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Problems with Internet and Library Usage for Secondary School Children

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Abstract

This research consisted of investigating seven hypotheses using the following components:

1. Observation of forty-three secondary school children using the Internet and the library to complete five tasks.

2. An interview was held with all the participants in the study that was audio taped and subsequently transcribed.

3. An on-line form was constructed so that the students could nominate their favourite educational web sites for each class subject.

The participants were given five tasks and had to find the answers using two of the most common forms of information retrieval found in Irish schools, the Internet and the school library. Subsequently they were asked twenty questions about their opinions on aspects of the library and the Internet. Points of interest here included that the majority of participants felt that the Internet is faster, easier to use, and better overall than the library, even though it was proven not to be the case. It was also found that the participants nominated sites by domain name without actually investigating if the domain name had any reference to the subject in question.

The observation, interview and voting data was then analysed using SPSS to investigate the seven hypotheses. These findings were then reported, discussed and ideas for future study were recommended. Proposed technical and teaching solutions to problems uncovered in this research are also outlined.

The above findings have implications for search engine design, the curriculum of the Irish education system, and for teachers in how they use both the Internet and the library to their full potential.

1 - Introduction

1.1 Problems with Internet and Library use for school children

This thesis examines areas where the Internet is misused, underused or misunderstood by school children. It is not our aim to portray the Internet in a negative light but rather to:

(a) Suggest possible technical solutions to some of these problems, and

(b) Suggest what schools should be teaching children about how to use the Internet so as to get the most out of it.

The purpose of this research is to investigate seven hypotheses by using information gained from observation of information retrieval using both Internet and library resources. The outcome of this research has implications for curriculum development in Ireland, school policies on information retrieval, designers of search engines and most importantly the teachers responsible for using the Internet as an educational tool in class.

1.2 Hypotheses to be tested

Hypothesis 1: *Without proper guidance schoolchildren have difficulty using the Internet effectively as an information retrieval tool.*

Previous research has shown that adults and children encountered difficulties when using the Internet for information retrieval (Bilal and Kirby, 1998). In this area I intend to explore the validity of this statement using my own subjects and test process. Evidence was found to support this hypothesis.

Hypothesis 2: *Students are not critical enough of the information they find on the Internet.*

From past teaching experience it is a personal belief that students tend to be more impressed by the innovative multi-media experience and thus fail to question the authenticity of the information provided. Not enough conclusive evidence was found to support this hypothesis.

Hypothesis 3: *Investigation of two information sources a) the Internet and b) the book to determine which is better for secondary school usage.*

My aim is here to investigate if one medium is superior to the other in terms of information retrieval. How effective is information retrieval from the Internet compared to the traditional resources such as libraries? The results of this hypothesis were inconclusive, as not enough evidence was found to support it.

Hypothesis 4: *Use of the Internet in secondary schools is leading to an increase in plagiarism.*

Because of the increasingly paperless role of the computer based classroom, are the copy and paste functions leading to an increase in plagiarism? Do students realise the implications of

plagiarism and what can we as concerned educators do anything about it? Evidence was found to support this hypothesis.

Hypothesis 5:   *Secondary school students believe that the content of a web site is directly related to its domain name.*

Does the domain name of a site matter, or is there a perception that a domain name is inherently linked to the content of a site? This hypothesis was supported by evidence found in this research.

Hypothesis 6:   *Students are being overwhelmed by Information Technology and as a result automatically believe the Internet to be superior to print media for information retrieval.*

Today's secondary school students are currently part of a multi-media world of computer games, DVD, mobile phones, email, and the World Wide Web. Their perceptions of technology and their actual effectiveness in relation to information retrieval are a cause of concern. Do students believe that the Internet is better than the library for information retrieval just because it is technological and multi-media based? This hypothesis was supported by evidence found by this research.

Hypothesis 7:   *There is a need for an information retrieval skills module to be introduced to the secondary school curriculum.*

The object of this hypothesis is to investigate whether or not there is an actual need to implement a specific programme for information retrieval skills as part of a secondary school syllabus. Examples might include library and Internet training. This hypothesis was supported by this research.

