance of the handouts is</td>
</tr>
<tr>
<td>Handouts organization</td>
<td>The organization of the handouts is</td>
</tr>
<tr>
<td>Content quantity</td>
<td>The length of the content is</td>
</tr>
</tbody>
</table>

Table 18

<table>
<thead>
<tr>
<th>Positive Constructs</th>
<th>Negative Constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enjoyable</td>
<td>Frustrating</td>
</tr>
<tr>
<td>Easy</td>
<td>Difficult</td>
</tr>
<tr>
<td>Effective</td>
<td>Ineffective</td>
</tr>
<tr>
<td>Useful</td>
<td>Useless</td>
</tr>
<tr>
<td>Motivating</td>
<td>Not motivating</td>
</tr>
<tr>
<td>Usable</td>
<td>Not usable</td>
</tr>
</tbody>
</table>
2. Using the handouts by myself is

<table>
<thead>
<tr>
<th>Enjoyable</th>
<th>A lot</th>
<th>A little</th>
<th>Neither</th>
<th>A little</th>
<th>A lot</th>
<th>Frustrating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Easy</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Difficult</td>
</tr>
<tr>
<td>Effective</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Ineffective</td>
</tr>
<tr>
<td>Useful</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Useless</td>
</tr>
<tr>
<td>Motivating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not motivating</td>
</tr>
<tr>
<td>Usable</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Not usable</td>
</tr>
</tbody>
</table>

*Figure 9. Rating Element 2 for the Simplified Handouts Grid*

V.5 Procedure

The four teachers who participated in developing the materials trained the participating students, in the groups described earlier. The intermediate group was split, with one teacher meeting with each of the subgroups.

The sessions with the students occurred after school hours at their school. Each session took almost one hour, similar to the time duration of classes students attend daily. Before the start of each session (introductory and lesson sessions), the researcher started the screen and camera recorders on all computers.

The teachers taught four lessons to the students, using the appropriate level of lesson for each group: beginner, intermediate or advanced. Before each lesson the students worked on a pre-test searching task. Then, during the training, the students used the worksheets to record their answers, and they recorded the search query they used. (For Lesson 4, the students were also asked to select answers from multiple choice questions.) After each lesson the students worked on an additional
search task, as a post-test. Finally, after completing the training, the students answered another set of search problems, independently. That is, the students were allowed to ask for assistance during the pre- and post-assessments but not for the final set of search tasks.

The study began with an introductory session for each group, in which the teacher guided the students in filling in the grid that focused on their abilities to search. Then, the teacher explained how to use Google search to allow students to be more familiar with the procedure before starting the training (i.e. how to open Google search). Additionally, the teachers illustrated the added web features (voice searching and images in search results). The teachers pointed out that these added features were optional to use. These features were only illustrated one time, in this introductory session. For other lessons, the teachers reminded the students to consider if they wanted to use it. The students had the added features manual with them as a supportive document during all sessions.

In the second session with each group, the teacher administered the pre-assessment, and gave the training for Lesson 1. The teachers gave time for the students to answer the search tasks and record the answers on their worksheets. Then the teachers stopped the students regardless of their answers and walked through the answer for the performed search task using the teachers’ instructions and the student step-by-step handouts. The assumption behind this procedure was that students could learn better by example, as they would be actively engaged. Moreover, performing the pre-assessment and the training in one session could
avoid some memory issues that these students might be expected to have. The teachers continued the same process until the search tasks were completed for the lesson. Finally, the teachers reviewed the lesson with the students, giving them the summary handout and going over it.

After finishing the pre-assessment and the training for Lesson 1 in this session, the students returned after two days to work on a post-test search task and to complete the grid on the lesson. To complete the grids, the teachers read all the statements aloud to the students before they were allowed to start working on their grids. Additionally, the teachers explained to the students that they had to use all the constructs to respond to each statement by selecting an emotion face. After that, the students were asked to work on the grids on their own while the teachers observed them and were available to help if needed. The exception to this process was the beginner group as the teacher worked with them on each statement.

For the post-assessment, the teacher had the option to change the search task for some students in the intermediate and advanced groups if they felt it would be appropriate. For example, for the intermediate group, the teacher started with an intermediate search task. If a student could not answer the question correctly, then the teacher gave the student an easy search task from the beginner level. Similarly, for the advanced group, a student who struggled with an advanced search task would receive an intermediate search task to try (all of the teachers were familiar with the tasks provided for each level). This approach was adopted so as to provide material at an appropriate level for each student, and to avoid unproductive
frustration. The teachers did not feel that trying to introduce easier material would work well for the beginners, so the option to choose a different problem was not used with them. After the students completed the post-assessment, the teachers guided the students on how to complete the grid for the tested lesson.

The same pattern of sessions was then carried out for the remaining three lessons. The pairs of sessions for each lesson were scheduled in such a way that the pre-assessment, the training, the post-assessment, and the grid ranking occurred in the same week. For example, students completed the pre-assessment and training on Monday, then returned on Wednesday of the same week to complete the post-assessment and ranking grid. There were no week-long breaks during the sequence of lessons.

After completing all lessons including pre-assessment, training, post-assessment and ranking grid for each lesson, the students had a two-week break. They then returned to work on a final set of search tasks that used skills from all four lessons. This final meeting took almost one hour. The students worked independently without any assistance from the teachers. Moreover, they were not allowed to use their handouts for the final search tasks. After finishing the final questions, the teachers guided the students to complete the same grid they completed before the training which focused on their ability to search. Additionally, the students completed the grid that was related to the handouts they used during the training program. After that, the researcher met with the students individually to gather their feedback about using Google search, the handouts and the training.
Finally, the researcher obtained feedback from the teachers about their experience with the training program. Table 19 shows the timing of when all the materials were used by the students during the training.

<table>
<thead>
<tr>
<th>Materials</th>
<th>When to use it</th>
</tr>
</thead>
<tbody>
<tr>
<td>Added Web Features</td>
<td>Introduction session and if needed later</td>
</tr>
<tr>
<td>Students’ Worksheet</td>
<td>With each lesson pre- and post- and final study</td>
</tr>
<tr>
<td>Students’ Handouts</td>
<td>With each lesson except for the final study</td>
</tr>
<tr>
<td>Searching Ability Grid</td>
<td>Twice: before and after completing the training program</td>
</tr>
<tr>
<td>Training Grid</td>
<td>After each post-lesson, not with the final study</td>
</tr>
<tr>
<td>Handouts Grid</td>
<td>After finishing the training program</td>
</tr>
</tbody>
</table>

V.6 Study Timeline

Table 20 shows the training program timeline, including both the meetings with the teachers to design the materials (Steps 1-8), gathering demographic information and obtaining consent (Step 9), placing the students in groups (Step 10) and the sessions with the students (Steps 11-21). The final step was meeting with the teachers for final feedback (Step 22).

<table>
<thead>
<tr>
<th>N</th>
<th>Phase</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Teachers attended the researcher presentation of the lessons</td>
<td>1 hour</td>
</tr>
<tr>
<td>2</td>
<td>Teachers completed demographic info and consent</td>
<td>1 hour</td>
</tr>
<tr>
<td>3</td>
<td>Teachers’ feedback on Google lessons and web search features</td>
<td>1 hour</td>
</tr>
<tr>
<td>4</td>
<td>Creating the searching tasks with the teachers</td>
<td>2 hours</td>
</tr>
<tr>
<td>5</td>
<td>Discussing teachers’ instructions, students’ handouts and worksheets</td>
<td>1 hour</td>
</tr>
<tr>
<td>6</td>
<td>Developing the final study search tasks</td>
<td>1 hour</td>
</tr>
<tr>
<td>7</td>
<td>Developing grids for searching ability, training and handouts</td>
<td>2 hours</td>
</tr>
<tr>
<td>8</td>
<td>Final review of the training plan with the teachers</td>
<td>1 hour</td>
</tr>
<tr>
<td>9</td>
<td>Students completed demographic inventory and consent</td>
<td>2 hours</td>
</tr>
<tr>
<td>10</td>
<td>Teachers met with the researcher to group the students</td>
<td>1 hour</td>
</tr>
</tbody>
</table>
V.7 Data Collection

Data were collected at several stages of the training study. First, participants' demographic information was gathered through interviews with the researcher. These demographics included gender, age, type of cognitive challenge, education level, and previous internet and web searching experience. Second, the researcher collected the completed grids that focused on the students’ abilities to search before the training.

Third, each week the researcher collected information regarding student experiences with the training lessons. These data included task completion in the pre- and post-assessments and final study, each user’s search behavior, and experience of the training for each lesson. These data were gathered using Morae (the screen recorder), version 3.3 and included any interaction between the student and the user interface such as keystrokes, link clicks, etc. Morae is a powerful
usability software system that allows screen recording, note-taking, and data analysis. Morae allows screen recording to check task completion and the user interaction with the Google search interface. Moreover, a camera was directed toward each participant’s face to record and capture reactions, but these recordings were not analyzed for this project. Morae can combine multiple recordings into one file. While completing tasks, Morae has a “pointer and clicker tracker” feature that can aid in determining where the user clicked or typed. Moreover, Morae allows task definition and scores for data analysis. After a researcher enters notes about task completion and scores, Morae can generate the result for each subject in the form of an Excel spreadsheet. Therefore, this software and its tools saves time for a researcher in analyzing the data.

In addition to using Morae, the students’ worksheets were collected containing their answers for each pre- and post-assessment and final study. Moreover, students’ ratings on the training grids were collected.

Fourth, the researcher collected two more grids for each student—one was focused on the ability to search after the training, and the other was related to using the handouts. In the final stage of data collection, the students responded to questions about using Google search interface, i.e., if and how the Google search had been useful, if they had benefited from learning to use the web searching techniques, and how they experienced the training program. Additionally, the researcher met with the teachers to get their feedback about the training. Table 21 provides a summary of this data collection process.
Three types of statistical analysis were applied in the research project using pre- and post-assessments and analyzing grid-generated data for each participant. The Sign test, the Wilcoxon signed rank test and t-test were used to identify significant differences between the pre- and the post-assessment scores. Cochran’s Q test was used to determine the significance of differences among the pre- and post-assessments and final study question scores. For analyzing the grids, a FOCUS or cluster analysis was performed to identify relationships between constructs and
elements and to conduct different comparisons between grids to find differences and
similarities among all students. Here are the details of these analyses.

V.8.1 Statistical Analysis

Student performance in the search tasks was scored as described in Table
22, resulting in numerical values for success, independence, preference for search
options, and downward adjustment (receiving an easier task than assigned for one’s
group.) The Morae recordings also allowed time on task to be measured for the
search tasks. Score differences between pre- and post-tests were analyzed using a
Sign test and a Wilcoxon Signed Rank test (nonparametric test for ordinal data). In
some cases, scores were reduced to binary values, so that Cochran’s Q, a
nonparametric test for dichotomous data, could be used to determine if a significant
difference existed among at least three related groups. Time on task was analyzed
with t-tests. Wilcoxon Signed Rank test, Cochran’s Q and t-test were measured
using IBM Statistical Package SPSS version 24.

Table 22
Conceptual and Operational Metrics

<table>
<thead>
<tr>
<th>Conceptual definition</th>
<th>Operational definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absent, Failure, Success: a complete success or a complete failure was measured for each task “searching problems and multiple choices from Lesson 4”. For the multiple choices, even if the chosen website was incorrect, the score of the multiple choices was not affected. Also, for Google images and snippets, the correct answer of the type of the website was “Informational”.</td>
<td>0: Absent: The participant missed the meeting. 1: Failure: The participant failed with the task and this includes:  Did not search or gave up  Searched but found the incorrect answer  Searched but found half of the answer (like not answering reliability part from Lesson 4).  2: Success: The participant searched and found the correct answer</td>
</tr>
</tbody>
</table>
Independence level: counted how many times a participant asked for help from a teacher.

1 point for receiving help to complete a task.

The number of technique preference in total session: The participants had the choice to choose any technique to perform searching tasks and they also had the choice to change it at any time in order to complete tasks. Each choice was counted

1: typing with no images in search results
2: typing with images in search results
3: microphone searching without images in search results
4: microphone searching with images in search results
5: typing and microphone with no images in search results
6: typing and microphone with images in search results

Downward adjustment: For the intermediate and advanced group only.

1 point for receiving an easier task

V.8.2 Grids Analysis

RGT is a technique for comprehending what picture a subject has of a specific concept (like “Google web searching lessons”) at any point of time, considering that this "word picture" for any person will change and vary by definition (Cook, & Krupar, 2011). This “picture” can be assessed from a student’s grid responses by using a focus analysis. The focus analysis is a cluster analysis of grid data, interpreting the “pictures” by determining patterns in how the constructs and elements of the grid are related. The constructs and elements are reordered so as to place the most similar entities together, and the similarities for both elements and constructs are shown as dendrograms. Figure 10 is an example of a searching ability grid, collected from a student before the training, as analyzed by FOCUS. Here the numeric entries are low for positive ratings and high for negative ones.
Looking at Figure 10, we can find that the most positive ranked element for this person is identified by a 2 in the column for Find Relevant Information. This element is described by the constructs as “provides sense of achievement”, and “simple.” The most negative ranked element for this person is identified by 4s and 5s, denoting these elements as the most challenging in this person’s view of his/her searching ability. These elements are Narrow Search Results, Create Keywords and Independency. These elements are described by the constructs as “confusing”, “provides sense of failure”, “difficult”, “frustrated”, “useless”, and “slow.” We can conclude that the picture of this person’s ability to search highlights difficulties in starting to search (creating keywords), and in locating information (narrow search results).
results) and independent use, apart from the student having some success in finding relevant information on the web.

Using the FOCUS analysis, more in-depth analysis was used to look for similarities and differences between grids to identify any consistent perception that existed between students. The comparisons were conducted using RepGrid version 5.1 (Rep 5 Conceptual Representation Tools, n.d.) and included:

a. Comparing the average data entry for each element for all searching ability grids before and after the training for each subject.

b. Comparing all searching abilities grids before and after training for each subject describing the related constructs to the elements.

c. Comparing all training lessons grids for all subjects by looking at the most preferred and disliked elements and constructs.

d. Comparing all handouts grids for all subjects by looking at the most preferred and disliked elements and constructs.
CHAPTER VI

RESULTS AND EVALUATION OF WEB SEARCHING TRAINING PROGRAM

VI.1 Introduction

This chapter aims to answer the second research question of this dissertation. The second question focuses on examining the possible impact of an accessible web searching training program on the web-searching performance of students with cognitive disabilities. To answer the second question, pre-training and post-training assessments of student performance were made using video and statistical analysis as well as analyzing Repertory Grid Technique (RGT)-generated data from training sessions.

The results in this chapter are organized into three sections. The first section presents performance on search tasks and encompasses quantitative and qualitative analysis of individual lessons, and the final assessment, in addition to grids analysis before and after the training. The second section focuses on students’ assessment of lessons, handouts and training experience. Finally, the third section highlights the final feedback from the teachers about the training experience.
VI.2 Performance on Search Tasks

This section has 10 subsections which highlight the search performance for the students across all lessons in addition to the final study. The first section presents the search performance of individual lessons, and the discussion of these individual lessons is presented in the second section. The third section highlights the causes of failure in terms of searching during the training. The fourth section includes statistical analysis by testing significance of improvement on individual questions using the Sign test while Section 5 shows a comparison between pre- and post-performance using the Wilcoxon signed rank test. Grids analysis before and after the training is highlighted in Section 6. Time on tasks, including distribution of time and t-test results, is presented in Section 7. The eighth section shows the search performance of the final study while the discussion of the final study is in Section 9. Finally, Section 10 focuses on main observations about searching. Table 23 shows all the subsections that focus on search performance.

<table>
<thead>
<tr>
<th>Table 23</th>
<th>Performance on Search Tasks Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Section</td>
<td>Subsections</td>
</tr>
<tr>
<td>Performance on search tasks</td>
<td>-Search performance of individual lessons</td>
</tr>
<tr>
<td></td>
<td>-Discussion of individual lessons</td>
</tr>
<tr>
<td></td>
<td>-Causes of failure</td>
</tr>
<tr>
<td></td>
<td>-Testing significance of improvement on individual questions using sign test</td>
</tr>
<tr>
<td></td>
<td>-Comparison between pre- and post-performance using Wilcoxon signed rank test</td>
</tr>
<tr>
<td></td>
<td>-Grids analysis (before and after training)</td>
</tr>
<tr>
<td></td>
<td>-Time on task</td>
</tr>
<tr>
<td></td>
<td>-Search performance of the final study</td>
</tr>
<tr>
<td></td>
<td>-Discussion of the final study</td>
</tr>
<tr>
<td></td>
<td>-Main observations about searching</td>
</tr>
</tbody>
</table>
VI.2.1 Search Performance of Individual Lessons

The results of the individual performance of the three groups in the training are presented in Tables 24, 25 and 26, respectively. Colors indicate the performance of the students for each pre- and post-question. Green colors indicate that students failed in the pre-question but succeeded in the post while red colors show the opposite. Blue colors highlight that students succeeded in both the pre-and post-questions while the grey colors indicate that they failed in both. No color is shown where students missed either a pre- or a post-session.

An all-or-nothing criterion was used to score the correctness of student responses. For example, some questions required students to find two things (e.g. 3 religions and their percentages in a country). If a student found two religions or found them all but without percentages, this would be considered a failure rather than a success. Future work will include an error type analysis which could reveal that students learned more than this first analysis suggests. For example, some errors might have become less frequent over the course of the study, even though students did not achieve complete correct performance.

Only 12 students fully participated in all four lessons. Seven students (P3, P4, P10, P12, P13, P14 and P19) were not able to attend some of the lessons. In Lesson 1, P12 and P13 missed the pre- and the post-meetings respectively. In Lesson 2, P13 missed the pre-session and P19 missed the post. For Lesson 3, three students (P10, P12 and P13) missed the pre-meeting while another three students
(P3, P4 and P14) missed the post. Finally, in Lesson 4, two students (P3 and P14) missed the pre- and the post-sessions respectively.

### Table 24
**Beginner Group Individual Training Performance**

<table>
<thead>
<tr>
<th>P</th>
<th>Lesson 1</th>
<th>Lesson 2</th>
<th>Lesson 3</th>
<th>Lesson 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Q2</td>
<td>F</td>
<td>S</td>
<td>F</td>
<td>S</td>
</tr>
<tr>
<td>Q3</td>
<td>F</td>
<td>S</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Q1</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Q2</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Q3</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
</tbody>
</table>


### Table 25
**Intermediate Group Individual Training Performance**

<table>
<thead>
<tr>
<th>P</th>
<th>Lesson 1</th>
<th>Lesson 2</th>
<th>Lesson 3</th>
<th>Lesson 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>F</td>
<td>S</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>Q2</td>
<td>F</td>
<td>F</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q3</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q1</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q2</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q3</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q4</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q1</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q2</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q3</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Q4</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>


### Table 26
**Advanced Group Individual Training Performance**

<table>
<thead>
<tr>
<th>P</th>
<th>Lesson 1</th>
<th>Lesson 2</th>
<th>Lesson 3</th>
<th>Lesson 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q2</td>
<td>S</td>
<td>S</td>
<td>F</td>
<td>S</td>
</tr>
<tr>
<td>Q3</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q1</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q2</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q3</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q4</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q1</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q2</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q3</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>Q4</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
</tbody>
</table>

VI.2.2 Discussion of Individual Lessons

The following information is presented here for each lesson. First, using the same color schemes from the tables in the previous section VI.2.1, bar charts summarize the group’s performance on each lesson across all questions in the lesson. The summary charts only include students who completed both pre- and post-tests for the specific lesson. Second, each lesson’s main goal is highlighted along with the lesson questions. Third, the qualitative information is presented and includes examples of successful cases or what a student did to answer questions correctly. Fourth, information about students’ difficulties is discussed. Finally, any additional noteworthy observations for the lesson are highlighted.

VI.2.2.1 Lesson 1

This lesson focused on understanding Google search results, such as title and snippet. There was only one question for each group. Table 27 shows Lesson 1 questions.

<table>
<thead>
<tr>
<th>Group/Questions</th>
<th>Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>Pre: Two things about “Rock of Ages”</td>
</tr>
<tr>
<td></td>
<td>Post: Two things about “Pocahontas”</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Pre: Number of dinosaurs on record</td>
</tr>
<tr>
<td></td>
<td>Post: Number of castles in France</td>
</tr>
<tr>
<td>Advanced</td>
<td>Pre: Finding a recipe involving celery, cream, and ground turkey</td>
</tr>
<tr>
<td></td>
<td>Post: Finding a restaurant serving crab in Denver</td>
</tr>
</tbody>
</table>
Considering the differences among groups, Figure 11 shows that only one student was successful in the beginner group while the majority of the intermediate students succeeded with 78%. In contrast, this lesson was difficult for almost none of the advanced students, as 60% succeeded in both pre- and post-tests, while 20% improved because of the training.

![Figure 11. Lesson 1 Percentages of Success](image)

Considering these examples of success, most of the students learned from the training by taking more time and looking at different search results. Additionally, students were reading titles and snippets before choosing a website. For instance, P2 checked two different websites to answer the question. Prior to the training, most of the students had difficulties when they looked at only the first three links from the search results to answer the question. Thus, the majority of the intermediate students failed
because they chose the wrong answers. Similarly, this approach also affected the beginner group who answered half of their questions. The other problem in the lesson was related to a frustration for one advanced student caused by misunderstanding the question. In this lesson, P4 received help (e.g., asked about the question) with the post question and succeeded. In addition, P14 received an easy question after struggling in the post session. However, despite this, the student failed and answered only half of the question.

Two further observations can be made about this lesson. The first observation relates to the use of a keyboard shortcut. Three students from the intermediate group used “Ctrl+F”, which facilitated a search for specific words when looking at different pages from the search results. The reason for using the shortcut was to avoid reading copious amounts of text in the search results and on a Wikipedia page. The second observation relates to reading reviews from the Google reviews on a restaurant website. The advanced students were able to make decisions about restaurants by exploring and reading reviews before choosing the correct answers.

VI.2.2.2 Lesson 2

The focus of this lesson was on creating appropriate keywords. The beginner group only had one question while the other groups both had two questions. Table 28 shows the question topics for Lesson 2.
**Lesson 2 Questions**

<table>
<thead>
<tr>
<th>Group/Questions</th>
<th>Q1</th>
<th>Q2</th>
</tr>
</thead>
</table>
| Beginner        | Pre: Percentages of 3 religions in Argentina  
Post: Percentages of 3 religions in California | Do not have |
| Intermediate    | Pre: Dolphins’ communication  
Post: Turtles’ communication | Pre: 4 things bottlenose dolphin eat  
Post: whether lions are faster than Thomson’s gazelle and why. |
| Advanced        | Pre: Name of the coded British communications language in the 1918 war and the name of the battle.  
Post: The name and the date of births of two explorers of North America, one Norwegian and the other Spanish. | Pre: Find Native American tribes that still eat traditional food.  
Post: Where Lewis and Clark (American explorers) travelled and what the name of their interpreter was |

Even though the groups had many differences, examining Figure 12 suggests that none of the beginner students were able to answer the questions correctly, while the intermediate students did not encounter as many problems because they succeeded in both pre- and post- for the first question with 90% and 70% for the second one. Similarly, half of the students in the advanced group succeeded in both the pre- and the post-portions of the first question. Additionally, all of the advanced students improved because of the training and succeeded in the second question.
Examples of success include students who succeeded in answering two-step questions such as the advanced group. They found where two American explorers travelled and what the name of the explorers’ interpreter was. The type of difficulty in this lesson focused around giving incomplete answers to two-step questions (mainly the beginner group) and being frustrated when results could not be found immediately. An example of the latter is when no link was evident that matched the search query (advanced group).

Finally, there are three observations in this lesson. First, all groups were familiar with the Wikipedia structure. Second, websites that incorporated visual presentation were preferred by students (such websites that had pictures of animals). Finally, websites that were structured with clear titles and headings also helped all the students to succeed.
VI.2.2.3 Lesson 3

The goal of this lesson was to educate students on narrowing search results using some of the Google search engine’s features. This included two main features - filters and operators. The filters can be accessed from the Google search menu and include images, news, and videos. The operators are specific characters or words that are used in a search query, such as “site.” Both the intermediate and the advanced groups had four questions while the beginner students had three questions. The questions that focused on filters were Q1 “Flights”, and Q2 “Images” for the beginner group, Q1 “News”, Q2 “Images”, and Q3 “Videos” for the intermediate group, while the advanced group had only one question, Q1 “images”. In contrast, both the beginner and the intermediate groups had only one question (Q3, and Q4 respectively) that focused on the “filetype” operator while the advanced students had three questions. These questions were Q1 “site.”, Q2 “double quotations”, and Q3 “filetype”. Table 29 shows the questions for Lesson 3.

<table>
<thead>
<tr>
<th>Table 29</th>
<th>Lesson 3 Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group/Questions</strong></td>
<td><strong>Q1</strong></td>
</tr>
<tr>
<td>Beginner</td>
<td>Large picture</td>
</tr>
<tr>
<td></td>
<td>Pre: George Washington Post: JFK</td>
</tr>
<tr>
<td>Intermediate</td>
<td>News article published last week Pre: ISIS Post: US election</td>
</tr>
<tr>
<td>Advanced</td>
<td>Large picture</td>
</tr>
<tr>
<td>----------</td>
<td>---------------</td>
</tr>
<tr>
<td>Pre: Colorado map 1800s</td>
<td>Post: Denver map 1900s</td>
</tr>
</tbody>
</table>

Comparing the differences among the groups and focusing on the filters questions, Figure 13 shows improvement in the advanced group with 80% for Q1, though the improvement was only 50% for the both Q1 and Q2 for the beginner group. On the other hand, the intermediate group succeeded in 50% of the cases in Q1 while the other two questions (Q2 and Q3) were easier (67% and 83% success in both sessions). For the “filetype” operator questions, we can also see that the performance of the advanced group (80%) was better on Q3 when compared with the other groups (Q3 for the beginner (50%) and Q4 for the intermediate (67%)). In fact, Q3 was the easiest question for the advanced group with 80% success in both pre- and post-sessions.
Several examples support the fact that students were successful and improved due to the training. One student from the beginner group knew how to use the “images” filter successfully to find the correct answer in the post test. Other students from the intermediate group were able to search easily for documentaries using the “Video” filter. Finally, 80% of the advanced group students were successful by using the “site:” operator to search for information from a specific domain.

Several types of difficulties surfaced in analyzing the results. Many students did not remember the “filetype” operator; some used their handouts, while the others failed to choose the correct file type even when they searched correctly. The videos of the training and testing offered evidence that the students were clicking on the various menu options to find a filter that could lead them to the correct
answer when they could not remember the operator. Few used this operator, and most of the students who answered this question correctly only added the file extension to the search query using PDF or DOC. In fact, two students from the advanced group explored the “Advanced Search Setting” menu that had a list of file extensions from which to select and search for without using the operator “filetype”. Thus, these two students obviated the need to remember the operator.

Some intermediate students had problems with “News” filter results when they were asked to find a news article that was published within the last week. First, students followed the training steps without checking the publication date in the search results, thus ending up exploring more articles. Second, most of the news article websites chosen by the students had a similar presentation regarding the date (small font “10 point” with the grey colored text), which potentially made it hard for some students to see the content. In this lesson, P6 received help from the teacher about the use of the operator for post-question 4 and succeeded. Also, P9 was given an easy question after struggling with post-question 2. However, P9 failed with the easy question as well due to evidenced frustration.

Three further observations can be taken away from the videos of this lesson. The first observation relates to the visual indicator in “Images” and “Videos” search results. Google provides the image size (dimensions) when a particular image is selected or chosen. Similarly, Google provides video lengths for each video that appears in the search results. These two features helped most of the students to succeed since the questions focused on image size and video length.
The second observation was related to the usability of the Google search interface. One intermediate student searched for an image but could not find any results because the “News” filter remained activated from the previous task. Google showed a message recommending to “Reset search tools.” The message helped the student to recognize that no results matched his search, so he changed his option from “News” to “Images” and answered the question correctly.

The final observation focuses on the number of questions for the beginner group, primarily when considering the pre-session. Going through three questions with the training in one meeting was quite challenging. Having only two questions was more attainable for this group.

**VI.2.2.4 Lesson 4**

The focus in this lesson was on searching for answers but also reporting why the chosen answer/website was reliable. Both the intermediate and the advanced groups had three questions, while the beginner students only had two questions. **Table 30** shows the questions for Lesson 4.

<table>
<thead>
<tr>
<th>Group/Questions</th>
<th>Q1</th>
<th>Q2</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>Pre: Distance in miles between US and China</td>
<td>Pre: Director of “Monster University” movie</td>
<td>Do not have</td>
</tr>
<tr>
<td></td>
<td>Post: Distance in miles between US and Italy</td>
<td>Post: Writer of “Minions” movie</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td>Pre: Colorado state population</td>
<td>Pre- and Post: The name of a person who said a quote</td>
<td>Pre: 3 things</td>
</tr>
<tr>
<td></td>
<td>Post: Washington state population</td>
<td></td>
<td>California imports</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Post: 3 things</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Colorado imports</td>
</tr>
</tbody>
</table>
Note that in addition to answering the questions in Table 30, all students were asked to identify why the chosen websites were reliable. Figure 14 shows that the advanced group performed much better when compared with other groups on this task. The beginner group apparently struggled in this lesson and could not answer any questions. Also, this lesson’s questions were not easy; almost half of the intermediate students failed in their three questions.

Several examples of success show that some students benefited from the training where students answered the questions and reported why chosen websites
were reliable. To answer the reliability part of the question, one student from the advanced group supported the chosen answer with a citation or reference. This student was reading some information on Wikipedia and clicked on the reference links to be able to justify the answers. Additionally, some students recognized reliable websites they had used in the pre-session, such as governmental and news websites.

Only one type of difficulty was noticed in this lesson. Though the majority of the students were able to find the correct answers for their searches, several successful students failed to answer the second part of the question that focused on reliability. Clearly, the reliability questions were beyond the beginner group’s capabilities. The other students who failed were either unable to write anything or chose the wrong type of website for their justification. During this lesson, P3 received help from the teachers for post question 2 but failed to answer it correctly. Also, P4 was frustrated with post question 2 and received an easier question. However, P4 continued to fail with the easy question due to obvious frustration.

There are five further observations in this lesson. The first observation focuses on the website title and the domain name of the chosen website. A clear title or the goal of the website helped many students to check the websites mainly when they were working on finding reliable websites. For example, some students chose CNN because the website contained the word “news”. Moreover, the majority of the students (mostly intermediate) who succeeded with the questions, depended on the domain name to answer the reliability part as they had learned about that in the
pre-session. Websites that had domain names including .edu (educational) or .gov (governmental) allowed students to recognize credible sources. The students were reading the URLs of the websites they checked looking for .edu or .gov in the domain names.

The second observation concerns autocomplete. All the students from all groups had depended on this feature in the previous lessons, but its value was very clear in this lesson. All groups had quote questions where they had to search for the name of a person who had said a quote. Since the quotes were long (e.g., had more than six words), almost all the students used the “autocomplete” in order to avoid typing long sentences as much as possible.

The third observation is about the use of the “Related Searches” option. This feature appears at the bottom of the Google search page and includes searches related to the term that has been searched. This feature helped one student who looked at the Google search results but could not find the answer until finding “Related Searches”. The listing included the searches related to his query and helped him prove successful.

The fourth observation relates to the presentation of a list of quotes that caused one student to fail. The student chose the wrong author from the list of quotes and authors primarily because the wrong author choice was located under (not over) each quote. Additionally, no numbers or bulleted point were presented.

The last observation focuses on the search functionality in a website. One advanced student struggled to find an answer for a list of imports by a state but
recognized the governmental website used in the training (handout). Thus, he chose
the governmental website since it was considered to be reliable. Instead of browsing
the website, the student used the search function in that website to search for the
state and found the correct answer about imports.

VI.2.2.4.1 Lesson 4 Multiple Choice Questions

Lesson 4 also included multiple choice questions. For each website chosen for
an answer by the students, they were asked to determine the type of website
selected, the source of information they found from the website and the evidence
they discovered. The results of the multiple choice questions for all groups are
presented in Tables 31, 32 and 33. Appendix E shows the chosen answers for the
multiple choice questions.

Table 31
Beginner Group Performance on Multiple Choice Questions

<table>
<thead>
<tr>
<th>P</th>
<th>Type of Website</th>
<th>Source of Information</th>
<th>Evidence Discovered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q1</td>
</tr>
<tr>
<td>1</td>
<td>F</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>3</td>
<td>*</td>
<td>S</td>
<td>*</td>
</tr>
</tbody>
</table>


Table 32
Intermediate Group Performance on Multiple Choice Questions

<table>
<thead>
<tr>
<th>P</th>
<th>Type of Website</th>
<th>Source of Information</th>
<th>Evidence Discovered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>F</td>
<td>S</td>
</tr>
<tr>
<td>6</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>7</td>
<td>F</td>
<td>F</td>
<td>S</td>
</tr>
<tr>
<td>8</td>
<td>F</td>
<td>F</td>
<td>S</td>
</tr>
<tr>
<td>9</td>
<td>F</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>10</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>11</td>
<td>F</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>12</td>
<td>F</td>
<td>S</td>
<td>F</td>
</tr>
</tbody>
</table>

Table 33

<table>
<thead>
<tr>
<th>P</th>
<th>Type of Website</th>
<th>Source of Information</th>
<th>Evidence Discovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>16</td>
<td>F</td>
<td>F</td>
<td>S</td>
</tr>
<tr>
<td>17</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>18</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>19</td>
<td>S</td>
<td>F</td>
<td>S</td>
</tr>
</tbody>
</table>

VI.2.2.4.1.1 Lesson 4 Type of Website Questions

The types of websites included options such as blogs, Wikis, questions and answers, news sites, informational, governmental and educational websites. Figure 15 presents differences between groups and suggests that the performance of the students varied given that the websites chosen for answering questions were different for many students. Examples of success encompassed the ability to recognize informational websites by the beginner group. The intermediate group was able to go beyond informational sites and succeeded to point out the other type of websites such as educational, governmental, and news websites. The advanced group mirrored the success of the intermediate group and also identified “Q&A” websites.

Different kinds of difficulties existed for each group. For some websites, the beginner students did not know what to choose and did not write anything. Some of
the intermediate and advanced students were confused and chose more than one type from the selected websites. Additionally, a few failed to identify a blog.

![Bar chart](image1)

**Figure 15. Performance on Type of Website Questions**

### VI.2.2.4.1.2 Lesson 4 Source of Information Questions

The sources of information included options such as charts, tables, texts, videos, and images. **Figure 16** shows that though these questions were easy to most of the groups, the intermediate group had problems in Q3. Focusing first on the successful examples, many students easily identified the source of information of their selected websites as images (mainly beginner group) and text. On the other hand, most of the students who failed did so because of the confusion between choosing charts or tables for the intermediate group. The students continued to choose chart over table even after receiving the training, thus choosing the same websites they had in the pre-session.
VI.2.2.4.1.3 Lesson 4 Evidence Discovered Questions

The options for the evidence-discovered questions included examples, definitions, statistics, quotes, and facts. Figure 17 illustrates how all of the groups shared difficulties with these questions. Some of the success cases encompassed recognizing quotes and chose quotes for an answer. Among those with difficulties, the majority of the problems were related to choosing statistics instead of facts. The reason was because of the websites the student chose for their answers. This website has a table supported with a list of imports of a state with numbers and percentages, although the question focused on the list of imports (facts), not the numbers.
VI.2.3 Causes of Failure

There were four different categories of failure for the students in the training. First, some students searched using a wrong query. Second, some students searched using an incomplete query. For example, a student might forget to add “PDF” when searching for a PDF file about a book. Third, some students had a complete query but failed for other reasons like not being able to find an answer. Finally, some students did not search to answer the question because the question was difficult. Figure 18 presents the percentages of frequency for the different failure categories for all groups. Note that those who either missed a pre- or a post-session were removed from the analysis. Figure 18 shows that only the advanced group did not encounter problems in creating appropriate search queries, in contrast to the beginner group which had wrong
queries 18% of the time. Additionally, the beginner group was the only group where the students had incomplete queries.

Figure 18. Causes of Failure

There are three types of errors associated with the complete query. First, a student might have answered only one part of the question and therefore ended up with an incomplete answer. For example, in Lesson 4 some students were able to answer the first part of the question when they searched but they failed with the second part which focused on the credibility of their answers. In a second type of error, a student might report a wrong answer for his/her search. The final type of error was when a student could not find any answer for the question being asked.
**Figure 19** presents the three types of failure in regards to complete queries for each group. It can be clearly seen from the figure that most of the failures for all of the groups were due to incomplete answers. For example, all the students in the beginner group failed to answer the reliability questions (the second part) in Lesson 4. This also applied to some students from both the intermediate and advanced groups. Based on their questions, both intermediate and advanced groups had wrong answers 35% and 32% of the time, respectively. An example of these errors includes choosing an incorrect link or just reading some information from a Google search snippet without clicking on any link. In rare cases, students in the intermediate or advanced groups could not find an answer. Sometimes the students became frustrated if they could not find an answer immediately, particularly when there was some KG information. **Appendix F** lists all the causes of failure for each participant during the training.
VI.2.4 Testing Significance of Improvement on Individual Questions

The Sign test was conducted to examine possible significant differences between the pre- and the post-versions of each individual’s questions. In order to conduct the Sign test, all the groups were treated as one group, thus including the total number of students who answered the question. For example, considering all groups, the total number of the students in Lesson 1 was 17. It should be noted that for each lesson, the questions address the same theme but at different levels appropriate for the different groups. In other words, for each question, three versions exist that are related thematically but not identically. Based on that, the Sign test shows that there is only one significant difference in pre- and post-scores for Q2 of Lesson 2 where p=.031. Table 34 shows the p-value for all the questions in each lesson along with the total number of participants who completed the questions and the number of students who improved because of the training.

<table>
<thead>
<tr>
<th>Values</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>17</td>
<td>17</td>
<td>14</td>
<td>13</td>
</tr>
<tr>
<td>I</td>
<td>9</td>
<td>2</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>P</td>
<td>.065</td>
<td>1.000</td>
<td>.031</td>
<td>.070</td>
</tr>
</tbody>
</table>

Note. N=total number of students. I=number of students who improved. P=P-value.

VI.2.5 Comparing Pre- and Post-Performance

Given the small sample, variables were computed grouping the individual group assignments to aggregate the data for all pre/post analysis. The new variables were created by collapsing categories to aggregate the raw data - e.g., all
pre- and all post-scores were computed across all three groups for all lessons. Thus, a pre-score was calculated that included all the pre-scores from all lessons for all students, and a post score was similarly calculated. Note that those who completed all ten questions (considering all lessons) are the only ones who were included in the analysis. Those who were absent from any session were excluded. In addition, the beginner students were removed since they had fewer questions compared with other groups. Considering all these factors, 10 students were included in this analysis (6 intermediate and 4 advanced). Appendix G presents the computed variables for the Wilcoxon signed rank test.

Of the six students who participated in the study from the intermediate group, the performance of five participants improved when comparing the pre- and post-training performance scores, and one participant saw no improvement. A Wilcoxon signed-rank test determined that there was a statistically significant increase in median performance when subjects received the training (Mdn=15) compared to pre-training (Mdn=17), z = -2.060, p = 0.039. Considering the difference in the pre- and post-scores, the following boxplot (Figure 20) shows positive ranked values indicating an improvement in the performance (Mdn=1).
Of the four students who participated in the study from the advanced group, the post-performance of all four participants improved compared to the pre-training performance. A Wilcoxon signed-rank test determined that no statistically significant median increase in performance existed when subjects received the training (Mdn=20) compared to pre-training (Mdn=14), $z = -1.826$, $p = 0.068$.

Considering the difference in the pre- and post-scores, the following boxplot (Figure 21) shows positive ranked values indicating an improvement in the performance, (Mdn=5.5).
VI.2.6 Searching Ability Grids Analysis

There are two notes that apply to all the grids analyses in this dissertation. First, six grids were eliminated for six subjects from the analysis. These subjects were P1, P2, P3, P4, P12, and P19. The concept of the grids for the students in the beginner group (P1, P2, and P3) was too challenging even when the teacher tried to explain it in more detail with simpler words and giving enough time. The beginner group students just chose all happy emotion faces regardless of how they did in the training and said “they liked it”. P4, P12, and P19 grids were removed based on the suggestion from their teachers as they rushed through it and wanted to finish it quickly. They chose randomly or chose one column for all the elements. Thus, their
grids were not appropriate to analyze since they did not reflect what they thought about the lessons.

Second, for the detailed analysis of each grid, all the negative elements are indicated (i.e., what the student did not like). If a student chose “Neither” or was neutral with an element, it also has been noted. Additionally, the most positive elements are highlighted to show the most important elements to the students for each lesson. However, not explaining some elements does not suggest that the students had a problem with it; it was still a success or preferred but was less positive. These notes apply to the analysis of the all the grids in this research project.

VI.2.6.1 Elements Comparison

Considering those who missed the final study and some of the grids that were removed (like beginner groups), 10 grids remain (6 intermediate and 4 advanced). A calculation of the average data entry for each element of the completed grids (where the small values indicate a better performance) was conducted to show the performance of each participant before and after the training. It should be noted that this presentation does not show the related constructs and their relationship to the elements. Colored spots were added where green means more satisfaction in post compared to pre and red shows the opposite. Also, blue indicates no changes but still generally satisfied in both pre- and post-assessments. Table 3 shows the
average data entry for all students for each element in the completed grids before and after the training.

Table 35
Grids Elements Comparisons before and after Training

<table>
<thead>
<tr>
<th></th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Pre</th>
<th>Post</th>
<th>Need addressed</th>
</tr>
</thead>
<tbody>
<tr>
<td>P1</td>
<td>2.33</td>
<td>1.83</td>
<td>4</td>
<td>2</td>
<td>3.5</td>
<td>1.5</td>
<td>4.33</td>
<td>2</td>
<td>3</td>
<td>1.83</td>
<td>1</td>
</tr>
<tr>
<td>P2</td>
<td>2.66</td>
<td>2.16</td>
<td>3.33</td>
<td>2.5</td>
<td>2.83</td>
<td>2.16</td>
<td>3</td>
<td>2.16</td>
<td>2.33</td>
<td>2</td>
<td>3.5</td>
</tr>
<tr>
<td>P3</td>
<td>2</td>
<td>1.83</td>
<td>1.5</td>
<td>1.5</td>
<td>1.66</td>
<td>1.66</td>
<td>1.66</td>
<td>1.66</td>
<td>1.33</td>
<td>1.33</td>
<td>2</td>
</tr>
<tr>
<td>P4</td>
<td>3.66</td>
<td>2</td>
<td>3.33</td>
<td>1.5</td>
<td>4.33</td>
<td>2.33</td>
<td>3</td>
<td>1.83</td>
<td>3</td>
<td>2</td>
<td>2.66</td>
</tr>
<tr>
<td>P5</td>
<td>2.16</td>
<td>1.66</td>
<td>1.33</td>
<td>1</td>
<td>2.66</td>
<td>1</td>
<td>2.16</td>
<td>1</td>
<td>2.33</td>
<td>1</td>
<td>2.83</td>
</tr>
<tr>
<td>P6</td>
<td>1.5</td>
<td>1.66</td>
<td>1.5</td>
<td>1.33</td>
<td>1.83</td>
<td>1</td>
<td>1.83</td>
<td>1.33</td>
<td>1.5</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>P7</td>
<td>1.83</td>
<td>1.5</td>
<td>1.5</td>
<td>1.66</td>
<td>2</td>
<td>1.5</td>
<td>1.83</td>
<td>1.5</td>
<td>1.33</td>
<td>1.16</td>
<td>1.33</td>
</tr>
<tr>
<td>P8</td>
<td>1.5</td>
<td>1.33</td>
<td>2.5</td>
<td>1.5</td>
<td>2.66</td>
<td>1.83</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1.66</td>
</tr>
<tr>
<td>P9</td>
<td>1.66</td>
<td>1.33</td>
<td>2.16</td>
<td>1.33</td>
<td>2.16</td>
<td>1.33</td>
<td>2</td>
<td>1.33</td>
<td>1.33</td>
<td>1.16</td>
<td>1.33</td>
</tr>
<tr>
<td>P10</td>
<td>1.16</td>
<td>1.83</td>
<td>1.33</td>
<td>2.33</td>
<td>2.33</td>
<td>2.5</td>
<td>1</td>
<td>2.16</td>
<td>1.16</td>
<td>1.5</td>
<td>1</td>
</tr>
</tbody>
</table>

Note. Green=satisfied in post. Red=dissatisfied in post. Blue=satisfied in both with no changes.

P18 was the only student who became less confident about his searching ability. P18 considered that he knew everything about Google searching before the training. When he was interviewed after the training, he said, “I thought I know everything about Google but there are lot things that I did not know like using “site” to narrow search results. I want to learn more about these features.” A summary of the table above can be seen in the following Figure 22.
VI.2.6.2 Detailed Analysis of Searching Ability Grid

Starting with the intermediate group, we can see a significant improvement in terms of how the students view their searching ability before and after the training. For example, P5 (see Figure 23) had many problems with finding relevant information, understanding search results and narrowing search results. These difficulties were explained by constructs such as slow, very confusing and useless and provides a lot of failure. Moreover, he found some confusion when searching independently and was neutral when considering (fast-slow) with creating keywords.

After the training, P5 became fast when finding relevant information, understanding and narrowing search results and seeing that as simple, obvious, very useful and providing a sense of achievement. Additionally, it become obvious
for him to search independently and also obvious to create keywords and be fast with it; see **Figure 24.**
There were two students (P7 and P10) whose grids before the training do not show any difficulties with searching. Both of them were neutral on some elements before the training. P7 had the same view after the training while P10 showed an improvement. However, both of them had an improvement on other elements as well. P7 was neutral with the speed of developing keywords and also neutral in enjoyment of understanding search results. His views remained the same, so there was no improvement in these elements, although there was some improvement with other elements. For example, developing the keywords became more useful and narrowing search results became simpler.

P10 also was neutral on the confusion with narrowing search results. However, P10 reported that narrowing search results became more obvious and useful. Also, there was an improvement in understanding search results (simpler and faster), and creating the keywords also became easier and could be done faster in addition to providing a lot of achievement.

P8 was the only one who showed some decrease in the evaluation for one element. Although he sees himself as being fast when it comes to narrowing search results and reports that this process is obvious, he had some problems with it (a lot of failure, very frustrating and very difficult). After the training, there were some improvements with narrowing search results. Although he reported that it provided a sense of achievement, was useful and enjoyable, he reported this process as confusing and neutral after the training, whereas it was “obvious” and “fast”
beforehand. However, P8 showed a lot of improvement with the other elements of the training.

For the advanced group, all the students in this group significantly improved except for P18. The grids for the students had many positive responses such as “very simple”, “very useful”, “very obvious” and “provides a lot of achievement.”

For P18, there was a decrease in the ranking scores compared to before the training (“2” scores rather than “1”). Instead of reporting “obvious” before, he was neutral for all elements. Moreover, some elements like “need addressed” and understanding search results became fast, simple, and provided a sense of achievement, where it was previously very simple and fast and provided a lot of achievement. Table 36 summarize the grids analysis before and after training for all students. All before and after training grids can be found in Appendix H.

Table 36. Grids Focus Analysis before and after Training

<table>
<thead>
<tr>
<th>P</th>
<th>Picture Before Training</th>
<th>Picture After Training</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Searching meets the need but difficulties in finding relevant information, understanding search results, and narrowing search results (slow and very confusing, useless a lot, provides a lot of failure). In addition to being confused on search independently and neutral for developing keywords.</td>
<td>A lot of improvement in terms of finding relevant information, understanding search results and narrowing search results (fast, simple, obvious, very useful and provides a sense of achievement). Searching independently became obvious rather than confusing and creating keywords became obvious and can be done fast.</td>
</tr>
<tr>
<td>6</td>
<td>Despite being able to search independently, a lot of problems with need addressed when searching, understanding search results and finding relevant information (useless, frustrating, difficult, provides a sense of failure, slow and confusing). Additionally, being neutral on how to narrow search results.</td>
<td>A lot of improvement in terms of finding relevant information need addressed (useful, enjoyable, fast, obvious and provides a sense of achievement). Additionally, improvement in understanding search results (obvious, useful, and fast and being neutral on the enjoyment, difficulty as it was frustrating and difficult before the training). Finally, a lot of</td>
</tr>
</tbody>
</table>
7 No searching problems were reported. However, he was neutral on the achievement with need addressed, neutral with the speed of developing keywords and also neutral with enjoyment for understanding search results.

8 Although he sees himself being fast and it is obvious when it comes to narrow search results, he has some problems with it (a lot of failure, very frustrating and very difficult). Keywords are also a problem (difficult, frustrating). Other difficulties were understanding search results as useless, finding relevant information as failure, and frustrating for independent use.

9 Despite being able to create keywords, he is slow to understand search results, finding relevant information and search independently. Additionally, being neutral on the usefulness, simplicity, confusion, achievement considering his learning needs.

10 No searching problems reported except being neutral on confusion with narrowing search results. Additionally, some of the least positive elements were keywords and understanding search results (more 2 scores).

15 Has a searching problem with narrowing search results and considers that to be frustrating. Also, he was neutral with the achievement and the enjoyment for finding relevant information and keywords.

16 No searching problems were reported except for being neutral on achievement,
enjoyment, confusion, for narrowing search result, understanding search results and need addressed. However, being neutral on enjoyment and the confusion remain the same for need addressed.

17 Consider himself slow with narrowing search results, finding relevant information and understanding search results. Additionally, he was neutral for provides sense of achievement with all the elements.

After the training, he considers himself being very fast with narrowing search results, finding relevant information and understanding search results. Additionally, there was an achievement in terms of his need addressed and the independent use while being neutral remained the same for the other elements.

VI.2.7 Time on Tasks

In section VI.2.1, seven students (P3, P4, P10, P12, P13, P14, and P19) were highlighted as having missed some lessons. Thus, no time was assigned for the missing sessions. Unfortunately, in addition to that, there were other missing video recordings. Five students turned the computers off during some lessons (P1, P2, P5, P8 and P11). Therefore, the recordings for these five students did not occur.

However, the students were writing their answers and the websites they chose thus making the analysis and scoring of task completion possible.

The reason for turning off the computers was because the students had learned to do that during their class activities on a daily basis. Usually, in a daily class at school, each student would log in to a computer, and after finishing a class activity (e.g. working on PowerPoint slide or word document), the students would save their work and turn off the computer. After that, a teacher could log in to see the students’ assignment or work. Thus, some students felt during the training sessions that they were doing regular class activities and accidentally turned off the computers.
Having even one missing value for the times prompted the SPSS software ver.24 to ignore the participant’s time values in total when the computed variables were calculated. Appendix I has the computed variables and the time on task for each subject. Based on that, only seven participants were included in this analysis. These participants were P6, P7, P9, P15, P16, P17 and P18. The time each student spent on the search questions was recorded in minutes using Morae software ver.3.

VI.2.7.1 Distribution of Time

The following boxplot (Figure 25) of the seven participants’ data shows the distribution of the time in minutes across all questions where Mdn=52.
VI.2.7.2 t-test

A paired-samples t-test was conducted to compare time in minutes for pre-training meetings and post-training meetings. A significant difference in the scores was found for the pre (M=29.1614, SD=11.40247) and post training (M=22.6386, SD=9.80372) sessions; t(6)=-2.831, p = 0.030. The following boxplot (Figure 26) shows the difference in time with negative values indicating that the participants took less time in the post sessions after they received the training.

![Figure 26. Difference in Time](image)

VI.2.8 Search Performance of Final Study

The students took two weeks off from the research and then received all the final assessment questions in one session. Note that in addition to missing some of the pre- and post-questions explained earlier, three students missed the final study
session as well (P11, P13 and P14). Thus, the number of students who completed the lessons and the final study questions was not the same for each chosen question. The final study included five questions in total for each group. These questions were created to correspond to some of the questions the students had during the training. A single question corresponded to each lesson except for Lesson 3, for which two questions were selected. The selection of the questions from the lessons varied because a total of three groups had a different number of questions in each lesson. Table 37 shows the chosen questions from each lesson for all groups.

Table 37
Selected Questions for Final Study

<table>
<thead>
<tr>
<th>Group</th>
<th>Lesson 1</th>
<th>Lesson 2</th>
<th>Lesson 3</th>
<th>Lesson 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>Q1</td>
<td>Q1</td>
<td>Q1, Q3</td>
<td>Q1</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Q1</td>
<td>Q2</td>
<td>Q2, Q4</td>
<td>Q3</td>
</tr>
<tr>
<td>Advanced</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3, Q2</td>
<td>Q2</td>
</tr>
</tbody>
</table>

Table 38 shows the performance of all students in final assessment session in comparison with pre- and post-questions from each lesson considering the organization of the questions from the previous Table 37. Colored spots are used where red means failure and green indicates success. Blue colors highlight that students succeeded in all three questions (the pre-, the post- and the final questions) while the grey colors indicate the opposite (failing in all the three questions). No color is shown if a student missed a pre-, a post- or a final study assessment.

Table 38
Final Study Individual Performance

<table>
<thead>
<tr>
<th>P</th>
<th>Lesson 1</th>
<th>Lesson 2</th>
<th>Lesson 3 Q1</th>
<th>Lesson 3 Q2</th>
<th>Lesson 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre Post Final</td>
<td>Pre Post Final</td>
<td>Pre Post Final</td>
<td>Pre Post Final</td>
<td>Pre Post Final</td>
<td>Pre Post Final</td>
</tr>
<tr>
<td>1</td>
<td>F</td>
<td>F</td>
<td>S</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
<td>S</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>4</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td>F</td>
<td>F</td>
</tr>
<tr>
<td>5</td>
<td>F</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>
VI.2.9 Discussion of Final Assessment

Three comments reflect upon this final study. First, the main goal of each question is highlighted. Second, statistical analysis for the final study employed Cochran’s Q to compare the final study questions with the corresponding pre- and post-questions from the previous data collection. This analysis is also supported with bar graphs visualizing the performance for these questions. The analysis only includes students who completed both pre- and post-tests and the final questions. Similar to the lesson analysis, computed variables were created in order to overcome the limitation of the small sample. Appendix J shows the newly computed variables.

The nonparametric Cochran’s Q test is used to examine the differences between dichotomous dependent variables for three related groups, e.g., the differences in the performance of the students between pre, post, and final study sessions. Three related groups of data were compared (the pre-lesson questions, the post-lesson questions, and the final study questions). The same participants are present in each group of scores. Additionally, an analysis was made for the three
multiple choice questions from Lesson 4 with the final study questions (the type of website, the source of information, and the evidence discovered from the chosen website). Third, qualitative analysis is provided, including examples of success, type of difficulties, and any other important observations.

**VI.2.9.1 Lesson1 and Final Study Questions**

The focus of the first question was related to the concept of Lesson 1 regarding the student’s ability to understand search results. **Table 39** shows the questions for all group.

<table>
<thead>
<tr>
<th>Group/Questions</th>
<th>Q1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>Two things when search “Hello again”</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Number of birds</td>
</tr>
<tr>
<td>Advanced</td>
<td>Finding a music band name and members names</td>
</tr>
</tbody>
</table>

Four students were not included in the analysis since they all missed at least one of the assessments. All the students who missed assessments were from the intermediate group. The analysis for this lesson involved the following variables: Lesson 1-Pre, Lesson 1-Post, and Final-Q1. Fifteen students (n=15) participated in this study which examined whether their performance changed significantly over three questions related to understanding the search results: a pre-, a post- and a final question.

A Cochran’s Q test determined that there was a statistically significant difference in the proportion of students who successfully answered their questions.
over time, p < .003. A pairwise comparison (each time point compared with the others) shows a significant difference between pre- and post-training questions, p=0.003 and between pre- and final, p=0.003 while there is no significant difference between post- and final questions, p=1.00. **Figure 27** shows the percentages of success for the first question.

![Figure 27. Cochran’s Q Question 1 Percentages of Success](image)

Examples of success in the final questions included the students’ reading the titles of the websites in addition to snippets that allowed the students to succeed. Moreover, the students did not only depend on information that came from Wikipedia but also looked at different search results. The difficulty in the final questions encompassed choosing the wrong answer or giving incomplete answers, such as those in the beginner group. One observation for this question where a
student benefited from the “Related Search” feature was explained earlier in section VI.2.2.

VI.2.9.2 Lesson 2 and Final Study Questions

The second final question was related to the concepts students learned in Lesson 2 and focused on creating appropriate keywords. Table 40 shows the questions for all groups.

<table>
<thead>
<tr>
<th>Group/Questions</th>
<th>Q2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>Percentages of 3 religions in France</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Elephants' communication</td>
</tr>
<tr>
<td>Advanced</td>
<td>Finding 2 explorers of North America; one whose nationality is uncertain and the other who was an Italian-born English explorer (their names and when they died)</td>
</tr>
</tbody>
</table>

Four students were not included in the analysis since they missed at least one of the assessments. All the students who missed were from the intermediate group. The analysis for this lesson involved the following variables: Lesson 2-Pre, Lesson 2-Post, and Final-Q2. Fifteen students (n=15) participated in the analysis that examined whether their performance changed significantly over three questions related to creating keywords: a pre-, a post- and a final question.

A Cochran's Q test determined that a statistically significant difference existed in the proportion of students who successfully answered their questions over time, p < .015. A pairwise comparison (each time point compared with the others) shows a significant difference between pre- and post-training questions (p = 0.006),
and a significant difference between post training and final questions ($p = 0.028$), while no significant difference existed between pre- and post-questions ($p = 0.584$). Figure 28 visualizes the percentages of success for the second question.

![Figure 28. Cochran’s Q Question 2 Percentages of Success](image)

Examples of success were mainly with the intermediate students who succeeded by choosing the right keywords. In terms of difficulty, the beginner students continued to answer only half of the questions. In other words, two-step keyword questions were challenging. Similarly, the advanced students struggled to answer the second part of their question and became frustrated. This struggle may be attributed to the question that focused on American explorers. Thus, a lot of information in the search results required more reading in order to find the answer.
VI.2.9.3 Lesson 3 (1st Question) and Final Study Questions

The goal of the third question focused on narrowing search results’ features from Lesson 3. The beginner group used the “Images” filter, the intermediate used the “Videos” filter, while the advanced had to use the “filetype” operator. Table 41 shows the questions for all groups.

<table>
<thead>
<tr>
<th>Group/Questions</th>
<th>Q3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>Large picture of Bill Clinton</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Video documentary which is longer than 20 minutes but less than an hour</td>
</tr>
<tr>
<td>Advanced</td>
<td>PDF document for a travel guide</td>
</tr>
</tbody>
</table>

Seven students were not included in the analysis since they missed at least one of the assessments. All the students who missed were from the intermediate group, except for one student who was from the beginner group. The analysis for this lesson involved the following variables: Lesson 3-Pre1, Lesson 3-Post1, and Final-Q3. Twelve students (n=12) participated in the study to examine whether their performance changed over three questions when using the video filter from the menu to narrow search results: a pre-, a post- and a final question.

A Cochran's Q test determined that no statistically significant difference existed in the proportion of students who successfully answered their questions over these different time events, $p < .368$. Figure 29 visualizes the percentages of success for the third question.
Examples of success included the ability of a beginner student to remember how to activate the “Images” filter and thus find the correct answer while the “Videos” filter allowed the intermediate students to find the answer quickly and easily. Additionally, the use of the “filetype” operator helped an advanced student to find the required file. Regarding difficulties, a beginner student found the required image but failed when determining the size. In general, this third question was the easiest for all students.

VI.2.9.4 Lesson 3 (2nd Question) and Final Study Questions

The goal of the fourth question focused also on narrowing search results and features that were used in Lesson 3. All students had the operator questions
(“filetype” for both the beginner and the intermediate and “double quotes” for the advanced). **Table 42** shows the questions for all groups.

<table>
<thead>
<tr>
<th>Group/Questions</th>
<th>Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>PowerPoint slides of a book</td>
</tr>
<tr>
<td>Intermediate</td>
<td>Word document of a book</td>
</tr>
<tr>
<td>Advanced</td>
<td>Quotation marks usage</td>
</tr>
</tbody>
</table>

Seven students were not included in the analysis since they missed at least one of the assessments. All the students who missed were from the intermediate group except for one student from the beginner group. The analysis for this lesson involved the following variables: Lesson 3-Pre2, Lesson 3-Post2, and Final-Q4. Twelve students (n=12) participated in the study to examine whether their performance changed over three questions when using the “filetype” operator to narrow search results: a pre-, a post- and a final question.

A Cochran’s Q test determined that no statistically significant difference existed in the proportion of students who successfully answered their questions over these time events, p < .156. **Figure 30** visualizes the percentages of success for the fourth question.
Examples of success included that all advanced students were able to remember from the training the usefulness of using the double quotes as they explained the differences in search results when applied. Considering difficulties, almost all the beginner and the intermediate students failed to remember the operator “filetype”. Additionally, almost all the students who failed mistakenly chose the wrong file extension from results (PDF instead of word document).

VI.2.9.5 Lesson 4 and Final Study Questions

The goal of this fifth question was related to the concepts students learned in Lesson 4 and focused on searching for answers and explaining why the chosen website was reliable. Table 43 shows the questions for all groups.
Table 43
Lesson 4 and Final Study Questions

<table>
<thead>
<tr>
<th>Group/Questions</th>
<th>Q5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beginner</td>
<td>Distance between US and Canada and why the website is reliable</td>
</tr>
<tr>
<td>Intermediate</td>
<td>3 things Michigan imports and why the website is reliable</td>
</tr>
<tr>
<td>Advanced</td>
<td>3 things Massachusetts imports and why the website is reliable</td>
</tr>
</tbody>
</table>

Four students were not included in the analysis since they missed at least one of the assessments. All the students who missed were from the intermediate group except for one student who was from the beginner group. The analysis for this lesson involved the following variables: Lesson 4-Pre-A, Lesson 4-Post-A, and Final-Q5-A. Fifteen students (n=15) participated in the study to examine whether their performance changed over the three questions related to the credibility of the chosen websites: a pre-, a post- and a final question.

A Cochran's Q test determined that no statistically significant difference existed in the proportion of students who successfully answered their questions over time, p < .091. **Figure 31** visualizes the percentages of success for the fifth question.
Examples of success included the ability to justify the answers by identifying governmental websites that were visited during the training. The difficulties encompassed those in the beginner group who continued to not answer the reliability part. One observation of this lesson was related to one advanced student who failed. The reason for failure was choosing wrong information about exports, not imports. The website he chose had a heading "exports and imports" with some information about a list of exports (in a small font size). The import section was at the bottom of the page and could not be noticed without scrolling. Thus, he thought the list presented both the imports and exports and chose the wrong answer.
VI.2.9.5.1 Final Study Performance on Multiple Choice Questions

The multiple choice questions were also evaluated since they were related to the Lesson 4 questions. The questions focused on three areas: the type of the chosen website, the source of the information and the evidence that was discovered. Table 44 shows the individual performance of the students for the multiple choice questions in the final study and during the training (pre and post). Appendix K shows chosen answers for all the final multiple choice questions.

<table>
<thead>
<tr>
<th>P</th>
<th>Type of Website</th>
<th>Source of Information</th>
<th>Evidence Discovered</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pre</td>
<td>Post</td>
<td>Final</td>
</tr>
<tr>
<td>1</td>
<td>F</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>2</td>
<td>F</td>
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<td>3</td>
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<td>4</td>
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<tr>
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<td>F</td>
<td>S</td>
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</tr>
<tr>
<td>6</td>
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<td>7</td>
<td>S</td>
<td>S</td>
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<tr>
<td>8</td>
<td>F</td>
<td>F</td>
<td>S</td>
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<td>9</td>
<td>F</td>
<td>F</td>
<td>S</td>
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<td>10</td>
<td>F</td>
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<td>11</td>
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<td>12</td>
<td>S</td>
<td>F</td>
<td>F</td>
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<tr>
<td>13</td>
<td>S</td>
<td>S</td>
<td>S</td>
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<td>14</td>
<td>S</td>
<td>S</td>
<td>S</td>
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<td>S</td>
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<tr>
<td>16</td>
<td>S</td>
<td>S</td>
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<tr>
<td>17</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>18</td>
<td>S</td>
<td>S</td>
<td>F</td>
</tr>
<tr>
<td>19</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
</tbody>
</table>


VI.2.9.5.1.1 Discussion of Multiple Choice Questions

Four students were not included in the analysis since they missed at least one of the assessments. All the students who missed were from the intermediate group except for one student who was from the beginner group. The analysis for this
lesson involved the following variables: (i) for type of website: Lesson 4-Pre-B, Lesson 4-Post-B, and Final-Q5-B, (ii) for source of information: Lesson 4-Pre-C, Lesson 4-Post-C, and Final-Q5-C, (iii) for evidence discovered: Lesson 4-Pre-D, Lesson 4-Post-D, and Final-Q5-D.

Fifteen students (n=15) participated in the study to examine whether their performance changed over three questions related to the type of website chosen, source of information and evidence discovered: students answered a pre-, a post- and a final question. For the type of the website questions, a Cochran's Q test determined that there was a statistically significant difference in the proportion of students who successfully answered their questions over time, p < .015. A pairwise comparison (each time point with the others) showed a significance between pre- and post-questions (p=0.028) and also between pre- and final questions (p=0.006) while there was no significant difference between post- and final questions, P=0.584. Figure 32 shows the percentages of success for the type of website question.

![Figure 32. Cochran's Q Type of Website Percentages of Success](image_url)
For the source of information question: a Cochran's Q test determined that there was a statistically significant difference in the proportion of students who successfully answered their questions over these time events, p < 0.717. **Figure 33** shows the percentages of success for the source of information question.

![Failure vs. Success](image)

**Figure 33. Cochran’s Q Source of Information Percentages of Success**

For the evidence discovered questions: a Cochran's Q test determined that there was a statistically significant difference in the proportion of students who successfully answered their questions over time, p < .017. A pairwise comparison showed only a significance between pre- and final questions (p=0.005) while there was no significance difference between pre and post (p=0.289) as well as no significant difference between post and final questions (p=0.077). **Figure 34** shows the percentage of success for this question.
VI.2.10 Main Observations about Searching

The following summarizes the main observations for the students during the training and the final study.

VI.2.10.1 The Searching Path

The searching path highlights what the students did in order to find an answer. In other words, what were the major steps taken to find an answer, whether correct or not? The searching path was nearly consistent for all groups with some exceptions in the beginner group. The first option to answer the questions for all groups was the information provided by the KG. Most of the time, the students found the KG information sufficient without the need to click on the website link in the KG. The second option was Wikipedia. Clearly, all students were familiar with the Wikipedia structure. Wikipedia was very valuable to all groups, particularly the beginner group. The beginner students became frustrated if they
could not find the answer on Wikipedia. The other groups used Wikipedia even if no answer was found, but this choice served as a starting point, particularly if they were not familiar with the content of the question. One other point related to the navigation of a Wikipedia page was that beginner students only checked or read the first two paragraphs at most, while the other groups explored the Wikipedia pages more by scrolling and searching for information. Generally, all students liked checking Wikipedia because this website is designed with page breaks with several headings that allow easier navigation.

The third option for answering questions was looking and scanning all the search results to see if a link matched the query; if it did, then that website would be chosen. Very few cases existed where the beginner group chose this route. On the other hand, all the other groups were able to look at different search results. When the students checked any website for an answer, they scanned and looked at the heading first. If there was a heading that matched the query (or at least had some words from the query), they would check the information under that heading. Without a heading present, most of the students avoided reading the page, but when students had to read a lot of textual information, most of them either failed or became frustrated and changed to a different website.

The fourth step was chaining the search query (keywords) with the help of the autocomplete feature. All students used this feature heavily, and this process helped them to find the answer quickly. The students depended on this feature
mainly because they knew it would help them to get either KG information or a link that matched their queries.

In almost all the cases, the students from all groups only looked at the search results on the first page. A few intermediate and advanced students checked the second page of the search results. Clearly, the students did not want to check the second page and preferred to only look at the first page. If they could not find answers on the first page, they kept changing the search query using autocomplete to locate one on Page 1 of the search results.

Because of the training, the students were asked to look at different results before answering the questions on their worksheet. Thus, the previous steps were used in combination for many of the intermediate and the advanced students. For example, if the students found an answer from the KG, they would check that answer on Wikipedia. If Wikipedia did not provide the answer, then they would look at the search results.

**VI.2.10.2 Natural Language Search and KG**

There are two further observations from all the lessons, about the use of the Natural Language Search (NLS) and the KG. According to the Search Engine Watch website, the NLS is a search carried out in everyday language, phrasing questions as you would ask them if you were talking to someone. These queries can be typed into a search engine, spoken aloud with voice search, or posed as a question to a digital assistant like Siri or Cortana. This is as opposed to keyword-based search, which is what most people who are used to using web search engines still default to. Keyword-based search is an attempt to break down a query into the most important terms, getting
rid of unnecessary connecting words like “how”, “and”, “the”, and so on (Sentance, 2016).

During the study, many students used the NLS approach to answer some broad questions. For example, “dolphins communication” became “how dolphins communicate.”

All the students from all groups depended on the information that came from the KG and considered it their first option to answer the questions. It should be noted that the KG can be generated by Google using both keyword-based and NLS approaches either by typing or using the voice searching. There are a variety of forms of the KG, including the quick answer feedback for questions, the summary information about a search query like “president of the United States”, information retrieved from a website like Wikipedia, a slider with information, or list of things like restaurants or cars. Also, the KG comes as a suggestion for some search queries. For example, the “People Also Ask” feature provides different questions related to your search queries. All these forms were used by some students to help them answer the questions.

Using the NLS and the KG was favored by all the students in this research project. Although the teachers taught them to use the static-based keyword following the recommendation from the Google search team, the students kept using the NLS approach. The NLS method was very valuable mainly when it was supported by the KG in the search results. For example, P2 had searched using the voice search “Minions” and found the results. Further searching for “Who is the director of the movie” prompted the answer from the KG. Using the NLS with P2
was very useful for several reasons. First, P2 was slow with speaking so speech was a challenging modality to use with this question “who was the director of the minions movie”. Additionally, selecting appropriate keywords was a struggle for this student. But in this example, using the NLS, Google knew what the student was asking regarding the director of the Minions movie, although the word “Minions” in the follow-up search was missing. The student just searched for “Who is the director of the movie”. Thus, a dialog with the Google user interface produced the correct response.

The KG was valuable when it was generated through the NLS or the keyword-based approach. For example, all the intermediate students in the final study were able to answer the second question correctly through the KG information, except for P7 who had no KG in the search results based upon the keyword choice. Also, for the same question, P6 was struggling and tried a variety of keywords and visited different websites but could not find an answer for the total number of birds on record. Finally, the student searched “how many birds species are there” and found the answer from the KG.

Other cases existed where the KG helped the student to overcome the problems of reading copious text from websites. Both P8 and P9 visited some websites to answer the questions, but since some websites were heavy with textual information, they ignored these websites and moved to other options. After trying different keywords, they found the answers from the KG. The KG information they used for their answers was retrieved from the websites they visited early in their
searches but had failed to choose because they could not find the answers from the
text-heavy presentations.

Several cases existed where students failed with the questions even when
there was a KG. One example is when a student chose the wrong answer from the
KG. For example, P18 chose the wrong North American explorer from a list
generated by the KG. A second scenario was when the KG led the student to the
wrong answer for a question. For instance, while searching for a country’s religion,
P3 chose Afghanistan instead of Argentina from the KG information. The reason
was because the word “Afghanistan” was the first word in the list and was
highlighted in bold, although P3’s search query was about Argentina. A third
scenario was when a student answered the question correctly from the KG but
failed on the reliability part. This mainly applies to the beginner group students
who could not answer the reliability section for any of the questions in the fourth
lesson or the final question. The score for these tasks was considered a “success” if
the students explained why the chosen website was reliable.

In two instances, students could not find the answer from the KG, although
the information was there. A few intermediate students ignored the KG if the title
of the website did not match their search query. For example, a link to the website
retrieved from the KG caused some confusion for several intermediate students.
They were searching for “dolphins communication” but the title of the link was
“How do whales, dolphins and porpoises communicate with each other”. Thus, they
skipped the KG as the word “whales” appeared first in the link terms. Also, it
should be noted that the KG information did not highlight the word “dolphin” in bold. A second instance was when there was a lot of information in the KG which was presented in a small font size. For instance, P15 and P18 could not find the sought-after band name from the KG for the first question of the final study given the amount of information presented before the band name, such as their song titles. Additionally, the band name was presented in a small font size, making it less obvious in the text.

VI.2.10.3 Voice Searching and Images in Search Results

All the students in the beginner group favored voice searching. In fact, the students only typed with the help of the autocomplete when the voice searching did not provide the required search query. Voice searching was valuable to the beginner students and enabled them to search more easily. For example, in Lesson 4, the beginner students used voice searching to search for the quote to avoid typing long sentences.

Only two students from the intermediate group, P5 and P6, preferred voice searching and used it several times while none of the advanced group used it. Additionally, none of the students liked the enhanced voice searching that was provided by the Web Speech API.

Regarding including images in search results, only two students from the intermediate group, P6 and P7, activated the extension a few times while no one used it from the other groups.
VI.2.10.4 Web Speech API Usage

All the students practiced using the web speech API twice during Lesson 3 for the pre- and the post-sessions, although none of them used it to answer questions. Some of them had some problems with using it. The following are the main qualitative observations:

VI.2.10.4.1 Typing the URL

The students had to type this URL (https://goo.gl/2MA6RW) in order to access the API. Although the length of the URL was only 21 characters, many students had problems typing that. The students in the beginner group were not able to type the URL and the teacher helped them. Some students from the other groups were frustrated as they could not type correctly. This frustration was prompted by focusing on what they were typing without looking at the screen until they were finished typing. For example, one student added an extra “G” character to the URL and was frustrated when the website was not available. Another reason for the problem with the typing could be that the name of the address involved a meaningless set of characters. These random characters and symbols lacked a recognizable pattern which was hard to remember when typing or spelling. Clearly, it was observed that all the students missed the prediction feature in the suggestive omnibox (URL address) provided by Google Chrome browser. The goal of this feature according to Google is to complete searches and URLs. Note that this feature works automatically but can be disabled using the advanced setting.
VI.2.10.4.2 API Access

Since the API requires permission (a pop-up window message) to activate the microphone and use the enhanced voice search, some students struggled and did not know how to activate that. Moreover, as the API requires additional permissions, such as always allowing the website to access the microphone, some students did not notice that and were frustrated because the microphone stopped working.

It was apparent that pop-up window messages were distracting to some students. For those who were able to activate the microphone, they were able to successfully test the operators. However, some had voice recognition issues and accuracy problems prompting obvious disappointment for those who wanted to try different examples and operators.

VI.3 Students’ Assessment of the Training

The students’ assessments of the training experience and the handout usage included summary analysis of their responses for the grids of each training lesson, analysis of the handouts they used during the training, and their final feedback about the training which was obtained through interviews.

VI.3.1 Grids Lessons Summary

The results of the analysis of the training showed a lot of satisfaction with the training program as all the students except for P6 and P7 had positive responses for all the lessons. Table 45 shows the most preferred elements for each subject for all the lessons. Table 46 shows the only negative responses in the
training for subject 6 and 7 and the related constructs. Appendix L includes the focus grids for all lessons.

<table>
<thead>
<tr>
<th>P</th>
<th>Lesson 1</th>
<th>Lesson 2</th>
<th>Lesson 3</th>
<th>Lesson 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Training experience, Time allotment</td>
<td>Time allotment, Amount of information, Participation</td>
<td>Communication with the teacher, Training experience</td>
<td>Training experience, Communication with the teacher</td>
</tr>
<tr>
<td>6</td>
<td>Time allotment</td>
<td>Time allotment, Amount of information</td>
<td>Training experience</td>
<td>Training experience</td>
</tr>
<tr>
<td>7</td>
<td>Time allotment, Participation</td>
<td>Time allotment</td>
<td>Communication with the teacher</td>
<td>Communication with the teacher</td>
</tr>
<tr>
<td>8</td>
<td>Time allotment, Participation</td>
<td>Time allotment, Participation</td>
<td>Communication with the teacher</td>
<td>Training experience</td>
</tr>
<tr>
<td>9</td>
<td>Participation</td>
<td>Time allotment, amount of information</td>
<td>Neutral</td>
<td>Communication with the teacher</td>
</tr>
<tr>
<td>10</td>
<td>Training experience, Participation</td>
<td>Time Allotment, Participation</td>
<td>Absent</td>
<td>Training experience</td>
</tr>
<tr>
<td>11</td>
<td>Training experience</td>
<td>Time allotment, Amount of information, Participation</td>
<td>Communication with the teacher, Training experience</td>
<td>Communication with the teacher</td>
</tr>
<tr>
<td>13</td>
<td>Absent</td>
<td>Absent</td>
<td>Absent</td>
<td>Training experience, Communication with the teacher</td>
</tr>
<tr>
<td>14</td>
<td>Training experience, Participation</td>
<td>Time allotment, Amount of information, Participation</td>
<td>Absent</td>
<td>Absent</td>
</tr>
<tr>
<td>15</td>
<td>Participation, Training experience, Communication with the teacher</td>
<td>Participation</td>
<td>Need addressed</td>
<td>Time allotment</td>
</tr>
<tr>
<td>16</td>
<td>Participation, Training experience</td>
<td>Participation, Amount of information, Need addressed</td>
<td>Need addressed</td>
<td>Time allotment</td>
</tr>
<tr>
<td>17</td>
<td>Participation, Communication with the teacher</td>
<td>Amount of information,</td>
<td>Need addressed</td>
<td>Time allotment</td>
</tr>
</tbody>
</table>
Table 46

Summary of Negative Elements for all Lessons

<table>
<thead>
<tr>
<th>Lesson</th>
<th>Participant</th>
<th>Negative Elements</th>
<th>Related Constructs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>P7</td>
<td>Amount of information, Need addressed</td>
<td>Not enough</td>
</tr>
<tr>
<td>2</td>
<td>P6</td>
<td>Need addressed, Participation</td>
<td>Useless, provides sense of failure</td>
</tr>
<tr>
<td></td>
<td>P7</td>
<td>Training experience, the communication with his teacher and his learning need, participation and the amount of information</td>
<td>Not enough, frustrating</td>
</tr>
<tr>
<td>3</td>
<td>P6</td>
<td>Participation, the need addressed and the amount of information, the communication with the teacher</td>
<td>Frustrating, not motivating and not enough, useless</td>
</tr>
<tr>
<td></td>
<td>P7</td>
<td>Need addressed</td>
<td>Not enough</td>
</tr>
<tr>
<td>4</td>
<td>P6</td>
<td>Need addressed, the communication with teacher, participation</td>
<td>Not motivating and frustrating, provides a sense of failure, useless</td>
</tr>
<tr>
<td></td>
<td>P7</td>
<td>Need addressed</td>
<td>Not enough</td>
</tr>
</tbody>
</table>

VI.3.2 Handouts Grids Analysis

Considering those who missed the final study and the grids that were removed for some of the students, we have only 10 grids (6 intermediate and 4 advanced) remaining for evaluating the handout use. No negative feedback was received from any of the students, which indicates that the students favored the handouts. An example of the positive responses can be seen with P9 who ranked all the elements with “1” indicating that he favored the handouts a lot. Also, P10 (see Figure 35) who liked everything about the handouts, although he was neutral with the motivation considering the content quality.
Generally, the handout organization was the most liked element followed by the independent use and being able to use the handouts every day. The most preferred element was the handout organization (title, steps with numbers, and screen shots). The second favored element was the ability to use the handouts daily followed by the independent use and the content quality. Table 47 shows the picture that each student had about the handouts. Appendix M has all the handouts focus grids.

<table>
<thead>
<tr>
<th>Participant’s Picture</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Liked the handout (all elements were positive) and most importantly the handout organization, the language and the content quality.</td>
</tr>
<tr>
<td>6</td>
<td>Despite being neutral with the difficulty, motivation, enjoyment of the visual format, he found it useful and effective. Additionally, he liked most of the elements and mainly the handout organization and can use it every day independently.</td>
</tr>
</tbody>
</table>
7 Liked everything about the handout and mainly the handout organization and can use it every day independently, although he was being neutral on the motivation with content quality and the visual format.

8 Despite viewing the handout as motivating for independent use, he was being neutral with motivation for all the other elements. Also, he was neutral with the motivation and the enjoyment for the language and the visual format, although he found them easy, and useful. Additionally, he can use the handout independently every day and consider that effective and useable.

9 He liked everything about the handout (all elements were ranked 1).

10 He liked the visual format, the language, the handout organization and can use it independently.

15 He liked the content quality, the handout organization and the independent use (effective, easy, enjoyable, and motivating). Except for the visual format which considered it enjoyable, he was neutral with the enjoyment for all the other elements. Additionally, he was neutral for the difficulty and the motivation of the language and the visual format, although he found them useful and usable.

16 The independent use and the content quality were her favorite (easy, useful and enjoyable). Although she was neutral with the motivation, and the enjoyment of the language, visual format, handout organization, she considered them usable and effective.

17 He favored everything about the lesson a lot (1 score) except for being neutral on the motivation for all the elements.

18 He mostly liked the handout organization, the language and being able to use the handout independently (enjoyable, usable and useful). Although he found that using the handout every day is effective and easy, he was neutral for all the other constructs for this element. Also, he was neutral of the difficulty and the enjoyment for visual format and the content quality. However, he found them effective and useful and usable.

VI.3.3 Students’ Final Feedback

VI.3.3.1 Beginner Group

For the beginner group, no problem was reported regarding the Google search interface. All the students acknowledged the value of the handouts (mainly the step-by-step instructions) and would use them in the future. Also, they reported being motivated to use Google search more after this training experience. P3 reported using the handouts to help some family members to learn more about
searching skills with Google. All the students favored the voice search option provided by Google not the API and are using it daily after the training, although P1 reported an issue with voice searching occasionally (e.g., voice recognition). The students did not use images in search results.

**VI.3.3.2 Intermediate Group**

Similarly, none of the intermediate group students had any problem with using the Google search interface. Additionally, they became more motivated to work with Google search and found the handouts very useful. All the students reported that they would use the handouts again. In fact, some of them said they were using the handouts daily at home and in their classes. As for the most difficult or confusing things the student encountered during the training, P4, P9 and P14 complained about the questions. Both P4 and P9 said that some of the questions were difficult for them to answer. P14 reported having some problems in understanding the questions being asked and knowing how to convert a question into a search query. P7 and P9 did not like the questions that focused on the “filetype” operator since they found the operator difficult to remember. The final complaint was from P12 who found the fourth lesson that focused on reliability very difficult to understand. The other students reported no problems with the training program.

Considering which lesson the students liked the most, P4 and P13 chose the first lesson which was related to understanding search results, while both P12 and P14 favored the second lesson that focused on creating keywords. Only P10 chose...
the reliability lesson (lesson 4) as the favorite. All the other students preferred the third lesson where they learned how to narrow search results and use the menu options. P5 said, “I like the menu options. I just discovered that you can search for copyrighted images.”

Only two students, P5 and P6, preferred the voice search option provided by Google, not the API, while the others chose typing. They explained their preference for voice searching as easier, and that they then do not have to type fast. This viewpoint was the opposite of that of the other students in the group who did not like the voice search option. The reasons for disliking voice searching were related to individual typing preferences, voice recognition concerns, and the need for multiple steps to complete a search. P4 said “Using the microphone requires a lot of things to search. I have to find the microphone and click on it, then speak and usually I am not understood. It is just a little long time to do so I type.”

When considering the value of the images in search results, only two students (P6 and P9) liked having the images in search results and found it helpful to understand the results better. P6 said “I have it on my computer and I use it daily.” On the other hand, four students (P5, P7, P10 and P12) were against it and found the images distracting. Both P5 and P12 said they prefer the default design of the user interface and reading the links. P7 and P12 reported that the design of the images in search results is similar to video links in the results. Thus, they can easily become confused trying to distinguish between a website link and a video link. All the other students found the images in the search results helpful, but they
may or may not use them. Regarding the repertory grids, all the students favored the design of the grids, specifically the emoticon faces, and found the grid intuitive and easy to use as a tool. Also, they reported that the number of elements (sentences) was appropriate and not overwhelming.

**VI.3.3.3 Advanced Group**

Two students from the advanced group reported some issues they had during the training. P15 complained about some of the questions and considered them too challenging to answer. P17, similarly to several students from the intermediate group, did not like the idea of having to remember the operator “filetype” in order to answer the question. As for the lessons the students liked the most, both P15 and P16 favored the narrowing search results and reliability lessons, P17 liked only the reliability lessons, and both P18 and P19 found narrowing search results the most useful lesson.

None of these students preferred to use voice searching. There were several reasons for this preference such as voice recognition issues, the speed of speaking when using voice searching, and a general preference for typing due to familiarity. All of the students found the images in search results useful, but they may or may not use it. P17 said, “It is helpful only if I am searching for something new or something I am not familiar with; otherwise I will not use it.” There were two more notes regarding the time that was given for the questions and the study requirements. P17 said, “I liked the time for the questions; it was not distracting.”
P16 said regarding the nature of the study, “I love the idea that we have to answer the questions regardless if it is right or wrong as it is not related to grades.”

VI.4 Teachers’ Final Feedback

None of the teachers who participated in the study encountered any difficulty in performing their assigned tasks except for one teacher who worked with one of the intermediate groups. The students’ group behaviors were hard to control, thus consuming more time to get the lessons started. However, all the teachers indicated that they would repeat this training experience with other students. As for the things that the teachers liked the most, the teachers found the handouts, their own instructions, and the time duration for each meeting very useful. In fact, none of the teachers had expectations that the training would work very well considering the known challenges of working with cognitively challenged students.

All of the teachers found the lessons and the handouts valuable for both themselves and for the students. One teacher said, “Handouts are fantastic. The students benefited from the visual part of it and did not need to read a lot of it.” Another teacher said, “The step-by-step instructions are very important and helpful to the students.” As for the value of the training to the teachers, one said, “I did not know how to do half of the stuff. I didn’t even know how to use it and I have learned a lot (lesson 2, lesson 3, lesson 4) and I am using that every day now. I think that I have learned more honestly than they did since I am exploring more of Google menus and features every day.”
Another favorite with the teachers was the timing that was sufficient for both the teachers and the students alike. The timing was primarily preferred by the beginner group’s teacher who also found the voice searching to be a life-changing tool for beginner students. Lastly, the teachers found their instructions very helpful in organizing each meeting with the students. One teacher said, “Instructions for teachers were great and I liked how it matched perfectly with the handouts.” The most favored lessons by the teachers were narrowing search results and finding credible websites, with the exception of the beginner group’s teacher who found the developing keywords lesson to be the most useful one. As for the usefulness of the lessons, the teachers noted that they see the students use the handouts and apply what they have learned in different classes at the school.

Considering their thoughts about changing anything in the current training program for the future, the teachers’ responses focused on the number of questions, the time of the training, the reliability lesson, parent involvement and the grids. The advanced group’s teacher believed that the students could handle working on five questions per meeting as these students finish the questions quickly. For them, increasing the number of questions would be useful. One teacher of the intermediate groups recommended conducting the study at other times rather than the end of the school hours in order to have more students participate. Also, this suggestion could be helpful to some students who finished the grids very quickly in order to get home.
The other teacher from the intermediate group suggested extending the fourth lesson further by asking students to search and find answers from blogs, governmental websites after they learned how to identify the websites. Finally, the beginner group’s teacher recommended having parent involvement to help the students practice more at home. The teacher said, “Have parent involvement somehow to work with the kids and let them practice at home at least once a week because repetition is really important for the beginner group kids considering their short-term memory.” One other note was related to having a more simplified version of the grids since the beginner group students could not work with the current one because of comprehension issues.

One of the questions was related to teachers’ ideas about having video training to support more teachers and many students. The teachers suggested setting up the videos in the same way that the lessons were prepared and including the students’ handouts and the teachers’ instructions with the videos. Additionally, researchers were suggested to highlight their questions as examples but allow the new teachers to create their own questions as well. Each video could have a brief introduction as well as background knowledge about the specific topic along with a demonstration. The teachers recommended making each tutorial 10-15 minutes long. They suggested having someone talk in the video and explain the material, while the mouse moved as the speaker talked. More importantly, the participant must feel free to search and follow the instructions. A strategy that the teachers used at the school when they asked students to follow video instructions is “Pause
here. Hear it, see it and then try for yourself and see if you understand it.” The same strategy could be used for the future video training.

The final question for teachers was focused on the teachers’ thoughts about creating a successful web-searching training program. The teachers recommended using the same structure (handouts, their own instructions, and time). Moreover, they found the order of the lessons to be useful by working with basic material and then moving on to the more advanced subjects. Additionally, the number of questions was appropriate by starting with one question for the first lesson and then adding more until reaching five questions for the final study. In this way, the students are able to become more comfortable with the process and the structure. Also, voice searching was helpful for some students who may have to deal with grammar issues. Additionally, the structure of the pre and post “was great.” The teachers indicated that this structure for learning helped the students to master and remember the skills. The teachers did stress that informing the students that the class would last for one hour was critical information. In this fashion, the students could anticipate receiving sufficient questions to answer without being frustrated or wanting to finish quickly.

As for the lessons, the teachers said that the focus should be on narrowing search results but also more on the reliability of the websites for the intermediate and the advanced students. These students know how to search but they struggle to find whether a website is trustworthy or not. The advanced group teacher said, "Because my students are really good with technology, you show them how to click a
button but they don’t know how to interact with the world." For the beginner group, the focus should be more on creating keywords for searches.

VI.5 Summary

This chapter has focused on answering the second research question of this dissertation. It shows that it was possible to improve the web-searching skills for some students with cognitive disabilities when they used accessible training handouts along with teachers’ support. Additionally, a final follow-up study (within two weeks after the training) showed that some students retained research skills from the training. Moreover, an analysis of RGT grids and students' feedback highlighted that students enjoyed the training lessons in addition to seeing an improvement in their perceptions of their own searching abilities before and after the training.
CHAPTER VII

DISCUSSION

This dissertation shows that people with cognitive disabilities have the ability to learn and master web searching skills. In fact, the dissertation shows that many students retained their web searching skills for a final study (two weeks after the training). However, despite having prior knowledge of the computer and the internet, not all the participants were able to learn from the training. This is understandable considering the low functioning participants who had a below-fourth-grade reading level and short-term memory limitations. The dissertation indicates the value of understanding the subjects by focusing on functional capabilities rather than the medical model. Since the participants had a variety of cognitive challenges, such as Down syndrome, Asperger, and mild learning disabilities, among others, the results could be representative of individuals with different learning difficulties. Tailoring lessons to learners at different levels was very useful and created a better learning experience for each participant as there was a match between the experience level and the learning content.
VII.1 Overview of Lessons

Based on the video analysis, students’ feedback and also the teachers’ feedback, this dissertation helps understand the value of the lesson preferences for different groups. Starting with the beginner group, “creating keywords” is the most important lesson as the students need more time and practice in order to phrase a question into a search query. Understanding search results was also helpful, specifically using the colors approach. The teacher explained the search results to the students by showing that blue indicated titles, and green meant web addresses. These explanations were very useful for this population. The big advantage of the lesson was to work with the KG. It helped the students to find the answers quickly and easily since looking at different websites was challenging to them. As for narrowing search results, using the filters like “Images” was more useful than trying to remember how to search using an operator like “filetype”. Understanding the credibility of websites was the most challenging lesson for this group and possibly beyond their capabilities without further training.

The intermediate group, on the other hand, did not have a problem with creating keywords and found that lesson easy. The same response applies to this group’s understanding of search results since they improved because of the training. The most preferred lesson was narrowing search results. The students enjoyed exploring menu options and different search tools. Almost all the students answered the questions correctly in the post meeting and the final study when they used the filters such as “Images” and “Videos”. However, they had difficulties trying to
remember the operator which was required to search for a specific result type like PDF or DOC. Even among those who answered the operator questions correctly, few of them used the operators in their queries; the majority just added the file extension and found the answer. However, some students were confused and chose different file types other than what they searched for such as PDF instead of DOC. As for the credibility questions, the majority of the students were successful only when there were some indications like domain names (such as .gov or .edu), a news website or a website they had seen in the pre-meetings. However, they struggled with other websites. Some students did not answer the reliability questions while the others just chose reliable (as if guessing) without explaining why.

The advanced group mostly favored the credibility lesson in addition to the lesson on narrowing search results. Because of the training, the students were able to justify credibility by looking at references and also comparing the results from two different websites. As for narrowing the search results, using the filters was within reach for all the students. However, they favored the operators over the filters like using the double quotes and (site:) feature. In contrast with the intermediate and the beginner students, the advanced group students did not have a problem with searching for a specific file type. However, most of them did not use the operators, but successfully searched and found the answer using the file extension. Two students even explored the Advanced Setting from the Google search interface and were able to search for file type and also use the site operator from there. Understanding search results was the easiest lesson for the advanced group.
On the other hand, creating keywords caused some problems for the students. For example, sometimes students got confused about what to search for but they improved in the post meetings.

VII.2 Reliability and Type of Website Questions

The main goal of the fourth lesson questions was not only to find an answer but also to indicate why a chosen website was reliable or not. Justifying an answer was too challenging for the beginner group, as it also was for some of the intermediate group students. Frequently, they did not answer the question on their worksheet and just chose reliable without justifying the answer. The other intermediate students and most of the advanced group students were able to answer the questions. Justifying the answers included choosing a website that the students were taught was reliable such as a governmental, educational or news website. The students were successful because they were able to identify domain names like .gov and .edu in addition to being familiar with some news sites like CNN. Other options included checking the page for any references or outside sources. Additionally, looking at two different websites or sources to confirm the information that had been found was considered a success.

However, looking at the answers for the type of the website from the same lesson, some inconsistency is apparent when examining the reliability portion. Two different possible explanations may account for this inconsistency. First, the student could have accurately answered the reliability part by choosing reliable because the website was a government-sponsored information site but then in
confusion chosen two types of website (governmental and informational) rather than one. Second, in contrast to the first explanation, some students successfully chose the type of the website, such as an educational website but did not answer the reliability part. Generally, if the answer for the reliability part was a type of website such as .gov or .edu or news, then a question remains as to why the answers were inconsistent (i.e., students answered reliability but failed to identify the type of website, or vice versa). In other cases, the answers of the reliability and the type of the website are not related. In general, with an exception for the advanced group, the reliability failure rate was higher in comparison with other failures. Excluding those who missed either a pre- or a post-session, Figure 36 shows that 63% of the failures were failures in answering the reliability part for the beginner group, and 42% out of 55% for the intermediates. This was not the case for the advanced group since other failure rates were higher, 30%, compared with the reliability failure rate of 23%. Note that reliability failure does not mean that students were unsuccessful in finding the correct answers for their questions. Appendix N has a table presenting the success, reliability failure, and other failures for all of the students participating in Lesson 4.
VII.3 Searching Methods

The majority of the participants in this research project used typing in order to search. The exceptions were the beginner group and two students from the intermediate group who used voice searching for almost all the questions. The voice search option was very valuable for the beginner group to help them overcome spelling difficulties. For instance, when there was a long sentence to search for, the students consistently used voice searching. Also, they heavily depended on the autocomplete feature for searching if voice searching was not working. However, voice recognition was an issue, as was having to speak quickly since the wait time for voice searches is roughly seven seconds. For the two students from the intermediate group who chose to use voice searching, they found this modality very useful in helping them to search more quickly than typing.
As for images in search results, few students from the intermediate group used this feature, although two of them found it useful. Based on the teachers’ recommendation prior to the study, we decided not to attempt a controlled comparison of searching methods. The decision was made to consider these different search techniques as options only so as not to overwhelm the students.

**VII.4 Google Search Interface**

Google search engine was proven to be usable by all students in this study, although some design issues caused problems for some students. The small font size along with the grey color presented in search results was not helpful for many students who tried to find articles based on specific dates. Additionally, when small font sizes were used in the KG, some students could not notice the answers there. Another point of difficulty was related to the number of results per page. Based on Google settings, the minimum number of results per page is ten. Reducing the number of results to less than ten (five might be ideal) could help some students with cognitive disability to read information more easily.

This simple presentation could help some cognitively challenged individuals to avoid scrolling since the participants in this study mostly avoided scrolling on all search problems, and when they did scroll, they became overwhelmed. Having the ability to notice the “related searches” feature also usually requires scrolling. Thus, lessening the number of search results per page might have improved students’ chance of finding relevant searches that could lead to a correct answer. Although the autocomplete feature helped all students, it could have been valuable to have
control over the number of suggestions provided; this could have enabled students find more relevant information without having to change the keyword and potentially fail to find the answer.

Finally, despite its value for all beginner students, two Google search issues were related to the voice searching feature. First, some voice recognition issues caused frustration for some students. Second, the wait time for speaking was too short when students had to say a long key phrase, as when they were searching for a quote. Additionally, there was one student who was slow in speaking due to his disability. Thus, he had to try several times or use fewer words in order to use the advantage of the voice searching feature. An improvement to the voice recognition mechanism, as well as allowing users to configure the length of the wait time for speech could aid many users with cognitive disabilities who might otherwise benefit from voice searching.

VII.5 Customization of the User Interface

Customizing the user interface in this study included students using the voice searching feature and images in search results. Those who used the voice searching option did not encounter problems to find it and use it as the opposite to including images in search results. This was because of the steps that were required to enable and disable the images extension; some students reported that it was overwhelming. To activate or deactivate this feature, the students needed to go to the Google search interface setting, then choose "Extension" option, find the extension icon, and then enable or disable the feature. Thus, there was a lot of
interaction cost required to achieve the goal. The interaction cost is “the sum of efforts — mental and physical — that the users must deploy in interacting with a site in order to reach their goals” (Budiu, 2013). A possible solution to this high interaction cost is to minimize the required number of steps as much as possible for enabling this feature. For example, the students found using Google search interface menu options was very easy and usable as they only needed to click on a menu option once or twice to customize the results like searching for videos and going back to the default search results.

Another issue was that some students were not interested in doing the required work to use the images feature as they felt it did not match their preferences. In fact, some reported that it could be more confusing since it made the presentation of the results look similar to the video results. This illustrates how sometimes users will not work with the customization features of an interface regardless of how usable and easy the customization process is; some users will only use the default design. Most of the students in this study preferred the default design of the Google search interface.

VII.6 The Repertory Grid Technique

Using grids was very helpful in understanding the different perceptions or views that each student had about the lessons, the handouts, and the ability to search. The design of the grids (changing the elements into sentence form and adding emoticon faces instead of ranking numbers) was very useful for all students. Considering the lessons, each lesson grid showed what students liked most, such as
their participation, learning needs, or time allotment. The grids about the handouts highlighted how all the students found the handouts useful due mainly to the organization and the ability to use it every day. Moreover, no negative responses were reported by any students regarding the handouts. Finally, the grids about students’ searching ability (before and after the training) have indicated a significant improvement in the students’ perceptions of their ability to search.

All the teachers indicated that the students understood the purpose of the grids. Although using the grids was useful, some features did not work for all the students. For example, it was challenging to the beginner group to complete the grid even when their teacher gave them more time and explained it in more detail. They kept choosing the happy faces and saying they liked everything a lot. The teacher who worked with this group said, “When I went through the grids like one-on-one with them, they all wanted to say that they like it. I don’t know exactly why but I think part of it was maybe a comprehension and the other part could be that they felt they have to give one answer about the whole session or lesson (like it or not). Therefore, they kept saying (I like it)”. On another note, some of the students, like P4, P12 and P19, chose randomly without reading the sentences or just made their choices quickly in order to be finished. Those students’ grids were not useful for analysis.

The other possible alternative grids that could have worked with the beginner student might have been to have only two options (thumbs up-thumbs down) for each statement rather than using six constructs. The RGT technique
could be modified to follow this approach and could be valuable for use with similar students for future studies.

In regards to the relationship between grid data and performance data, only the grids that focused on the students’ ability to search show that students’ ratings improved after the training. This was not the case for the lesson grids since almost all the students expressed liking everything about the lessons. One explanation for this result was observed during the interview with the students after finishing the study. The students reported that even in the easiest lesson, such as understanding search results, they had learned at least one new idea from each lesson. Considering the searching ability grids, some students had less positive (but not negative) responses after the training when compared to the pre-training. However, this finding does not necessarily indicate a decrease in performance but merely a different view of themselves in regard to their searching ability. The students who had these responses indicated that they had believed that they knew everything about Google. However, after the training, they believed that they had learned a lot, and they wanted to explore more Google features. Thus, they made less positive responses than in their pre-training grids.

VII.7 The Value of the Setting and Collaborating with the Teachers

This project focused on applying an accessible web searching training program to students with cognitive disabilities at their own school. The aim was to adapt research methods to the school environment in order to suggest guidelines for such a training program in a real-life scenario of what similar schools could do.
The teachers played a significant role in this project and worked as knowledge generators. In addition to their prior knowledge, the teachers had completed the human research training program and worked as co-investigators. These teachers made a major contribution in two areas: working with the researcher to design the training program and conducting the training in place of the researcher.

The teachers helped in creating the training programs by encouraging consideration of some of the issues they encounter with the students in their classrooms, such as anxiety and students’ functional differences. The teachers participated in developing the training manual (a step-by-step handout and summary), which was kept to one page long for each lesson, defining appropriate times for each meeting, determining a number of questions that could be increased gradually, and, most importantly, grouping the students. Additionally, the teachers helped us to create an effective learning method. For example, the teachers suggested giving the students a pre-question and then explaining the answer using the step-by-step handout. Thus, we were able to avoid memory issues. Initially, we wanted to give students an example and then allow them to complete the question on their own, which could have caused confusion and distraction.

In terms of allowing teachers to conduct the study instead of the researchers, the main idea was that teachers had a distinct advantage over outsiders in terms of their knowledge and experience working with these students on a daily basis. The teachers were more familiar than the researcher with issues of practice and
classroom culture. Additionally, it was important for the students to feel most comfortable by working with their own teachers, whom they already knew. However, teachers were asked to complete human research training so as to avoid any coercion of subjects, and the teachers were able to inform the participating students that their participation was totally voluntary without any consequences if they decided to withdraw at any time during the study.

VII.8 The Value of the Functional Model

Grouping participants based on the GRADE reading assessment rather than the medical diagnosis or the age was a valuable decision which made the training more effective. For instance, there were five autistic students. Using GRADE, one student was placed in the beginner group while the other four placed in the intermediate and the advanced group (two in each group). Considering the performance of all the five students when they had the same questions, the results were varied. For instance, in the question that focused on the “filetype” operator, the beginner student found the question very difficult to comprehend even when using the handout while the intermediate students understood the question and search correctly but failed to recognize the correct file extension in the search results. In contrast, the advanced students found this question the easiest question regarding the different operators they used during the training.

Another example related to the questions that focused on the reliability of the chosen websites for answers. These questions were beyond the beginner students’ ability to understand and answer. The intermediate students were able to answer
the questions only when there were indicators like .gov or .edu in the domain name indicating governmental or educational websites. In contrast, the advanced students went beyond the domain indicators to look at two different websites that had the same information to assure credibility in addition to checking references like books for a chosen article.

Dividing students by their functional ability was also valued over grouping them based on their age. For example, both P2 (beginner student) and P15 (advanced student) were the same age (15 years old). However, their performance in answering the same question was completely different. For instance, P2 could not answer any reliability question or explain why a chosen website was or was not reliable. On the other hand, P15 learned from the training and was able to answer all reliability questions successfully in the post-session.

Based on previous outcomes, if the medical diagnosis or the age of the students had been used for grouping purposes, students with similar diagnosis or age would not have been placed in the appropriate groups.

VII.9 The Impact of the Training and the Handouts

An extremely important observation relates to something that was not pre-planned to be observed and discussed in this dissertation. This was the impact of the training and use of the handouts after the study was completed. Based on teachers’ feedback, the students found the training handouts very useful. In fact, they continue using the handouts in their classes on a daily basis. Moreover, they
are sharing the skills they learned with their classmates who were not in the study by showing them the handouts.

One teacher said, “My students bring the handouts daily. They use it to answer questions like finding PDF and PowerPoint slides more easily. It’s helped them since they can download the file immediately from the search results. Previously they had some problems when they accessed websites and looked for specific files.” Another teacher added, “The students loved the organization of the handout since it has less text with a lot of images. For my class, they used the handout to help them find large pictures. These large pictures are important to them for the posters for their science projects.” Yet another teacher reported, “One student asked me for an extra copy since she lost hers and wanted another copy so she can use the handouts when she will be in college later next year. Also, I had other students who did not attend the training wanting to have a copy of the handouts so they can use them.”

Sometimes, there is a disconnect between a research study and real life. It is not very common to hear about the impact of tools, materials, or training programs once a study is finished. However, this case is different. The handouts were created specifically for this study, and highlighted evidence indicates that the students found these handouts useful beyond what happened in the study itself. Academically, many things were learned during this research, but practically, these students valued the helpful handouts that continue to enrich their worlds well beyond the confines of the study.
VII.10 Limitations

The number of participants in the study was small (n=19) considering that they were also divided into three distinct groups. For example, the beginner group contained only three students. The scheduling of when the training program was conducted (after school hours) may have been a challenge that limited the number of potential student participants. Transportation through a free carpool service was provided for students who wanted to participate as an encouragement for more people to participate, and in fact, half of the students who participated in the study took advantage of the carpool service. However, since the teachers were in charge of doing the training, the time of the study was constrained by the teachers’ own schedules and availability.

The time required to complete the whole study (four complete lessons and a final study) was difficult for some students to manage, and some did not attend all the meetings. Also, students were occasionally sick or otherwise absent on the days of the study and missed sessions. Another issue that impacted data collection was related to lost videos. Occasionally but rarely, students unplugged the camera or shut down the computer after they finished a lesson disregarding the instructions from their teachers who told them not to do so. For cases of lost videos, the student worksheets had the answers and the names of the websites the students had accessed, thus providing data for these students. Additionally, the teachers helped by reporting what search methods the students used, as well as other observations.
It was not possible to have a counterbalanced order of the searching tools (typing, images, and voice searching). The study was designed to honor the teachers’ earlier recommendation about avoiding confusion for the students during the study. Thus, the search methods were considered as options for those who wanted to use them. However, based on analysis of the study, the students from the advanced group and some of the intermediate group appeared able to handle the task order in the future if a study following the same structure, the time duration, and instructions are employed.

All the students who participated in the study had computer and internet experience. These were considered qualifying factors when accepting participants for the study as teaching them how to use the computer and the internet was beyond the scope of this dissertation. Additionally, the students who were recruited for the study were all from the same school where they use computers and the internet on a daily basis. Therefore, these participants are considered high-functioning cognitively challenged students, and this should be considered when interpreting the results of the study. Although the students had computer and internet experience, some students still failed to answer questions, indicating that some searching skills were still difficult for them or that they lacked time and practice for mastery. For future studies, having data on participants who are not experienced with using computers would permit comparisons between two groups of differently-skilled participants.
The students in this research study simultaneously received all questions both verbally and in written form. The teachers read the questions aloud to the students. Having only verbal questions could have caused other problems such as grammar issues. Additionally, some students may have copied the question in order to answer it. However, since one of the lessons was related to developing keywords, the content of the question was not easy to copy. Each question was developed in such a way as to provide a prompt or a scenario, and the students needed to create their own keywords from these scenarios. For example, one student from the beginner group copied a question that focused on religions in France. The student searched “the most three religion in that country” since this sentence was followed by a question mark. At the beginning of the question, some information had been provided about France but the student was not able to figure that the question was about France.

**VII.11 Recommendations**

The results of this research project lead to two sets of recommendations. The primary set is for researchers seeking to conduct further research in this area; since the teachers worked as co-investigators in this study, the researchers’ recommendations also apply to them. Another set of recommendations has been created to aid web developers and accessibility experts on some user interface design features that can support cognitively-challenged individuals.
VII.11.1 Recommendations for Researchers and Teachers

For those seeking to do research similar to this project, many specific details are important.

VII.11.1.1 The Focus on the Functional Capabilities

The value of using the functional model was highlighted in Chapter II and Section VII.6 from this chapter and showed the importance of using the results of a reading assessment to group the students, regardless of the medical diagnosis.

Recommendations for best practices:

- Consider participants’ reading and comprehension abilities when grouping participants for a web search study.

- Develop an appropriate number of questions that considers the students’ abilities. For instance, an advanced student with higher reading scores may be able to answer more questions in one session than a beginner student.

VII.11.1.2 The Training Handouts

As discussed in Chapter V, the teachers suggested using two forms of handouts, namely, handouts with answers and summary notes. The following information frames what worked in the handout design employed in this research.

VII.11.1.2.1 Handout Design

Three comments in terms of the current design created a better searching experience for the students. First, each of the two handouts (answers and summary notes handouts) was only one page long. This structure helped the students to avoid
distraction and to focus on working with the handouts more easily. Secondly, another advantage related to the use of simplified written sequential (step-by-step) instructions. This organization helped both teachers and students. The teachers were able to explain answers to students by indicating which step they were on, and the students were able to follow this instruction and avoid getting lost. The final feature of the design related to the screenshots of the results and the answers supported using the numbers of the previous instructions. Additionally, the labels were appropriately designed to show where the student should click. The visual presentation allowed the students to be more comfortable with the handouts while learning to use the material independently.

Recommendations for best practices:

- For future researchers, include teachers or caregivers as co-investigators for developing appropriate material and questions that fit the needs of the participants.

- For future research that involves students with cognitive disabilities, use simplified written instructions (step-by-step) supported with visual material (consisting of fewer words and more images) with no more than one page long for each search task or lesson goal.

VII.1.1.2.2 Provide Answer Sheets as Handouts

The Google search engine updates results frequently, thus creating a challenge in designing answer handouts in advance for students with cognitive disabilities. As explained in Chapter V, the teachers suggested that for any given
query in the answer handouts, Google search results must match what the students have in the handouts. For example, this includes specific information about what link appears first, and if there is a KG or not. For this study, the answer handouts were created in advance but were updated before each meeting with the students. This presentation of results was critical for helping the students focus their attention on how to answer a given search problem.

Recommendations for best practices:

- Create answer handouts on the same day of the study so that current and correct results are offered.
- Ensure that the search query to be explained during the lesson matches what the students have in answer handouts, avoiding the confusion of presenting different search results.

VII.11.2.3 Use Summary Notes

The summary notes must focus on the main goals of the lesson to be taught in order to contribute to the training’s success. Based on the teachers’ notes in Chapter V, many students with cognitive disabilities get frustrated if they do not know why they should do a specific learning activity in the class. In other words, the students need to know why a particular activity is important to them. Additionally, students more easily forget topics or lessons that are taught without these appropriate summary notes. Thus, explaining the main goals of each lesson is crucial to successfully engaging the students in the activity.

Recommendations for best practices:
• Create summary notes that highlight the main goals of each specific lesson by explaining the topic of the lesson, what the important skills are for the student, ideas the students need to grasp, and how these skills/ideas are important for them.

VII.11.1.3 Lesson Planning

In addition to the material that can be used with the students, several notes may create a better training experience. One of the most important study-developed materials was the teachers’ instruction manual that allowed the teachers to have control of each session, in terms of how many questions needed explanation and what to do if a student became frustrated.

Recommendations for best practices:

• Always prepare and review the teachers’ instruction materials in advance.

• For each search task, practice the task in advance to become familiar with it before explaining it to the students. Make sure to use the same query the students have in their handouts.

VII.11.1.4 The Training Session

Some students with cognitive disabilities easily become anxious if no session or class instruction is provided in advance, such as information on how to use a computer or watch a documentary to answer questions. Informing the students about what they have to do in the session and predicting the length of class (in this case, the study) is essential for optimum success. This note was included in the
teachers’ instructions for all the sessions and helped both teachers and students to be more engaged in the study.

As discussed in Chapter V, some students with cognitive disabilities have memory and confusion issues. In order to address this challenge in the study, the students were given pre-search tasks without any explanation or help. After that, the teachers used the step-by-step handouts to explain the answers. This approach was valuable for three reasons. First, this approach helped the students learn by examples or from their mistakes in some cases. Second, this approach addressed (to some extent) the memory issues by giving the students opportunities to repeat information as they were practicing the step-by-step handouts regardless of their answers. Third, giving the students one search problem but explaining another problem as an example in the training could cause confusion and increase the issues already addressed in the previous points.

Timing was another point related to the training session. In this study, scheduling one hour was sufficient for providing the training and allowing students to answer the questions. This worked because the students were used to spending one hour for each class they attended in the school. Thus, the familiarity with this time duration allowed the students to feel that they were attending a class.

Recommendations for best practices:

- At the start of training sessions, inform the students about the length of the training meeting and explain how many questions they will have to answer, thus avoiding potential frustration.
• Explain the answers to the same problems that the students search for in the same session so as to avoid memory and confusion issues.

• Plan a reasonable and familiar time duration for training by learning more about the participants, their customary schedules, and their learning limitations.

VII.11.1.5 Setting

The final notes are related to the research setting. These may vary depending on the type of study and the location. The following suggestions contribute to making a maximally successful training program for a similar research study.

Recommendations for best practices:

• Choose the study setting carefully.

• Conduct the study at a setting familiar to the participants, such as their school, which can create a more comfortable environment for students with cognitive disabilities.

• Carefully plan the length of time for conducting the study. Consider a time that is potentially familiar and appropriate for participants based on the setting where the study will be conducted.

• Have extra equipment available, such as headphones, microphones, and cameras, if video recording is an integral part of the study.

• Bring extra copies of all materials such as questions and handouts.

• Create a folder for each student that includes an extra copy of each handout because some students may forget to bring their own folders for the training.
• Arrange transportation for the participants to encourage better study participation.

VII.11.2 Recommendations for Web Developers and Accessibility Experts

The following lists of recommendations were created from observations discussed in Chapter VI. These recommendations may be useful to enhance web access for some individuals with cognitive disabilities.

VII.11.2.1 Search Engine

Google search engine enabled students in this research to search and find information, although there were design problems that need to improve to help more students with cognitive disability benefit from web searching.

Recommendations for best practices:

• Avoid using small font sizes in grey colors (10 points or less) for reporting search results as they are difficult to be noticed. Instead, relevant text could be highlighted in bold, as this was helpful to some students with cognitive disabilities.

• Enable customizing search results to less than 10 results per page (e.g. 5), as this could help some cognitively challenged students to avoid scrolling and have a simpler presentation of the results as one chunk.

• Give the user the ability to increase the number of suggestions in the autocomplete feature to help cognitively challenged students find more search suggestions/predictions.
• Make the “related search” feature more apparent by changing its position from the bottom of the page where scrolling is required. Including this feature on the right side of the results when there is no KG information could help some people with cognitive disability to quickly find relevant information.
• For voice searching features, increase the time span for speech detection so that people with cognitive disability can speak and search easily.

VII.11.2.2 Searching Features

Three searching features helped the students in this project. First was the custom search option within a website. One advanced student did not browse websites but used the search functions on those websites to successfully answer questions. Second, all students depended heavily on the “autocomplete” feature provided by Google, which helped students overcome spelling problems, find information faster by looking at search predictions, and avoid typing long search queries.

Third, another feature that helped some students to succeed was the “Related Search.” This feature provides searches that are similar to a target search. This feature was valuable and provided a similar function as the “autocomplete”. The reason fewer students used this feature relates to its position at the bottom of the page of Google search results, which sometimes requires scrolling before it is noticed. However, some websites that focus on web accessibility, like WebAIM and the Coleman Institute websites, add “related search” features at the top of the page.
so that all users can have a more successful search experience


Recommendations for best practices:

- Add the search function feature to the developed website specifically if the site contains copious content and extensive menu options, thus helping cognitively challenged individuals find information more easily.
- Add the “autocomplete” feature to a website to help people with cognitive disabilities make more search predictions, overcome spelling issues, and avoid typing long queries.
- Add related searches or related resource suggestions and links about the topic the audience is searching for in order to help them find relevant information more quickly.

VII.11.2.3 A Consistent Navigation Scheme

WCAG 2.0 recommends designing a consistent navigation scheme to help users with disabilities navigate the user interface more easily. The consistency in the navigation menu in the Google search interface supported the students in developing usage patterns. The students learned what different "filters" or links look like and were able to comprehend the different functionality that each one of these options provided. Moreover, the students were able to explore and understand how to activate new "filters" based on their experience with the current filters.

Recommendations for best practices:
• Provide predictability by creating consistency in navigation and menu options.

VII.11.2.4 Images to aid Comprehension

As explained earlier in Lesson 2, all the students preferred websites that had visual presentations over text-heavy ones. This finding supports previous findings from the literature by Johnson and Hegarty (2003).

Recommendations for best practices:

• Pair images with text to clarify meaning and aid comprehension.

VII.11.2.5 Error Messages

Based on WCAG 2.0, informing a user when there is an error is essential. In this study, one student could not find any results when the wrong filter was activated. Google showed a message recommending to "Reset search tools." The message helped the student to recognize that no results matched the requested search, so he selected the correct filter and answered the question successfully.

Recommendations for best practices:

• Use error recovery messages to show how to correct and overcome errors.

VII.11.2.6 Lists

The organization of a list and a difficult textual presentation can confuse some students with cognitive disabilities. A disorganized list (with no numbers or bulleted points) caused one student to fail by choosing the wrong answer from the list.
Recommendations for best practices:

- Use bullet points or numbering to separate information into clearly marked lists.

VII.11.2.7 Headings

All the students in this study preferred websites with headings and they browsed and the read a page when there were some headings presented.

Recommendations for best practices:

- Use headings to organize content into visual chunks of text.
- Use different font colors or sizes to highlight headings so that they are visually distinguishable from the main text.

VII.11.2.8 Text, Paragraphs and Font Size

Many students avoided reading copious textual information and long paragraphs as often as possible. Some students failed to find answers when there was copious textual information and depended on the KG to succeed. Short paragraphs (around six lines) were valuable for all students, especially the beginner group who were reading these paragraphs on Wikipedia.

Small font sizes (10 points or less) caused trouble for some students. Some students failed to find the correct news articles because the publication dates were in small font size. Additionally, some advanced students in the final assessment could not distinguish the answers about band names from the KG because of small font sizes.
Recommendations for best practices:

- Break up long paragraphs in order to create shorter blocks of text.
- Provide summary information about more complicated topics or where there is more textual information that could be an obstacle for someone with a cognitive disability.
- Avoid using small font sizes (10 points or less) as these are very difficult to notice for some people with cognitive disabilities.

VII.11.2.9 Website Domain Name

Websites with clear titles or a clearly stated purpose helped many students; for example, students often chose CNN because the website contained the word “news”. Additionally, associating websites with domain names like .edu or .gov may allow people with cognitive disabilities to select websites that would be considered reliable. Moreover, creating meaningful website addresses is also important. Many students failed to enter the URL of the enhanced web speech API correctly because it was a mix of non-meaningful characters.

Recommendations for best practices:

- Provide clear title names or definitions on the home page of the website (governmental, news, etc.) to help cognitively challenged individuals to identify the website type (and the potential reliability of the website), e.g., CNN website (as a news site).
- Associate the developed website with a proper domain type, like .gov or .edu, to help people with cognitive disabilities find more credible information.
- Create meaningful and short (if possible) web address names to help people with cognitive disability to search for sites correctly.
CHAPTER VIII

CONCLUSION AND FUTURE DIRECTIONS

This dissertation has explored the potential for improving the web searching skills of individuals with cognitive disabilities. In this context the general contributions of this study include (i) creating accessible web-searching training handouts, (ii) highlighting the value of the functional model over the medical condition model by grouping students based on their abilities, (iii) pointing out the usefulness of alternative search methods like voice searching, (iv) providing a list of recommendations that support researchers, teachers, web developers and accessibility experts when they consider the web-searching needs of people with cognitive disabilities. Including the teachers in this work was an important factor that made this dissertation successful in terms of creating handouts and appropriate search tasks, as well as in terms of working with the students on the training and task completion. Since there is limited research in the literature focusing on people with cognitive disabilities and use of the web (and particularly web searching), this dissertation has provided important information for the field.
This chapter provides an overview of the contributions of this dissertation and then discusses future directions for further research and presents reflection.

VIII.1 Contributions

VIII.1.1 Web Searching Training Program

The structure of the developed training handouts was discussed. The way that teachers’ instructions were created is presented in this dissertation since these were invaluable to the teachers in managing each meeting with the students. The time for conducting the study was one of the limitations reported in the literature (Egan, J., Worrall, L., & Oxenham, D, 2004). In contrast, the work presented here addressed this limitation by conducting the study after school hours, which provided more flexibility for both the teachers and the students and limited interference from other duties during school hours. Additionally, the structure of the pre- and post-assessment was successful in helping the students master the web searching skills. Most importantly, providing the training during the pre-meeting in order not to distract the students and to help them focus on the assigned tasks was crucial and enabled the students to enjoy the training experience.

The design of the handouts in terms of being only two pages long, one for the answers to the questions and the other for the summary of the lessons was useful and favored by all students and their teachers. Including a step-by-step instruction sheet supported by screenshots and labels was the most important. Analysis of the data showed an improvement in the students’ performance between pre- and post-
training meetings. Moreover, a final study (two weeks after the training) indicated that the students had retained some of the web searching skills they had learned.

VIII.1.2 Grouping and Functional Capabilities

Many reviewed studies in the literature lacked information about the subjects who participated in the study. More precisely, information related to the functional capabilities, or what a cognitively challenged individual is capable or not capable of, was not discussed or defined. Thus, interpreting any results or information from published studies was difficult. However, this dissertation included the functional capabilities of each subject. Most importantly, the value of grouping the students using the GRADE assessment exam which mainly focused on reading and comprehension has been highlighted in this study. Therefore, developing meaningful training handouts and search questions that closely fit the needs of each group was possible. This created a better learning experience for each group as the students in each group were at the same functional level.

VIII.1.3 Search Tools

The results chapter supports the value of using alternative search input methods such as voice searching. Voice searching was a life-changing tool mainly for the students in the beginner group. It helped them to overcome grammar issues. Additionally, it helped them to search quickly compared to typing when they encountered a long sentence or search query.
VIII.1.4 Guidelines and Recommendations

As a result of this dissertation, different lists of recommendations are offered to support teachers, researchers, and web developers when they work with cognitively challenged individuals. These lists focus on many things such as the importance of having teachers test the search tasks before each meeting with the students in order to have the same results as the students when they use the same search query. Moreover, the researcher should consider meeting with the teacher prior to their meetings with students in order to create instructions for the teachers for managing each meeting. Finally, web developers should avoid small font sizes, include error messages, and create predictable and consistent menus and navigation paths. Each of the web accessibility guidelines was linked with a research finding.

VIII.2 Future Directions

Searching for information on the web is an essential skill for anyone in the 21st century. Supporting individuals with cognitive disabilities through training can help them to master web searching skills and open the door for many opportunities for them. The results of this dissertation have suggested different research directions for future work.

VIII.2.1 Focus on Search Tools

For future studies, a worthy consideration would be to design a counterbalanced study with some advanced students to evaluate the effectiveness of
VIII.2.2 More Skills to Narrow Search Results

Although the students learned some skills for narrowing search results in the third lesson, there are other filters and operators that could be explored further. Using more filters and operators in subsequent studies is worthwhile. For example, some other useful filters that could be used are Books, Shopping, and Apps. It would be valuable to investigate how students can navigate and buy things using the “Shopping” filter. The hyphen symbol, the two periods, the asterisk, and related websites feature are all helpful operators that might benefit people with cognitive disabilities. For instance, a student could search for a price range using the two periods like “camera $50..$200.”

VIII.2.3 Finding Reliable Sources

Although some students have learned how to find information from reliable sources using domain names like .gov or .edu, exploring how the students would find information from different websites without a specific domain name using some search tools is advisable. For instance, the new version of the Search Preview extension (which was used in this work to add images in search results) has added a popularity rank feature for each website in the search results. A student could focus
more on websites with higher rankings to find additional reliable information.

Another idea is to ask the students to find information from different websites after they have completed the training. For example, students could be instructed to find a blog and an educational website about the Native American culture and compare the content of the two sites.

**VIII.2.4 Video Training**

Another idea is to provide online video training for both teachers and students. This would help to address some of the difficulties of the limited number of participants in this study. Using an online service like Wistia would permit the creation of videos with transcripts and captions in addition to detailed analytics over the uploaded videos which could help indicate video behavior and a player look. For example, collecting viewer count and viewer heatmaps might be possible in order to identify which parts of videos have been watched, re-watched or skipped over.

**VIII.2.5 Teaching Keyboard Shortcuts for Web Navigation**

Another idea emerged from the video analysis as two of the students used a keyword shortcut (Ctrl+F) in order to search for a specific word on a page. According to Dan Russell from Google, 90% of computer users do not know that the shortcut (Ctrl+F) can be used to search for a word on a web page (Kwek, 2011). Teaching people with cognitive disabilities how to use such a feature can help them to overcome the issue of having a lot of textual information on the page. Other useful
shortcuts could be used as well for different functions like Select All (Ctrl+A), copy (Ctrl+C), paste (Ctrl+V), and undo (Ctrl+Z). The only limitation with this idea is that it would not work for those who only want to use voice searches. However, a modification to Metalmouth Voice Browser Chrome extension will overcome this issue. This extension allows navigation by voice commands in addition to intuitive keyboard controls.

**VIII.3 Reflection**

This research has helped me to gain the knowledge and experience I need to contribute to the fields of human computer interaction, web accessibility and cognitive disability. I enhanced my understanding of related topics from the literature and now I feel more confident to talk with other professionals in the field about cognitive disability, cognitive web access and research techniques that can support understanding people with cognitive disabilities.

This research has provided me with a great opportunity to use different research methods and techniques that supported me in dealing with a complex research problem and improved my evaluation skills. Using a simple version of RGT was valuable as an interviewing technique which helped the understanding some cognitively disabled students’ perceptions of the training. Additionally, grouping the students based on their functional abilities rather than based on age or medical diagnosis was one of the major approaches contributed to making the web searching training lessons in this research successful. I would use these same approaches in future studies that focus on individuals with cognitive disabilities.
I learned considerably about ethical research for people with disability. Working with Dr. Cathy Bodine's group at Assistive Technology Partners gave me an ideal opportunity to observe and learn how to conduct research with people with disability. With the group, I visited different institutes and schools that support people with disability and I attended many sessions that involved conducting research with cognitively disabled individuals. Moreover, completing the Human Research Training required by the University of Colorado provided me with required information about the ethics of research with people with disability.

The impact of this research reaches beyond what happened in the study. Google provided the overall skills that needed to be mastered but I was able to learn about teachers’ perceptions about what skills were most important to teach students with cognitive disability. This resulted into the creation of different lessons that covered different skills. I increased my understanding of doing research with cognitively challenged individuals by working with the teachers who were knowledge creators in this research.

Although the students mastered some web searching skills in this research, this was not just a matter of “school subject” for them. In fact, learning these skills added more personal value for them related to things they are interested in looking up online. For example, one student was interested in Photography and the law and the ethics of copyright and fair use of online images. Exploring the “Images” filter on Google’s search interface allowed him to find different images based on usage rights like “labeled for reuse” or not. Another example was related to finding
specific files such as PDF or word documents. Prior to the training, some students were able to search for some files. However, they failed to find the files once they accessed the website that had them due to design issues on the website. After the training, the students reported that searching using the filetype operator provided the convenience of downloading the files immediately to their desktop from Google results without the need to access any confusing website. This helped these students to find some book summary files they were interested in reading and using as examples.

Additionally, most of the advanced students who plan to go to college indicated that they enjoyed the lesson that focused on finding reliable information. They reported that they are now more confident about finding credible sources as they look for references to justify their answers. This skill will help them with classes in college in the future. The final example focuses on the value of filtering results by time, such as “Past 24 hours” or “Past week”. Many of the students in this research reported using Google to search for information about different video games they play. They indicated that learning how to filter results based on dates helped them to find more relevant information and updated tutorials about the games they play.

This research shed light on the value of computer and internet training for people with cognitive disability. It was possible to improve the students’ web searching skills when they were provided with accessible training lessons that fit their needs. Providing appropriate computer and internet training can open the
door for new opportunity for these students, especially in employment. Many people with disability lose job opportunities due to the lack of required skills related to computer and internet usage. However, providing appropriate training programs can support them and increase their chances of acquiring jobs.
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Lesson 1: Pre-Meeting All Groups

1. Number of questions for today: 1

2. Introduction and remind the students they can use web added features if they want to (voice searching, images in results)

3. The students work independently on the task for ( ) minutes. Remind the students that they must write their names and the answers on the worksheets.

4. Once the time you determined is over do the following:
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell students that there are different ways to find the correct answer, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. Finally, explain the main goals of the lesson by using the summary handout and give it to the students. Use the following example for Goal 2:
   o Title, web address, snippet, and search terms, search “president job democracy”
   o Ads, search “cheap furniture”
   o Knowledge Graph, search “president john f kennedy”

Note:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 1: Post-Meeting All Groups

1. Number of questions for today: 1

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the task for ( ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

5. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Notes:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 2: Pre-Meeting Beginner Group

1. Number of questions for today: 1

2. Introduction and remind the students they can use web added features if they want to (voice searching, images in results)

3. The students work independently on the task for (   ) minutes. Remind the students that they must write their names and the answers on the worksheets.

4. Once the time you determined is over do the following:
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell students that there are different ways to find the correct answer, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:

1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 2: Post-Meeting Beginner Group

1. Number of questions for today: 1

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the task for ( ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   a) Remind the students they can use a step-by-step handout from previous session (pre).
   b) Remind the students they can use the summary handout from previous session (pre).

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

5. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Notes:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 2: Pre-Meeting Intermediate Group

1. Number of questions for today: 2

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

4. Once the time you determined is over, do the following:
   
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell the students that there are different ways to find correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. The students work on the 2nd task independently for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

6. Once the time you determined is over, follow the same steps you did for task 1.

7. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:

1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 2: Post-Meeting Intermediate Group

1. Number of questions for today: 2

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).
   d) If time permits:
      i. A Student who struggles or gives up quickly, give him/her a beginner task from the beginner lesson.

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

5. The students work on the 2nd task independently for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

6. Once the time you determined is over, follow the same steps you did for task 1.

7. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Notes:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 2: Pre-Meeting Advanced Group

1. Number of questions for today: 2

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

4. Once the time you determined is over, do the following:
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell the students that there are different ways to find correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. The students work on the 2nd task independently for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

6. Once the time you determined is over, follow the same steps you did for task 1.

7. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 2: Post-Meeting Advanced Group

1. Number of questions for today: 2

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).
   d) If time permits:
      i. A Student who struggles or gives up quickly, give him/her a beginner task from the beginner lesson.
      ii. If the student continues to have problems, give him/her an easy task from the beginner lesson.

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

5. The students work on the 2nd task independently for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

6. Once the time you determined is over, follow the same steps you did for task 1.

7. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Notes:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 3: Pre-Meeting Beginner Group

1. Number of questions for today: 3

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for (   ) minutes. Remind the students that they must write their names and the answers on the worksheet.

4. Once the time you determined is over, do the following:
   
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell the students that there are different ways to find correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. For task 2 and 3, follow the same steps you did for task 1.

6. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:

1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 3: Post-Meeting Beginner Group

1. Number of questions for today: 3

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st ask for ( ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

5. For task 2 and 3, follow the same steps you did for task 1.

6. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Notes:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 3: Pre-Meeting Intermediate Group

1. Number of questions for today: 4

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for (   ) minutes. Remind the students that they must write their names and the answers on the worksheet.

4. Once the time you determined is over, do the following:
   
   a) Stop the students regardless of their answers  
   b) Collect answer sheets  
   c) Explain the answer by using and giving them the step-by-step handout.  
   d) Make sure to type the same search query in the handout to get the same results.  
   e) Tell the students that there are different ways to find correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. For task 2, 3 and 4, follow the same steps you did for task 1.

6. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:

1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 3: Post-Meeting Intermediate Group

1. Number of questions for today: 4

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).
   d) If time permits:
      i. A Student who struggles or gives up quickly, give him/her a beginner task from the beginner lesson.

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

5. For task 2, 3 and 4, follow the same steps you did for task 1.

6. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Notes:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 3: Pre-Meeting Advanced Group

1. Number of questions for today: 4

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

4. Once the time you determined is over, do the following:
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell the students that there are different ways to find correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. For task 2, 3 and 4, follow the same steps you did for task 1.

6. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 3: Post-Meeting Advanced Group

1. Number of questions for today: 4

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for (   ) minutes:
   
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).
   d) If time permits:
      i. A Student who struggles or gives up quickly, give him/her a beginner task from the beginner lesson.
      ii. If the student continues to have problems, give him/her an easy task from the beginner lesson.

4. Once the time you determined is over:
   
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

7. For task 2, 3, and 4, follow the same steps you did for task 1.

8. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Note:

1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 4: Pre-Meeting Beginner Group

1. Number of questions for today: 2

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

4. Once the time you determined is over, do the following:
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell the students that there are different ways to find correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. The students work on the 2nd task independently for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

6. Once the time you determined is over, follow the same steps you did for task 1.

7. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 4: Post-Meeting Beginner Group

1. Number of questions for today: 2

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for (   ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

5. The students work on the 2nd task independently for (   ) minutes. Remind the students that they must write their names and the answers on the worksheet.

6. Once the time you determined is over, follow the same steps you did for task 1.

7. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Notes:
  1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 4: Pre-Meeting Intermediate Group

1. Number of questions for today: 3

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

4. Once the time you determined is over, do the following:
   
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell the students that there are different ways to find correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. For task 2 and 3, follow the same steps you did for task 1.

6. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:

1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 4: Post-Meeting Intermediate Group

1. Number of questions for today: 3

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).
   d) If time permits:
      i. A Student who struggles or gives up quickly, give him/her a beginner task from the beginner lesson.

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

5. For task 2 and 3, follow the same steps you did for task 1.

6. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Notes:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 4: Pre-Meeting Advanced Group

1. Number of questions for today: 3

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes. Remind the students that they must write their names and the answers on the worksheet.

4. Once the time you determined is over, do the following:
   
   a) Stop the students regardless of their answers
   b) Collect answer sheets
   c) Explain the answer by using and giving them the step-by-step handout.
   d) Make sure to type the same search query in the handout to get the same results.
   e) Tell the students that there are different ways to find correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.

5. For task 2 and 3, follow the same steps you did for task 1.

6. Finally, explain the main goals of the lesson by using the summary handout and give it to the students.

Note:

1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
Lesson 4: Post-Meeting Advanced Group

1. Number of questions for today: 3

2. Introduction and remind the students they can use voice searching or images in results if they want to.

3. The students work independently on the 1st task for ( ) minutes:
   a) Remind the students they must write their names and the answers on the worksheets.
   b) Remind the students they can use a step-by-step handout from previous session (pre).
   c) Remind the students they can use the summary handout from previous session (pre).
   d) If time permits:
      i. A Student who struggles or gives up quickly, give him/her a beginner task from the beginner lesson.
      ii. If the student continues to have problems, give him/her an easy task from the beginner lesson.

4. Once the time you determined is over:
   a) Stop the students regardless of their answers.
   b) Collect the answer sheets.
   c) Give the students the step-by-step handout, and inform them that there are different ways to find the correct answers, not only what they have in their handouts, indicating that some of them might have found the right answer already.
   d) You don’t need to explain the answer.

8. For task 2 and 3, follow the same steps you did for task 1.

9. Guide the students to complete the grids of this lesson. Collect the grids at the end.

Note:
1. Remind the students that their participation in this study is totally voluntary. Any student has the right to choose not to take part in this session. Any student can leave the session at any time.
1) How to have images in search results

Google Chrome allows you to have thumbnail images for every search results. See the example below:

The following steps show you how to enable or disable images in search results.

Note that this feature will only work with Chrome browser and not for other browsers like Internet Explorer or Safari.

1) Open your Chrome browser and click on the option icon on the upper right corner as the following:
2) Once you click on it, scroll down, and choose setting as the following:

![Webpage screenshot with Chrome settings window open]

3) A new window will be opened to take you to the browser setting. From that new window click on the “Extension” on the upper left corner as the following:
4) Here you can find all the browser’s extensions, look for Search Preview and you can either check or uncheck “Enabled” box to use the images in search results.

5) Close the browser and reopen it again to see the changes you made.
2) Using Google Voice Searching

1) Open Google.com and click on the microphone to speak.
2) A new page will open allowing you to speak “Speak Now”
3) If you did not speak directly, Google would keep listening to you for about 7 seconds and then would turn off. To start searching again, click on the microphone.
3-Customized Voice Searching Handout (This is for lesson 3)

We use this customized voice searching to address the limitation which Google voice searching has when you search by your voice using symbols or operators like site: or quotation marks “ “.

**Example**

If you search by your voice for a quote using the quotation marks “ “, Google will give you the word quote in your search rather than the symbol “ “.

“imagine all people” → using Google voice searching you will have → quote imagine all people.

To use the customized voice searching:

1- Type in search bar: [https://goo.gl/2MA6RW](https://goo.gl/2MA6RW)

2- Click on the microphone

3- A new window on the left side will appear asking for your permission to use the microphone. Choose “Allow”.

![Web Speech For Search Operators](image-url)
4) If you click on the microphone and it does not work, click on the camera icon on the right corner.

4) Then choose “Always allow” option and click on “Done”.
4) If you still have a problem, a new pop up window will appear. Again, choose “Always allow” option and click on “Done”.

4) Before you speak, look at the table below to help you understand how to search by voice using some operators.

<table>
<thead>
<tr>
<th>Operators</th>
<th>Usage</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site</td>
<td>Get results from certain sites or domains. For example, you can find all mentions of broncos from denver.com website</td>
<td>broncos site:denver.com</td>
</tr>
<tr>
<td>Start End</td>
<td>Search for a phrase or quote</td>
<td>Start imagine all people end The query will be “imagine all people”</td>
</tr>
</tbody>
</table>
APPENDIX C. STUDENT WORKSHEET

Lesson 1 Beginner Pre

Your friends say they love the lines in "Rock of Ages" so you use Google search to look them up and find two things about them. What did you find? How did you find it?

Lesson 1 Beginner Post

You are trying to know two things about "Pocahontas" by using Google search. What did you find? How did you find it?

Lesson 1 Intermediate Pre

Your friend tells you there are 30,000 different dinosaurs on record. Others say there are 60,000. You are pretty sure there may only be 100. How could you use Google search to settle this debate? What website you have chosen for your answer? Why?

Lesson 1 Intermediate Post

Your aunt is obsessed with two things: castles and France. Your father told her that in France, the number of castles are between 300 and 600 while your mom says there are only 700. Your aunt wants to know the total number of the castles. How could you use Google search to help her with that? What website you have chosen for your answer? Why?

Lesson 1 Advanced Pre

You have not been grocery shopping in a while but you just learned that you have a guest coming over for dinner. It’s storming outside and you really do not want to go to the grocery store.

You remember something about a recipe involving celery, cream, and ground turkey, all of which you happen to have. However, you do not remember if you need anything else or how much of each ingredient to use. How could you possibly use Google search to find the recipe to make this dish?

Lesson 1 Advanced Post
You are in your first real job. One afternoon you are told that your company’s CEO will be in town. As a policy to meet workers, this man likes to go out to dinner with employees in whatever town they are visiting, and you have been chosen to attend the dinner.

You remember hearing once that this CEO really loves Blue Shell Crabs, something that is not really common in Denver. However, you really want to impress him. Although you know that there is one, you cannot remember a restaurant that serves this dish. How can you use Google search to find a crab-serving restaurant in time to impress your CEO?

**Lesson 2 Beginner Pre**

You have to make a poster of information about a country. Your group chooses Argentina and you are in charge of finding the most common 3 religions in that country. How would you use the Google search to find this information? Write the 3 religions and their percentage?

**Lesson 2 Beginner Post**

You are working on a group report about California. You think that people should know which religions are in the state. How could you use Google search to find 3 religions in California?

**Lesson 2 Intermediate Pre 1**

You are babysitting a younger sibling and have offered to help them with their homework, a small report on dolphins. Your sibling wants to know how they communicate. How would you use Google search to find this out?

**Lesson 2 Intermediate Pre 2**

You have been curious about the bottlenose dolphin ever since you saw something about them on TV. You do not remember their favorite food. How could you find this out using Google search? Write 4 things.

**Lesson 2 Intermediate Post 1**

You heard someone saying that turtles are “deaf and dumb” and cannot communicate with each other. How could you use Google search to find if it is true or false?

**Lesson 2 Intermediate Post 2**
Your friend told you that lions are faster than a particular type of ghazal named Thomson. How could you use Google search to find if it is true or false?

**Lesson 2 Advanced Pre 1**

If you were a soldier in 1918 during the war, what language would you have had to speak to understand coded British communications? What was the name of the battle? Use Google search to find the answer.

**Lesson 2 Advanced Pre 2**

You are writing a report about Native Americans and their food. You heard that some tribes are still eating their traditional food and not a modern one, how could you use Google search to find these tribes?

**Lesson 2 Advanced Post 1**

Your history teacher wants you to study the explorers of North America. How could you use Google search to find 2 explorers of North America, one was Norwegian and the other was Spanish. Write their names and date of births.

**Lesson 2 Advanced Post 2**

You realize there are many American explorers and you only need to write a report on one or two. You choose Lewis and Clark. How could you Google search to find where they travelled? And what was the name of their interpreter?

**Lesson 3 Beginner Pre 1**

Using Google search, find a large picture of George Washington. Identify how you found that the picture is large?

**Lesson 3 Beginner Pre 2**

Using Google search, find a roundtrip flight to Dublin, Ireland from Denver, Colorado. Write the names of 4 different airlines?

**Lesson 3 Beginner Pre 3**

Using Google search, find PowerPoint slides file that talk about book titled (20,000 Leagues Under The Sea) by Jules Verne?
Lesson 3 Beginner Post 1
Using Google search, find a large picture of John Kennedy. Identify how you found that the picture is large?

Lesson 3 Beginner Post 2
Using Google search, find a roundtrip flight to Hamburg from Denver, Colorado. Write the names of 4 different airlines?

Lesson 3 Beginner Post 3
Using Google search, find PowerPoint slides file that talks about a book titled (The Adventures of Huckleberry Finn) by Mark Twain?

Lesson 3 Intermediate Pre 1
Using Google search, find a news article that talks about ISIS and the violence in the Middle East? The article you will choose must be from the last week.

Lesson 3 Intermediate Pre 2
Using Google search, find a video documentary of (Billy the Kid). Your chosen video must be longer than 20 minutes, but shorter than one hour?

Lesson 3 Intermediate Pre 3
Using Google search, find a large picture of the American flag. Identify how you found that the picture is large?

Lesson 3 Intermediate Pre 4
Using Google search, find a word document that talks about a book titled (The Grapes of Wrath) by John Steinbeck?

Lesson 3 Intermediate Post 1
Using Google search, find a news article that discusses the US presidential election of 2016. The article you chose must be from the last week.

Lesson 3 Intermediate Post 2
Using Google search, find a video documentary of (Wild Bill). Your chosen video must be longer than 20 minutes, but shorter than an hour?

Lesson 3 Intermediate Post 3
Using Google search, find a large picture of Colorado flag. Identify how you found that the picture is large?

Lesson 3 Intermediate Post 4
Using Google search, find a word document that talks about a book titled (Journey to the Center of the Earth) by Jules Verne?

Lesson 3 Advanced Pre 1
Using Google search, find a map from the 1860s of the area that became Colorado? Please make sure that the map is a large enough picture to see detail. How did you find that the map is large?

Lesson 3 Advanced Pre 2
Using Google, search (Billy the kid was a gunslinger) and see what you find. Then search the same phrase “Billy the kid was a gunslinger” but with quotation marks. How is the information different?

Lesson 3 Advanced Pre 3
It is often challenging writing your first resume. Use Google to search for a resume template that is in the document format so that you can edit it in Microsoft Word?

Lesson 3 Advanced Pre 4
The CIA has information about every country in the world. By making all Google search results come from CIA website, find information about the people in Sweden on the CIA website?

Lesson 3 Advanced Post 1
Using Google search, find a map of Denver from the early 1900s. Please make sure that the map is a large enough image to see details. How did you find that the map is large?

Lesson 3 Advanced Post 2
Using Google, search (wash me from within) and see what you find. Then search the same phrase “wash me from within” but with quotation marks. How is the information different?
Lesson 3 Advanced Post 3

A curriculum vita is very similar to a resume, but it contains all of the achievements that you've accomplished, while a resume is just a summary. Using Google search, find a pdf file of a curriculum vitae template?

Lesson 3 Advanced Post 4

The CIA has information about every country in the world. By making all Google search results come from CIA website, find information about the people in Thailand on the CIA website?

Lesson 4 Beginner Pre 1

You need to know the distance between the US and China in miles. Use Google search to find the answer.

* All the questions in lesson4 have the following multiple choices questions for all groups.

2. Complete the following questions:

A- The website you chose for your answer was: Reliable ( ) Misleading ( )

Why?

B- The type of the website you chose was:

- Blog ( ) Wikis ( ) Question and answer site ( )
- Discussion lists, forums or groups ( ) News/article site ( )
- Informational site ( ) Governmental site ( ) Educational site ( )

C- The source of the information you found:

- Image ( ) Video ( ) Text ( ) Chart ( ) Table ( )

D- The evidence you discovered from the website you chose was:

- Facts ( ) Examples ( ) Definitions ( ) Quotes ( )
- Stories ( ) Statistics ( )

Lesson 4 Beginner Pre 2

There is an animation film names “Monster University”. Your friend wants to know who was the director of that film. Use Google search to find the answer.
Lesson 4 Beginner Post 1

You need to know the distance between the US and Italy in miles. Use Google search to find the answer.

Lesson 4 Beginner Post 2

There is an animation film named “Minions”. Your friend wants to know who the name of the writer of this film. Use Google search to find the answer.

Lesson 4 Intermediate Pre 1

Your friend wants to know the population of Colorado in 2015. Use Google search to tell him the answer.

Lesson 4 Intermediate Pre 2

Using Google search, find who said this quote “Innovation distinguishes between a leader and a follower”?

Lesson 4 Intermediate Pre 3

For a Geography project, you will need to gather information on California’s economy and mainly on California imports. Write 3 things that California is importing?

Lesson 4 Intermediate Post 1

You friend wants to know the population of Washington State in 2015. Use Google search to tell him the answer.

Lesson 4 Intermediate Post 2

Using Google search, find who said this quote “Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important.”?

Lesson 4 Intermediate Post 3
For a Geography project, you will need to gather information on Colorado’s economy and mainly on Colorado imports. Write 3 things that Colorado is importing?

**Lesson 4 Advanced Pre 1**

You are writing a report about lobster and you want to know the size of the largest lobster in the world. How can use Google search to find the answer?

**Lesson 4 Advanced Pre 2**

For a Geography project, you will need to gather information on Utah’s economy and mainly on Utah imports. Write 3 things that Utah is importing?

**Lesson 4 Advanced Pre 3**

You heard this quote "you must be the change you wish to see in the world". Your brother says that Steve Jobs said that quote. Your mom said it was not Steve Jobs but does not know who said that, while your friend says he is quite sure it was Mahatma Gandhi. Using Google search, how can find the right answer?

**Lesson 4 Advanced Post 1**

You friend wants to know the size of the red crab. How can use Google search to find the answer?

**Lesson 4 Advanced Post 2**

For a Geography project, you will need to gather information on Virginia’s economy and mainly on Virginia imports. Write 3 things that Virginia is importing?

**Lesson 4 Advanced Post 3**

You heard this quote "I Disapprove of What You Say, But I Will Defend to the Death Your Right to Say It". Your brother says that Claude Helvetius said that quote. Your mom said it was not Claude Helvetius but does not know who said that, while you think it was Voltaire. Using Google search, how can find the right answer?

* All the final fifth questions for all groups have multiple choice questions.
Final Beginner Q1
Your friends say they love the lines in "hello again" so you use Google search to look them up and find two things about it. What did you find? How did you find it?

Final Beginner Q2
Your group chooses France and you are in charge of finding the most common 3 religions in that country. How would you use the Google search to find this information? Write the 3 religions and their percentage?

Final Beginner Q3
Using Google search, find a large picture of Bill Clinton. Identify how you found that the picture is large?

Final Beginner Q4
Using Google search, find a PowerPoint slides that talk about a book titled (harry potter and the sorcerer's stone) by J.K. Rowling.

Final Beginner Q5
You need to know the distance between the US and Canada in miles. Use Google search to find the answer.

Final Intermediate Q1
You have been debating with your friend about bird population. He tells you there are 90 million different birds on record. You are certain that he is wrong but you cannot remember the actual number. How could you use Google search to settle this debate? What website you have chosen for your answer? Why?

Final Intermediate Q2
You are writing a small report on elephants and you want to know how they communicate. How would you use Google search to find this out?

Final Intermediate Q3
Using Google, find a video of the US president John F Kennedy when he was giving a speech. Your chosen video must be longer than 20 minutes, but shorter than an hour.

**Final Intermediate Q4**
Using Google search, find a word document that talks about a book titled (Around the World in 80 Days) by Jules Verne?

**Final Intermediate Q5**
For a Geography project, you will need to gather information on Michigan’s economy and mainly on Michigan imports. Write 3 things that Michigan is importing?

**Final Advanced Q1**
You are currently working a summer job in San Francisco, California. There is a friend at work that you are interested in. Your other friends suggest that you simply pay attention and learn about the things they might be interested in. At lunch one day, everyone is talking about their favorite bands. This person mentioned that they are obsessed with a certain band that is coming to San Francisco this summer, and you realize that this is your chance to really impress them with a pair of tickets to the concert! The problem is that you cannot seem to remember the name of the band at all. You try to remember the things they mentioned to clue together the name. You remember they hit the top 100 chart, and have several albums, one called *El Camino*. How can you use Google search to find this band’s name? Write the names of the members?

**Final Advanced Q2**
Your history teacher wants you to study the explorers of North America. How could you use Google search to find 2 explorers of North America; one explorer’s nationality is uncertain and the other was an Italian-born English explorer. Write their names and when did they die?

**Final Advanced Q3**
You are planning to go to Paris and you need a travel guide document. Use Google search to find a Paris travel guide in a pdf format?

**Final Advanced Q4**
Using Google, search (pull me up from the waters) and see what you find. Then search the same phrase “Pull me up from the waters” but with quotation marks. How is the information different?

Final Advanced Q5

For a Geography project, you will need to gather information on Massachusetts’s economy and mainly on Massachusetts imports. Write 3 things that Massachusetts is importing?
Lesson 1: Pre 1 (Beginner)

1- Open Google.com
2- Type in the search bar: Rock of Ages
3- Rock of Ages is a show playing in Las Vegas
4- Rock of Ages (2012) is a movie film
5- Rock of Ages is a rock musical
Lesson 1: Post 1 (Beginner)

1- Open Google.com
2- Type in the search bar: Pocahontas
3- Pocahontas (1995) is a movie from the International Movie Database (IMDB)
4- Pocahontas is an American native according to history
5- Pocahontas is a Disney character
Lesson 1: Understanding search results (Beginner)

Main goal: Learn about the different parts of the results page, and about how to evaluate individual results based on cues like web addresses and snippets.

Goal 1: Understand how Google search works
Search engines cannot truly understand the context of a query the way a person can, and that they function by matching the words you type in to the words that occur on various pages. Therefore, it is not surprising that many similar search results appear. Example: searching “Pocahontas” gives information about Disney movie and a Native American.

Goal 2: Explore the search results page.
1- Title: In blue, the first line of a search result.
2- Web Address: In green, it is the location of the page on the Web to identify page source (.edu,.gov)
3- Snippet: Some information about your search, which is taken from the web page.
4- Search terms: The Bolded words are your search terms you used when you searched.
5- Advertisement: appear if they are relevant to your search and always are marked with the word “Ad” or “Ads”.
6- The Knowledge Graph: Is a summary information from Google about people, places, and things.

Goal 3: Analyze and read before choose from the results.

Goal 4: Understanding specialization
Specialization is a strategy to undertake when a student cannot remember, or does not know, the term for a whole, larger concept—or simply cannot find information on the whole thing. Instead, the searcher knows one component of the desired whole, and leverages that knowledge to find the information needed. For example: searching for ingredients to make a dish, you are familiar with but do not remember the name of the dish.
Lesson 1: Pre 1 (Intermediate)

1- Open Google.com
2- Type in the search bar: How many dinosaur species
3- Choose: How many dinosaurs were there? - National Museum
4- Read the page to find that there were over 1000 dinosaurs. The page is reliable because it is an educational page edu.
Lesson 1: Post 1 (Intermediate)

1- Open Google.com
2- Type in the search bar: How many castles are in France
3- Choose from the results: Are There Castles in France? | USA Today
4- Read the page to find that there are more than 1000 castles. The page is reliable because it is a national American daily newspaper.
Lesson 1 Intermediate: Understanding search results (Intermediate)

**Main goal:** Learn about the different parts of the results page, and about how to evaluate individual results based on cues like web addresses and snippets.

**Goal 1: Understand how Google search works**
Search engines cannot truly understand the context of a query the way a person can, and that they function by matching the words you type in to the words that occur on various pages. Therefore, it is not surprising that many similar search results appear. Example: searching “Pocahontas” gives information about Disney movie and a Native American.

**Goal 2: Explore the search results page.**
1- Title: In **blue**, the first line of a search result.
2- Web Address: In **green**, it is the location of the page on the Web to identify page source (.edu,.gov)
3- Snippet: Some information about your search, which is taken from the web page.
4- Search terms: The **Bolded words** are your search terms you used when you searched.
5- Advertisement: appear if they are relevant to your search and always are marked with the word “Ad” or “Ads”.
6- The Knowledge Graph: Is a summary information from Google about people, places, and things.

**Goal 3: Analyze and read before choose from the results.**

**Goal 4: Understanding specialization**
Specialization is a strategy to undertake when a student cannot remember, or does not know, the term for a whole, larger concept—or simply cannot find information on the whole thing. Instead, the searcher knows one component of the desired whole, and leverages that knowledge to find the information needed. For example: searching for ingredients to make a dish, you are familiar with but do not remember the name of the dish.
Lesson 1: Pre 1 (Advanced)

1- Open Google.com
2- Type in the search bar all the ingredients together: **celery cream ground turkey**
3- Browse the search results and choose a website that has a recipe using those ingredients
4- Choose any recipe you prefer.
Lesson 1: Post 1 (Advanced)

1- Open Google.com
2- Type in the search bar all the words together: Blue Shell Crabs Denver Restaurants
3- Brows search result and choose a website that has seafood.
4- Crawling Crab is an example of a restaurant that sells blue shell crabs.
Lesson 1: Understanding search results (Advanced)

Main goal: Learn about the different parts of the results page, and about how to evaluate individual results based on cues like web addresses and snippets.

Goal 1: Understand how Google search works
Search engines cannot truly understand the context of a query the way a person can, and that they function by matching the words you type in to the words that occur on various pages. Therefore, it is not surprising that many similar search results appear. Example: searching “Pocahontas” gives information about Disney movie and a Native American.

Goal 2: Explore the search results page.
1- Title: In blue, the first line of a search result.
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Goal 3: Analyze and read before choose from the results.

Goal 4: Understanding specialization
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Lesson 2: Pre 1 (Beginner)

1- Open Google.com
2- Type in the search bar: religion in argentina
3- Choose from the results: Religion in Argentina - Wikipedia, the free encyclopedia
4- Look at the pie chart on the right and choose any 3 religions with their percentage.
Lesson 2: Post 1 (Beginner)

1. Open Google.com
2. Type in the search bar: religion in italy
3. Choose: Religion in Italy - Wikipedia, the free encyclopedia
4. Look at the pie chart on the right and choose any 3 religions with their percentage.
Lesson 2: Picking the right search terms (Beginner)

Goal 1: Parse a question to arrive at a query

-Circle keywords – keywords are essential words you can make a list of it. 
-Underline “maybe” words, offer synonyms or replacement terms. 
-Add missing words. 
-Identify unique words. 
-Ignore unnecessary words. 
-Do not use too many words. 
-Use mostly nouns.

Goal 2: Use a graphic organizer to develop your query

Goal 3: What Matters In My Search Query?

<p>| | |</p>
<table>
<thead>
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<th></th>
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<tbody>
<tr>
<td>1</td>
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</tr>
<tr>
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<td>Order matters.</td>
</tr>
<tr>
<td>3</td>
<td>Capitalization does not matter.</td>
</tr>
<tr>
<td>4</td>
<td>Punctuation does not matter.</td>
</tr>
<tr>
<td>*</td>
<td>There are some exceptions! $ C# C++ Google+ but not: $E©©@% $()@</td>
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Goal 4: Savvy searchers sometimes use context terms to describe the type of sources they want. An example of context terms is searching for a map of China. Using only China will give a lot of information. On the other hand, searching for China map is more specific. Map here is a context term.
Lesson 2: Pre 1 (Intermediate)

1- Open Google.com
2- Type in the search bar: how turtles communicate
3- Choose: Turtles 'Talk' to Each Other, Parents Call Out to Offspring
4- Scroll down and read the 2nd paragraph to find the answer.

The film Teenage Mutant Ninja Turtles has topped box offices for two weeks in a row, despite poor reviews. It’s no surprise, of course, that the film is wildly scientifically inaccurate—it is about human-sized mutant turtles, of course. But in one important way, the science flies: Turtles really “talk.”

Sure, they can’t speak English (so far as we know), but real-life turtles communicate underwater with low-pitched calls that they use to help them travel together and to find mates, says Richard Vogt, a researcher at National Institute of Amazonian Research in Manaus, Brazil.

Much of Vogt’s work focuses on Giant South American river turtles, which migrate from beaches into dense, flooded forests. “You're watching a sand beach in the Amazon, and in a manner of minutes, 200 turtles all come out at the same time and start sunning. How do they decide to do it?” By talking to each other, he says.
Lesson 2: Pre 2 (Intermediate)

1- Open Google.com
2- Type in the search bar: lions faster than Thomson's gazelle
3- Choose: 10 Fastest Animals On Earth - Fastest Animals In The World
4- Scroll down and to find that both lions and Thomson’s gazelle have the same speed (50 m/h)
Lesson 2: Post 1 (Intermediate)

1- Open Google.com
2- Type in the search bar: how dolphins communicate
3- Choose: All About Dolphins Q & A - Scholastic
4- Read the paragraph “how do dolphins communicate” to find the answer (sound, vision, touch and taste).
Lesson 2: Post 2 (Intermediate)

1- Open Google.com
2- Type in the search bar: **bottlenose dolphin food**
3- Choose: **What do Bottlenose Dolphins Eat?**
4- Read the 1st sentence to find the answer.

![Google Search Result](image)

A bottlenose dolphin's diet usually consists of a wide variety of foods including fish, squid and crustaceans. An adult dolphin may eat 15 - 30 pounds (6.8 - 13.5 kg) of food each day. **Bottlenose dolphins do not use their teeth to chew their food.**

**Bottlenose Dolphin - KDE Santa Barbara**

Kids.nceas.ucsb.edu/...bottlenose.ht... University of California, Santa Barbara

![Website Screenshot](image)

**What do Bottlenose Dolphins Eat? - Dolphin Facts and ...**

www.dolphins-world.com › FAQs -

**Bottlenose dolphins eat fish and squid like most of the popular dolphins eat.**

![Dolphins World Website](image)

**WHAT DO BOTTLENOSE DOLPHINS EAT?**

Answer:

Bottlenose dolphins diet consists mainly of small fish with occasional squid, crabs, shrimp, and other smaller animals.

Their teeth are not used to chew the food. When a shoal of fish is found dolphins work as a team to keep the fish close together and maximize the harvest. They also search for fish schools often homing in while making
Lesson 2: Picking the right search terms (Intermediate)

Goal 1: Parse a question to arrive at a query

- Circle keywords – keywords are essential words you can make a list of it.
- Underline “maybe” words, offer synonyms or replacement terms.
- Add missing words.
- Identify unique words.
- Ignore unnecessary words.
- Do not use too many words.
- Use mostly nouns.

Goal 2: Use a graphic organizer to develop your query

![Graphic Organizer]

Goal 3: Savvy searchers sometimes use context terms to describe the type of sources they want. An example of context terms is searching for a map of China. Using only China will give a lot of information. On the other hand, searching for **China map** is more specific. **Map** here is a context term.
Lesson 2: Pre 1 (Advanced)

1- Open Google.com
2- Type in the search bar: coded british communications 1918
3- Choose from the results: Code Talkers - Native American Page
4- Scroll down and read under the title “Use of Cherokee”
Lesson 2: Pre 2 (Advanced)

1- Open Google.com
2- Type in the search bar: Native American food
3- Choose form the results: Native American Food: Agriculture, Hunting and Gathering ...
4- Read the paragraph: “How did Native American eating habits change after Europeans arrived?” The answer is remote rainforest tribes.
Lesson 2: Post 1 (Advanced)

1. Open Google.com
2. Type in the search bar: explorers of north america
3. Choose: Explorers of North America - EnchantedLearning.com
4. Read the page to find the 2 explorers highlighted below
Lesson 2: Post 2 (Advanced)

1- Open Google.com
2- Type in the search bar: **lewis and clark explorers**
3- Choose: **Lewis and Clark: American Explorers - EnchantedLearning ...**
4- Read the highlighted paragraph to find the answer.
Lesson 2: Picking the right search terms (Advanced)

Goal 1: Parse a question to arrive at a query

- Circle keywords – keywords are essential words you can make a list of it
- Underline “maybe” words, offer synonyms or replacement terms.
- Add missing words.
- Identify unique words.
- Ignore unnecessary words.
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Goal 2: Use a graphic organizer to develop your query

Goal 3:

Goal 4: Savvy searchers sometimes use context terms to describe the type of sources they want. An example of context terms is searching for a map of China. Using only China will give a lot of information while China map is more specific. Map here is a context term.

Goal 5: Soft search terms: Are less likely to appear consistently on pages about your topic, and/or can be expressed in so many different ways that it is too difficult to come up with a good term or set of terms that are likely to find what you need. Example: Native Americans.
Lesson 3: Pre (Beginner)

1- Open Google.com
2- Type in the search bar: **abraham lincoln**
3- Select “Images” from the search menu
4- Choose “Search Tools” from the search menu
5- Then a new menu will appear, choose “Size”
6- From “Size” option, select “Large”
7- Now, all images are large. Select any for answer.
Lesson 3: Pre 2 (Beginner)

1- Open Google.com
2- Type in the search bar: denver to dublin flights
3- You will find different airlines.
4- To explore more airlines, click on “Flights” from the menu.
5- You can also click on “More Google flight results” to see more flights.
6- Look at the other flights, you can scroll down to see more.
Lesson 3: Pre 3 (Beginner)

1- Open Google.com
2- Type in the search bar: **20,000 Leagues Under The Sea filetype:ppt**
3- You will see [PPT] before any results. This means that the file is a PowerPoint. Now, all Google results will be PowerPoint slides. You can open the file or save directly to your computer.
4- Choose any link with the title of your search for the answer.
Lesson 3: Post 1 (Beginner)

1- Open Google.com
2- Type in the search bar: john kennedy
3- Select “Images” from the search menu
4- Choose “Search Tools” from the search menu
5- Then, a new menu will appear, choose “Size”
6- From “Size” option, select “Large”
7- Now, all images are large. Select any for the answer.
Lesson 3: Post 2 (Beginner)

1- Open Google.com
2- Type in the search bar: **denver to hamburg flights**
3- You will find different airlines.
4- To explore more airlines, click on “**Flights**” from the menu.
5- You can also click on “**More Google flight results**” to see more flights.
6- Look at the other flights, you can scroll down to see more.
Lesson 3: Post 3 (Beginner)

1- Open Google.com
2- Type in the search bar: The Adventures of Huckleberry Finn filetype:ppt
3- You will see [PPT] before any results. This means that the file is a PowerPoint. Now, all Google results will be PowerPoint slides. You can open the file or save directly to your computer
4- Choose any link with the title of your search for the answer.
Lesson 3: Narrow Search Results (Beginner)

Main Goal:
Apply a variety of filtering tools and symbols to narrow search results.

Goal 1: Use filters to narrow search results.

1) Filters: At the top of a search results page, you will see a number of ways to filter your results to see one type of content. For example, click Images to have your entire search results be pictures.

2) More filters: Some filters do not appear on the menu bar; you can find them by clicking on More.

3) Search tools: Once you have decided which type of results you want; you can refine your results even further using Search tools. Search tools can include things like location, color, size, the date a page was published, and others.

Goal 2: Use symbol to narrow search results.

You should use the symbols as they are written below; otherwise they will not work because they are case sensitive and have a specific format.

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| " "   | When you put a word or phrase in quotes, the results will only include pages with the same words in the same order as what's inside the quotes. **Note:** Only use this if you are looking for an exact word or phrase, otherwise you will exclude many helpful results by mistake. Example: "imagine all the people"
| site:  | Get results from certain sites or domains. For example, you can find all mentions of broncos from denver.com website by using this example: broncos site:denver.com |
| filetype: | To restrict results to a specific file type. The **filetype:** symbol should be written all in lower case with no space between the symbol and the specified file type. Example: cv filetype:pdf. The following are the list of searchable files: Adobe Portable Document Format: pdf Microsoft Word: doc, docx Microsoft PowerPoint: ppt, pptx |
Lesson 3: Pre 1 (Intermediate)

1- Open Google.com
2- Type in the search bar: *isis and the violence in the middle east*
3- Select “News” from the search menu
4- Choose “Search Tools” from the search menu
5- Then, a new menu will appear, choose “Recent”
6- From “Recent” options, select “Past week”
7- Now, you will see some articles are from last week. Select any for the answer
Lesson 3: Pre 2 (Intermediate)

1- Open Google.com
2- Type in the search bar: Billy the Kid
3- Select “Videos” from the search menu
4- Choose “Search Tools” from the search menu
5- Then, a new menu will appear, choose “Any duration”
6- From “Any duration” options, select “Long (20+ min)”
7- Now, all videos are longer than 20 minutes. Select one which is less than 1 hour
Lesson 3: Pre 3 (Intermediate)

1- Open Google.com
2- Type in the search bar: **amERICAN flag**
3- Select “Images” from the search menu
4- Choose “Search Tools” from the search menu
5- Then a new menu will appear, choose “Size”
6- From “Size” option, select “LARGE”
7- Now, all images are large. Select the answer
Lesson 3: Pre 4 (Intermediate)

1- Open Google.com
2- Type in the search bar: **The Grapes of Wrath filetype:doc**
3- You will see [DOC] before any results. This means that the file is a word document. Now, all Google results will be word documents. You can open the file or save directly to your computer
4- Choose any link with the title of your search for the answer
Lesson 3: Post 1 (Intermediate)

1. Open Google.com
2. Type in the search bar: **US presidential election of 2016**
3. Select “**News**” from the search menu
4. Choose “**Search Tools**” from the search menu
5. Then, a new menu will appear, choose “**Recent**”
6. From “**Recent**” options, select “**Past week**”
7. Now, you will see some articles from last week. Select any for the answer
Lesson 3: Post 2 (Intermediate)

1- Open Google.com
2- Type in the search bar: **wild bill**
3- Select “**Videos**” from the search menu
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5- Then, a new menu will appear, choose “**Any duration**”
6- From “**Any duration**” option, select “**Long (20+ min)**”
7- Now, all videos are longer than 20 minutes. Select one which is less than 1 hour

![Google Search Steps]

[Google Search Steps Image]
Lesson 3: Post 3 (Intermediate)

1- Open Google.com
2- Type in the search bar: colorado flag
3- Select “Images” from the search menu
4- Choose “Search Tools” from the search menu
5- Then, a new menu will appear, choose “Size”
6- From “Size” option, select “Large”
7- Now, all images are large. Select any for the answer
Lesson 3: Post 4 (Intermediate)

1- Open Google.com
2- Type in the search bar: Journey to the center of the Earth filetype:doc
3- You will see [DOC] before any results. This means that the file is a word document. Now, all Google results will be word documents. You can open the file or save directly to your computer
4- Choose any link with the title of your search for the answer
Lesson 3: Narrow Search Results (Intermediate)

Main Goal:
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Goal 1: Use filters to narrow search results.

1) Filters: At the top of a search results page, you will see a number of ways to filter your results to see one type of content. For example, click Images to have your entire search results be pictures.

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</tr>
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</table>
Lesson 3: Pre 1 (Advanced)

1- Open Google.com
2- Type in the search bar: **colorado historical map 1860**
3- Select “**Images**” from the search menu
4- Choose “**Search Tools**” from the search menu
5- Then a new menu will appear, choose “**Size**”
6- From “**Size**” option, select “**Large**”
7- Now, all images are large. Select the answer
Lesson 3: Pre 2 (Advanced)

1- Open Google.com
2- Type in the search bar: **Billy the kid was a gunslinger**
3- You will see mixed results and Billy the kid is reported in criminal biography.
4- Delete what you typed and type **“Billy the kid was a gunslinger”** with quotation marks
5- Quotation marks give you more specific information and let you have results about that exact phrase. Here, **“Billy the kid was a gunslinger”** is a lyric for a song
Lesson 3: Pre 3 (Advanced)

1- Open Google.com
2- Type in the search bar: **resume template filetype:doc**
3- You will see [DOC] before any results. This means that the file is a word document. Now, all Google results will be word documents. You can open the file or save directly to your computer
4- Choose any link with the title of your search for the answer
Lesson 3: Pre 4 (Advanced)

1- Open Google.com
2- Type in the search bar: **sweden site:cia.gov**
3- You will only see the results from the CIA.gov website.
4- Choose: *Sweden – CIA* from the result to explore the website.
Lesson 3: Post 1 (Advanced)

1- Open Google.com
2- Type in the search bar: **denver historical map 1900**
3- Select “**Images**” from the search menu
4- Choose “**Search Tools**” from the search menu
5- Then a new menu will appear, choose “**Size**”
6- From “**Size**” option, select “**Large**”
7- Now, all images are large. Select the answer.
Lesson 3: Post 2 (Advanced)

1- Open Google.com
2- Type in the search bar: **wash me from within**
3- You will see mixed results.
4- Delete what you typed and type **“wash me from within”** with quotation marks
5- You will get more specific information as “wash me from within” is a lyric for a song
Lesson 3: Post 3 (Advanced)

1- Open Google.com
2- Type in the search bar: **curriculum vitae filetype:pdf**
3- You will see [PDF] before any results. This means that the file is a pdf. Now, all Google results will be pdfs. You can open the file or save directly to your computer
4- Choose any link with the title of your search for the answer.
Lesson 3: Post 4 (Advanced)

1- Open Google.com
2- Type in the search bar: **thailand site:cia.gov**
3- You will see only the results from the CIA.gov website.
4- Choose: **Thailand – CIA** from the result to explore the website.
Lesson 3: Narrow Search Results (Advanced)

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Lesson 4: Pre 1 (Beginner)

1- Open Google.com
2- Type in the search bar: distance between the US and China in miles
3- Choose: Distance from United States to China
4- The answer is 7245 miles

A- The website you chose was: reliable because it is an information site that has Google map
B- The type of the website you chose was: informational site
C- The source of the information you found: text
D- The evidence you discovered from the website you chose was: facts
Lesson 4: Pre 2 (Beginner)

1- Open Google.com
2- Type in the search bar: monsters university film
3- Choose: Monsters University (2013) – IMDb
4- The answer is: Dan Scanlon

A- The website you chose was: reliable because it is the internet movie database
B- The type of the website you chose was: informational site
C- The source of the information you found: text
D- The evidence you discovered from the website you chose was: facts
Lesson 4: Post 1 (Beginner)

1- Open Google.com
2- Type in the search bar: **distance between the US and Italy in miles**
3- Choose: **Distance from United States to Italy**
4- The answer is **5362 miles**

A- The website you chose was: **reliable because it is an information site that has Google map**
B- The type of the website you chose was: **informational site**
C- The source of the information you found: **text**
D- The evidence you discovered from the website you chose was: **facts**
Lesson 4: Post 2 (Beginner)

1- Open Google.com
2- Type in the search bar: minions
3- Choose: Minions (2015) – IMDb
4- The answer is: Brian Lynch

A- The website you chose was: reliable because it is the internet movie database
B- The type of the website you chose was: informational site
C- The source of the information you found: text
D- The evidence you discovered from the website you chose was: facts
Lesson 4: Handout (Beginner)

Main Goal: Identify evidence, explore different type of sources and page formats and evaluate the reliability of different sources.

Goal 1: List of evidence and sources in web searching

A) Example of different page type/formats include: blogs, Wikis, question and answer sites, discussion lists (or forums or groups), news/article sites, informational sites, governmental pages and educational sites.

B) Examples of different sources include: images, maps, videos, text, charts, and tables.

C) Examples of different evidence include: facts, examples, definitions, quotes, anecdotes, and statistics.

Goal 2: How to evaluate the reliability of the sources.

1- Websites with known domains are reliable. You know them by reading the website address.
   - Governmental website: .gov  Example: www.cia.gov
   - Educational website: .edu  Example: www.harvard.edu

2- Some websites can be considered as a good start for your search but do not rely on them:
   - Wikipedia  Anyone can create a user and edit the information on Wikipedia.
   - Questions and Answers sites or discussion lists (or forums or groups)  Random people post information based on their experience. Sometimes they post useful information but usually the information is not accurate.

   - You should search for another reliable website to check the accuracy of the information you get from Wikipedia, questions and answers sites, or forums.

3- To find a reliable information for your search, the website you choose must have some of the following:
   - You should be able to identify the author name and/or his/her professional title.
   - You should be able to identify the date of when the article/information was written.
   - You should find some works cited or other links to provide additional resources or original source information.
   - The website should have contact information or contact us links to receive questions.

   - If what you read or find conflicts with something you already know to be true, you should search again and find other sources that share the same information.

   - Always look for at least 2 websites to check the accuracy of the information you searched.
Lesson 4: Pre 1 (Intermediate)

1- Open Google.com
2- Type in the search bar: population of colorado 2015
3- Choose: Colorado QuickFacts from the US Census Bureau”>
4- Look at the table to find that the answer is: 5,456,574

A- The website you chose was: reliable because it is a governmental site: www.census.gov
B- The type of the website you chose was: governmental site
C- The source of the information you found: table
D- The evidence you discovered from the website you chose was: statistics
Lesson 4: Pre 2 (Intermediate)

1- Open Google.com
2- Type in the search bar: **Innovation distinguishes between a leader and a follower**
3- Choose: **10 great quotes from Steve Jobs - CNN.com**
4- Look at number 8 to find that Steve Jobs said that quote. This quote is in a book called “The Innovation Secrets of Steve Jobs”

A- The website you chose was: **reliable because the author of the article put the reference of the quote (the name of the book that has the quote and the date).**
B- The type of the website you chose was: **news site**
C- The source of the information you found: **text**
D- The evidence you discovered from the website you chose was: **quote**
Lesson 4: Pre 3 (Intermediate)

1- Open Google.com
2- Type in the search bar: california state imports
3- Choose: California State Imports - Census.gov
4- Choose 3 things that California State is importing from the “Description” column.

A- The website you chose was: **reliable because it is a governmental site**: [www.census.gov](http://www.census.gov)
B- The type of the website you chose was: **governmental site**
C- The source of the information you found: **table**
D- The evidence you discovered from the website you chose was: **facts**
Lesson 4: Post 1 (Intermediate)

1- Open Google.com
2- Type in the search bar: population of washington state 2015
3- Choose: Washington QuickFacts from the US Census Bureau
4- Look at the table to find that the answer is: 7,170,351

A- The website you chose was: reliable because it is a governmental site: www.census.gov
B- The type of the website you chose was: governmental site
C- The source of the information you found: table
D- The evidence you discovered from the website you chose was: statistics
Lesson 4: Post 2 (Intermediate)

1- Open Google.com
2- Type in the search bar: Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important.
3- Choose: Bill Gates Quotes - The Best Quotes for Life and Business …
4- Scroll down until you find “15 BILL GATES QUOTES TO GET YOU MOTIVATED”. You will find the quote under this title

"Success is a lousy teacher. It seduces smart people into thinking they can't lose."
- Bill Gates

"It's fine to celebrate success but it is more important to heed the lessons of failure."
- Bill Gates

"If you can't make it good, at least make it look good."
- Bill Gates

"Technology is just a tool. In terms of getting the kids working together and motivating them, the teacher is the most important."
- Bill Gates

A- The website you chose was: reliable because you can see the bio of the author of this article, date when the article was published, and some links to provide additional resources about Bill Gates
B- The type of the website you chose was: news site
C- The source of the information you found: text
D- The evidence you discovered from the website you chose was: quote
Lesson 4: Post (Intermediate)

1- Open Google.com
2- Type in the search bar: **colorado state imports**
3- Choose: **Colorado State Imports - Census.gov**
4- Choose 3 things that Colorado State is importing from the “Description” column.

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A- The website you chose was: **reliable because it is a governmental site**: [www.census.gov](http://www.census.gov)
B- The type of the website you chose was: **governmental site**
C- The source of the information you found: **table**
D- The evidence you discovered from the website you chose was: **facts**
Lesson 4: Handout (Intermediate)

**Main Goal:** Identify evidence, explore different type of sources and page formats and evaluate the reliability of different sources.

**Goal 1: List of evidence and sources in web searching**

A) **Example of different page type/formats include:** blogs, Wikis, question and answer sites, discussion lists (or forums or groups), news/article sites, informational sites, governmental pages and educational sites.

B) **Examples of different sources include:** images, maps, videos, text, charts, and tables.

C) **Examples of different evidence include:** facts, examples, definitions, quotes, anecdotes, and statistics.

**Goal 2: How to evaluate the reliability of the sources.**

1- Websites with known domains are reliable. You know them by reading the website address.
   - Governmental website: .gov Example: [www.cia.gov](http://www.cia.gov)
   - Educational website: .edu Example: [www.harvard.edu](http://www.harvard.edu)

2- Some websites can be considered as a good start for your search but do not rely on them:
   - Wikipedia ➔ Anyone can create a user and edit the information on Wikipedia.
   - Questions and Answers sites or discussion lists (or forums or groups) ➔ Random people post information based on their experience. Sometimes they post useful information but usually the information is not accurate.

   - **You should search for another reliable website to check the accuracy of the information you get from Wikipedia, questions and answers sites, or forums.**

3- To find a reliable information for your search, the website you choose must have some of the following:
   - You should be able to identify the author name and/or his/her professional title.
   - You should be able to identify the date of when the article/information was written.
   - You should find some works cited or other links to provide additional resources or original source information.
   - The website should have contact information or contact us links to receive questions.

   - **If what you read or find conflicts with something you already know to be true, you should search again and find other sources that share the same information.**

   - **Always look for at least 2 websites to check the accuracy of the information you searched.**
Lesson 4: Pre 1 (Advanced)

1- Open Google.com
2- Type in the search bar: largest lobster recorded
3- Choose: Lobsters, Lobster Pictures, Lobster Facts - National ...
4- Scroll down until you find “Fast Facts”. The answer is 44.4 lbs

A- The website you chose was: reliable because it is considered the 1st reference site about animals and has a lot of information and documentaries.
B- The type of the website you chose was: information site
C- The source of the information you found: text
D- The evidence you discovered from the website you chose was: facts
Lesson 4: Pre 2 (Advanced)

1- Open Google.com
2- Type in the search bar: utah state imports
3- Choose: Utah State Imports - Census.gov
4- Choose 3 things that Utah State is importing from the “Description” column

A- The website you chose was: reliable because it is a governmental site: www.census.gov
B- The type of the website you chose was: governmental site
C- The source of the information you found: table
D- The evidence you discovered from the website you chose was: facts
Lesson 4: Pre 3 (Advanced)

1- Open Google.com
2- Type in the search bar: you must be the change you wish to see in the world
3- Choose: Falser Words Were Never Spoken - The New York Times
4- Scroll down to find that Gandhi did not say that quote and it is unknown

The website you chose was: **reliable** because the author cited what Ghandi actually said and explained the difference between the quotes.

The type of the website you chose was: **news site**

The source of the information you found: **text**

The evidence you discovered from the website you chose was: **facts**
Lesson 4: Post 1 (Advanced)

1- Open Google.com
2- Type in the search bar: **red crab size**
3- Choose: **Red Crabs, Red Crab Pictures, Red Crab Facts -- National ...**
4- Scroll down until you find “Fast Facts”. The answer is **5 in**

A- The website you chose was: **reliable** because it is considered the 1st reference site about animals and has a lot of information and documentaries.
B- The type of the website you chose was: **information site**
C- The source of the information you found: **text**
D- The evidence you discovered from the website you chose was: **facts**
Lesson 4: Post 2 (Advanced)

1- Open Google.com
2- Type in the search bar: virginia state imports
3- Choose: Virginia State Imports - Census.gov
4- Choose 3 things that California State is importing from the “Description” column

A- The website you chose was: reliable because it is a governmental site: www.census.gov
B- The type of the website you chose was: governmental site
C- The source of the information you found: table
D- The evidence you discovered from the website you chose was: facts
Lesson 4: Post 3 (Advanced)

1- Open Google.com
2- Type in the search bar: I Disapprove of What You Say, But I Will Defend to the Death Your Right to Say It
3- Choose: Remember, That Famous Voltaire “Quote” About Free ...
4- Scroll down to find that the answer is Beatrice Evelyn Hall who wrote about Voltaire

A- The website you chose was: reliable because the author of this article put the reference of the book with the date of publication. Additionally, you can find the bio of the author.
B- The type of the website you chose was: news site
C- The source of the information you found: text
D- The evidence you discovered from the website you chose was: facts
Lesson 4: Handout (Advanced)

Main Goal: Identify evidence, explore different type of sources and page formats and evaluate the reliability of different sources.

Goal 1: List of evidence and sources in web searching

A) Example of different page type/formats include: blogs, Wikis, question and answer sites, discussion lists (or forums or groups), news/article sites, informational sites, governmental pages and educational sites.

B) Examples of different sources include: images, maps, videos, text, charts, and tables.

C) Examples of different evidence include: facts, examples, definitions, quotes, anecdotes, and statistics.

Goal 2: How to evaluate the reliability of the sources.

1- Websites with known domains are reliable. You know them by reading the website address.
   - Governmental website: .gov Example: www.cia.gov
   - Educational website: .edu Example: www.harvard.edu

2- Some websites can be considered as a good start for your search but do not rely on them:
   - Wikipedia → Anyone can create a user and edit the information on Wikipedia.
   - Questions and Answers sites or discussion lists (or forums or groups) → Random people post information based on their experience. Sometimes they post useful information but usually the information is not accurate.

   - You should search for another reliable website to check the accuracy of the information you get from Wikipedia, questions and answers sites, or forums.

3- To find a reliable information for your search, the website you choose must have some of the following:
   - You should be able to identify the author name and/or his/her professional title.
   - You should be able to identify the date of when the article/information was written.
   - You should find some works cited or other links to provide additional resources or original source information.
   - The website should have contact information or contact us links to receive questions.
   - If what you read or find conflicts with something you already know to be true, you should search again and find other sources that share the same information.
   - Always look for at least 2 websites to check the accuracy of the information you searched.
APPENDIX E. LESSON MULTIPLE CHOICE QUESTION ANSWERS FOR ALL GROUPS

The following tables represent all the answers for the multiple choice questions where the incorrect answers are highlighted in red.

Table 1
*Beginner Pre 1 Multiple Choice Question*

<table>
<thead>
<tr>
<th>P</th>
<th>The type of website chosen by a student</th>
<th>The type of website</th>
<th>The source chosen by a student</th>
<th>The source of information</th>
<th>The evidence chosen by a student</th>
<th>The evidence discovered</th>
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<tbody>
<tr>
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<td>Image</td>
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<td>None</td>
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Table 2
*Beginner Post 1 Multiple Choice Question*

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<th>The source of information</th>
<th>The evidence chosen by a student</th>
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<td>Facts</td>
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<td>Image</td>
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<th>The source of information</th>
<th>The evidence chosen by a student</th>
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Table 4
*Beginner Post 2 Multiple Choice Question*

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<th>The source of information</th>
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Table 5

**Intermediate Pre 1 Multiple Choice Question**

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<td>12</td>
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<td>Text</td>
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Table 6

**Intermediate Pre 1 Multiple Choice Question**

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Table 8
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<td>Governmental</td>
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**Intermediate Post 3 Multiple Choice Question**

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<th>The evidence chosen by a student</th>
<th>The evidence discovered</th>
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<td>Table</td>
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</tr>
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<td>Table</td>
<td>Statistics</td>
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</tr>
<tr>
<td>13</td>
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<td>Governmental</td>
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<td>Table</td>
<td>Statistics</td>
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</tr>
<tr>
<td>14</td>
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### Table 11
**Advanced Pre 1 Multiple Choice Question**

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<th>The source of information</th>
<th>The evidence chosen by a student</th>
<th>The evidence discovered</th>
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</thead>
<tbody>
<tr>
<td>15</td>
<td>News</td>
<td>News</td>
<td>Text</td>
<td>Text</td>
<td>Examples</td>
<td>Facts</td>
</tr>
<tr>
<td>16</td>
<td>Educational</td>
<td>Blog</td>
<td>Text</td>
<td>Text</td>
<td>Facts</td>
<td>Facts</td>
</tr>
<tr>
<td>17</td>
<td>Q&amp;A</td>
<td>Q&amp;A</td>
<td>Text</td>
<td>Text</td>
<td>Facts</td>
<td>Facts</td>
</tr>
<tr>
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<td>News</td>
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<td>Text</td>
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<td>Facts</td>
<td>Facts</td>
</tr>
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Table 12
**Advanced Post 1 Multiple Choice Question**

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<th>The source of information</th>
<th>The evidence chosen by a student</th>
<th>The evidence discovered</th>
</tr>
</thead>
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<tr>
<td>15</td>
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<td>Text</td>
<td>Text</td>
<td>Facts</td>
<td>Facts</td>
</tr>
<tr>
<td>16</td>
<td>Governmental</td>
<td>Governmental Table</td>
<td>Table</td>
<td>Table Statistics</td>
<td>Facts</td>
<td>Facts</td>
</tr>
<tr>
<td>17</td>
<td>Informational</td>
<td>Informational</td>
<td>Text</td>
<td>Text</td>
<td>Facts</td>
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<tr>
<td>18</td>
<td>Wikipedia</td>
<td>Wikipedia Text</td>
<td>Table</td>
<td>Text</td>
<td>Facts</td>
<td>Facts</td>
</tr>
<tr>
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<td>Wikipedia Text</td>
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Table 13
**Advanced Pre 2 Multiple Choice Question**

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<th>The source of information</th>
<th>The evidence chosen by a student</th>
<th>The evidence discovered</th>
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</thead>
<tbody>
<tr>
<td>15</td>
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<td>Table</td>
<td>Table Statistics</td>
<td>Facts</td>
<td>Facts</td>
</tr>
<tr>
<td>16</td>
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<td>Governmental Table</td>
<td>Table</td>
<td>Table Facts</td>
<td>Facts</td>
<td>Facts</td>
</tr>
<tr>
<td>17</td>
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<td>Governmental Table</td>
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<td>Table Examples</td>
<td>Facts</td>
<td>Facts</td>
</tr>
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<td>18</td>
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<td>Informational None</td>
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<td>Statistics</td>
<td>Facts</td>
<td>Facts</td>
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<tr>
<td>19</td>
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<td>Governmental Table</td>
<td>Table</td>
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Table 14
**Advanced Post 2 Multiple Choice Question**

<table>
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<th>The type of website</th>
<th>The source chosen by a student</th>
<th>The source of information</th>
<th>The evidence chosen by a student</th>
<th>The evidence discovered</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>Governmental</td>
<td>Governmental Table</td>
<td>Table</td>
<td>Table Statistics</td>
<td>Facts</td>
<td>Facts</td>
</tr>
<tr>
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<td>Governmental Table</td>
<td>Table</td>
<td>Table Statistics</td>
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<td>Governmental</td>
<td>Governmental Table</td>
<td>Table</td>
<td>Table Examples</td>
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<td>18</td>
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<td>Table</td>
<td>Text</td>
<td>Examples</td>
<td>Facts</td>
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**Advanced Pre 3 Multiple Choice Question**

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<th>The source of information</th>
<th>The evidence chosen by a student</th>
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<td>Informational</td>
<td>Text</td>
<td>Text</td>
<td><strong>Quotes, Facts</strong></td>
<td></td>
</tr>
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<td><strong>Discussion List</strong></td>
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<td>Text</td>
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<td>Text</td>
<td>Text</td>
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### Table 16
**Advanced Post 3 Multiple Choice Question**

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<th>The source of information</th>
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<td>Facts</td>
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</table>
APPENDIX F. CAUSES OF FAILURE DATA

The coding for the following tables:

- Wrong query: 1
- Incomplete query: 2
- Incomplete answer: 3
- Wrong answer: 4
- Answer not found: 5
- Success: 6
- Absent: *

### Beginner group causes of failure

<table>
<thead>
<tr>
<th>P</th>
<th>Lesson 1</th>
<th>Lesson 2</th>
<th>Lesson 3</th>
<th>Lesson 4</th>
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</thead>
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### Intermediate group causes of failure

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### Advanced group causes of failure

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<td>6</td>
<td>5</td>
<td>6</td>
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</table>
APPENDIX G. NEW VARIABLES FOR WILCOXON SIGN RANK TEST
(TRAINING LESSON QUESTIONS)

<table>
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<th>Variable</th>
<th>Value</th>
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<tbody>
<tr>
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<td>L1_Score_Pre1+L2_Score_Pre1+L2_Score_Pre2+L3_Score_Pre1+L3_Score_Pre2+L3_Score_Pre3+L3_Score_Pre4+L4_Score_Pre1_A+L4_Score_Pre2_A+L4_Score_Pre3_A</td>
</tr>
<tr>
<td>Total_Post_Training_Score</td>
<td>L1_Score_Post1+L2_Score_Post1+L2_Score_Post2+L3_Score_Post1+L3_Score_Post2+L3_Score_Post3+L3_Score_Post4+L4_Score_Post1_A+L4_Score_Post2_A+L4_Score_Post3_A</td>
</tr>
</tbody>
</table>
APPENDIX H. GRIDS FOCUS ANALYSIS (SEARCHING ABILITY)

Focus Searching Ability before The Training
"P6"

<table>
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<tr>
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<th>5</th>
<th>2</th>
<th>4</th>
</tr>
</thead>
<tbody>
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<td>3</td>
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<td>3</td>
<td>4</td>
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<td>4</td>
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<tr>
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<td>5</td>
</tr>
<tr>
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<td>6</td>
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</table>

Focus Searching Ability after the Training
"P6"

<table>
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<th>4</th>
<th>5</th>
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</thead>
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<td>2</td>
<td>2</td>
</tr>
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<td>2</td>
<td>2</td>
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<tr>
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<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Obvious 4</td>
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<td>2</td>
</tr>
</tbody>
</table>

(Charts and analysis details)
Focus Searching Ability before the Training
"F8"

Slow 3
Confusing 4
Useful 5
Provides a sense of achievement for me 6
Enjoyable 1
Simple 2

3 Fast
4 Obvious
5 Useless
6 Provides a sense of failure for me
1 Frustrating
2 Difficult

Focus Searching Ability after the Training
"F8"

Provides a sense of achievement for me 6
Useful 5
Enjoyable 1
Simple 2
Fast 3
Obvious 4

1 Creating keywords
2 Understanding search results
4 Finding relevant information
6 Need addressed
5 Independent use
3 Narrowing search results

3 Narrowing search results
5 Independent use
1 Creating keywords
2 Understanding search results
4 Finding relevant information
6 Need addressed
Focus Searching Ability before the Training
“F9”

Useful 5
- 3 1 1 1 2 1
Simple 2
- 3 2 2 2 1 1
Obvious 4
- 3 3 3 2 3 1
Provides a sense of achievement for me 6
- 3 2 3 3 3 2
Enjoyable 1
- 1 1 3 3 3 1
Slow 3
- 2 2 2 4 4 4

Focus Searching Ability after the Training
“F9”

Useful 5
- 1 1 1 1 1 1
Enjoyable 1
- 1 1 1 1 1 1
Obvious 4
- 1 1 1 1 1 2
Simple 2
- 1 1 1 1 1 2
Fast 3
- 1 1 1 1 1 2
Provides a sense of achievement for me 6
- 1 1 1 1 1 2

1 Creating keywords
2 Understanding search results
3 Narrowing search results
4 Finding relevant information
5 Independent use
6 Need addressed
Focus Searching Ability before the Training "P10"

Obvious 4 2 2 1 1 1 3
Enjoyable 1 2 1 1 1 2 1
Useful 5 1 1 1 1 2 2
Simple 2 1 1 2 2 2 2
Fast 3 1 2 2 2 2 2
Provides a sense of achievement for me 6 2 2 2 2 2 2

Focus Searching Ability after the Training "P10"

Useful 5 1 1 1 1 1 1
Enjoyable 1 2 2 1 1 1 1
Simple 2 2 1 1 1 1 2
Fast 3 2 1 1 2 2 2
Obvious 4 1 1 1 1 2 2
Provides a sense of achievement for me 6 2 2 1 2 2 2

- 3 Narrowing search results
- 4 Finding relevant information
- 5 Independent use
- 6 Need addressed
- 1 Creating keywords
- 2 Understanding search results
- 5 Useless
- 1 Frustrating
- 2 Difficult
- 3 Slow
- 4 Confusing
- 6 Provides a sense of failure for me
Focus Searching Ability before the Training

"P15"

6 5 2 1 4 3

Useful 5 1 1 1 1 1 5 Useless
Obvious 4 1 1 1 1 1 4 Confusing
Fast 3 1 1 1 1 1 3 Slow
Simple 2 1 1 1 2 2 2 2 Difficult
Provides a sense of achievement for me 6 2 2 2 3 3 2
Enjoyable 1 2 2 3 3 4 6 Provides a sense of failure for me

6 5 2 1 4 3

3 Narrowing search results
4 Finding relevant information
1 Creating keywords
2 Understanding search results
5 Independent use
6 Need addressed

Focus Searching Ability after the Training

"P15"

6 5 4 3 1 2

Fast 3 1 1 1 1 1 2 3 Slow
Obvious 4 1 1 1 1 1 4 Confusing
Useful 5 1 1 1 1 1 5 Useless
Simple 2 1 1 2 2 1 1 2 Difficult
Provides a sense of achievement for me 6 1 2 2 2 2
Enjoyable 1 1 1 2 2 3 3 1 1 Frustating

6 5 4 3 1 2

2 Understanding search results
1 Creating keywords
3 Narrowing search results
4 Finding relevant information
5 Independent use
6 Need addressed
APPENDIX I. NEW VARIABLES FOR T-TEST AND STUDENTS’ TIME SCORES

1) Computed variables to conduct t-test.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total_Pre_Time</td>
<td>L1_Time_Pre1+L2_Time_Pre1+L2_Time_Pre2+L3_Time_Pre1+L3_Time_Pre2+</td>
</tr>
<tr>
<td></td>
<td>L3_Time_Pre3+L3_Time_Pre4+L4_Time_Pre1+L4_Time_Pre2+L4_Time_Pre3</td>
</tr>
<tr>
<td>Total_Post_Time</td>
<td>L1_Time_Post1+L2_Time_Post1+L2_Time_Post2+L3_Time_Post1+L3_Time_Post2+</td>
</tr>
<tr>
<td></td>
<td>L3_Time_Post3+L3_Time_Post4+L4_Time_Post1+L4_Time_Post2+L4_Time_Post3</td>
</tr>
</tbody>
</table>

2) The following tables show the time on task in minutes for all students in the training. Note that 99 means either a student was absent or no video (corrupted).

a) All Lessons-time on task (Beginner Group)

<table>
<thead>
<tr>
<th></th>
<th>Lesson 1</th>
<th>Lesson 2</th>
<th>Lesson 3</th>
<th>Lesson 4</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Q1</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
<tr>
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<td>2.19</td>
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<td>4.37</td>
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b) Lessons 1, 2, and 3-time on task (Intermediate Group)

<table>
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<tr>
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<th>Lesson 3</th>
</tr>
</thead>
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<tr>
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<td>99</td>
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c) Lessons 4-time on task (Intermediate Group)

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d) Lessons 1, 2, and 3-time on task (Advanced Group)

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e) Lesson 4-time on task (Advanced Group)

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f) Follow-up study-time on task (Beginner Group)

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g) Follow-up study-time on task (Intermediate Group)

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h) Follow-up study-time on task (Advanced Group)

<table>
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<th>Q3</th>
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<tr>
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## APPENDIX J. NEW VARIABLES FOR COCHRAN’S Q TEST

<table>
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<th>Variable</th>
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<tbody>
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<td>L1_score_pre1(Beginner)+ L1_score_pre1(Intermediate)+ L1_score_pre1(Advanced)</td>
</tr>
<tr>
<td>L1_score_post</td>
<td>L1_score_post1(Beginner)+ L1_score_post1(Intermediate)+ L1_score_post1(Advanced)</td>
</tr>
<tr>
<td>F_score_Q1</td>
<td>F_score_1(Beginner)+ F_score_1(Intermediate)+ F_score_1(Advanced)</td>
</tr>
<tr>
<td>L2_score_pre</td>
<td>L2_score_pre1(Beginner)+ L2_score_pre1(Intermediate)+ L2_score_pre2(Advanced)</td>
</tr>
<tr>
<td>L2_score_post</td>
<td>L2_score_post1(Beginner)+ L2_score_post1(Intermediate)+ L2_score_post2(Advanced)</td>
</tr>
<tr>
<td>F_score_Q2</td>
<td>F_score_2(Beginner)+ F_score_2(Intermediate)+ F_score_2(Advanced)</td>
</tr>
<tr>
<td>L3_score_pre1</td>
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<td>L3_score_post1</td>
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<td>F_score_Q3</td>
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<td>L4_score_post_A</td>
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</tr>
<tr>
<td>F_score_Q5_A</td>
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</tr>
<tr>
<td>L4_score_pre_B</td>
<td>L4_score_pre1_B(Beginner)+ L4_score_pre3_B(Intermediate)+ L4_score_pre2_B(Advanced)</td>
</tr>
<tr>
<td>L4_score_post_B</td>
<td>L4_score_post1_B(Beginner)+ L4_score_post3_B(Intermediate)+ L4_score_post2_B(Advanced)</td>
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<tr>
<td>------------------</td>
<td></td>
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<tr>
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</tr>
<tr>
<td>B: Type of website questions</td>
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<tr>
<td>C: Source of information questions</td>
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</tr>
<tr>
<td>D: Evidence discovered questions</td>
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</table>
APPENDIX K. FINAL STUDY MULTIPLE CHOICE QUESTION ANSWERS FOR ALL GROUPS

The following tables represent all the answers for the multiple choice questions where the incorrect answers are highlighted in red.

Table 1
Beginner Final Multiple Choice Question

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<th>The source chosen by a student</th>
<th>The source of information</th>
<th>The evidence chosen by a student</th>
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Intermediate Final Multiple Choice Question

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Advanced Final Multiple Choice Question

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LESSON 2 GRIDS FOCUS ANALYSIS

Focus Lesson 2
"P5"

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5 Not motivating
4 Not enough
2 Useless
1 Frustrating
3 Provides a sense of failure for me
6 Distracting

Focus Lesson 2
"P6"

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1 Frustrating
4 Enough
6 Distracting
5 Not motivating
2 Useless
3 Provides a sense of failure for me

1 Need addressed
2 Participation
3 Communication with teachers
6 Training experience
5 Time allotment
4 Amount of information
LESSON 3 GRIDS FOCUS ANALYSIS
LESSON 4 GRIDS FOCUS ANALYSIS
Focus Lesson 4
"P16"

Enough 4
Useful 2
Provides a sense of achievement for me 3
Motivating 5
Helped me concentrate 6
Enjoyable 1

Not enough 4
Useless 2
Provides a sense of failure for me 3
Not motivating 5
Distracting 6
Frustrating 1

Communication with teachers 3
Need addressed 1
Training experience 6
Participation 2
Amount of information 4
Time allotment 5

Focus Lesson 4
"P17"

Helped me concentrate 6
Enough 4
Enjoyable 1
Useful 2
Motivating 5
Provides a sense of achievement for me 3

Distracting 6
Not enough 4
Frustrating 1
Useless 2
Not motivating 5
Provides a sense of failure for me 3

Time allotment 5
Communication with teachers 3
Need addressed 1
Amount of information 4
Participation 2
Training experience 6
APPENDIX M. HANDOUTS GRIDS FOCUS ANALYSIS

Focus Handout
"F5"

Useful 4
1 1 1 1 1 2
Usable 6
1 1 1 1 1 2
Effective 3
1 1 1 1 1 2
Motivating 5
1 1 1 1 1 2
Enjoyable 1
1 1 1 1 2 2
Easy 2
1 1 1 2 2 2

Focus Handout
"F6"

Motivating 5
1 3 3 3 3
Easy 2
2 2 2 2 2 3
Usable 6
1 2 2 2 2 3
Effective 3
1 1 2 3 2 2
Enjoyable 1
1 1 2 3 3 3
Useful 4
1 1 2 2 3 2
Focus Handout
"F7"

- Useful 4
  - 2 2 1 1 1 1
- Effective 3
  - 2 1 1 1 1 1
- Usable 6
  - 2 1 1 1 1 2
- Easy 2
  - 1 1 1 1 2 2
- Enjoyable 1
  - 3 2 2 2 2 2
- Motivating 5
  - 2 3 2 2 2 3

Focus Handout
"F8"

- Effective 3
  - 2 1 1 1 1 2
- Usable 6
  - 2 2 1 1 1 1
- Useful 4
  - 2 2 2 2 1 1
- Easy 2
  - 1 1 2 2 2 1
- Enjoyable 1
  - 2 2 2 2 3 3
- Motivating 5
  - 3 3 2 3 3 3

- 4 Visual format
- 3 Language (Readability)
- 1 Everyday use
- 2 independent use
- 5 Handouts organization
- 4 Content quantity
- 2 Not usable
- 4 Useless
- 2 Difficult
- 5 Frustrating
- 5 Not motivating
### APPENDIX N. RELIABILITY AND MULTIPLE CHOICE QUESTION DATA

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Note. S=success. RF=reliability failure. F=other failures.