2   Literature Review

2.1 Trust & Relevancy issues

Watson (1998) analysed a group of students and their perceptions of the World Wide Web. It found that a very small number reported evaluating the content of information for accuracy and adequacy. These findings also were similar to Kafai and Bates (1997) whose study found that published information from all sources; both web and print were believed to be true by the students.

Hirsh (1999) found that only 2% of the participants mentioned authority as criteria when evaluating information from the Internet and generally did not question the accuracy or validity of the information they found from any electronic resource. Fidel et al (1999) also found that students in high school also did not question the accuracy of the information they found on the Internet. An interesting point here is the fact that half of the participants in the study believed that Microsoft was responsible for the information on the Internet and a quarter of them believed that Bill Gates was in control of the information on the Internet and directly monitored its use.

A finding from the Small and Ferreira (1994) study gives an insight into why children place a higher value on multimedia sources than traditional print sources. They found that students searching multimedia resources spent far more effort and time locating information than their colleagues searching print resources. Therefore the student's perception of information from multimedia resources was higher.

Kafai and Bates (1997) found that although students employed clear criteria on good and bad web pages, and in turn had a critical view of the web and had low expectations of its resources in comparison to other library resources, they considered the web very highly. This appears to be ironic in the sense that although the participants rated the library resource higher in terms of its effectiveness, the World Wide Web was still held in high regard.

This literature suggests that students do not properly evaluate the information they find and more importantly do not question the source of this information. A reason for this might be the age category of the participants in the various researches, as they were primarily in the 6 to 12 years old bracket. It could be said that these participants would not have the cognitive skills or life experience to properly criticise and evaluate information that they found. Indeed due to the multimedia side of the Internet they would automatically hold information found on this resource in higher regard.

With the web such a vast resource and the amount of information on it growing exponentially each year, it seems impossible to authenticate the information on it. Unregulated information raises questions about where the information originated, who produced it, and how accurate it is (Hernon, 1995).

2.2 Search Strategies

In his study Watson's (1998) participants revealed that to search successfully on the Internet, a focus or defined question is required. However previous research has proven that children rarely employ systematic search strategies and spend little time planning their searches (Marchionini 1989, 1995). It has also been proven that children who carry out unsuccessful searches are more likely to try and reduce or increase retrieval output as successful searchers do (Fidel, 1991; Hsieh-Yee, 1993).

Previous research has shown that children use keyword based search strategies for tasks that are well defined and browsing strategies for ill defined tasks (Borgman et al, 1995). Due to the cognitive nature of both of these strategies, keyword based strategies create a higher cognitive load due to its recall nature. Children will therefore favour browsing strategies with its recall nature. Browsing strategies according to the literature, have been shown to be a more effective search strategy when the task is ill defined (Marchionini, 1995). The web imposes a cognitive overload and is 'likely to exacerbate users feelings of being lost in hypertext, and cause them difficulties in navigating WWW subspaces' (Cockburn & Jones, 1996). Large and Behesti (1999) report that 'most information on the web has not been written with a young audience in mind and may impose a greater cognitive effort on the students part in comparison with books and CD-ROMs that have been specifically prepared with school students in mind'. This statement is quite significant for all the studies including this one as they deal with the information retrieval of school children.

Schacter et al (1998) also found that the vast majority of participants sought information by browsing techniques rather than keyword searches. Not one participant used Boolean searches or exact term searching. This high level of browsing may indicate that children are not carefully surveying or reading any of the information. One might also question whether a group of 9 to 12 year old children could be expected to formulate complex search queries. Although the study states that the participants had been using the Internet as an educational resource for the previous 5 months, it failed to say what training the participants had in using search engines and retrieving information in general.

These results i.e. the necessity for clear defined tasks in order for Internet searching to be successful and the less taxing option of browsing on the Internet would lead to the following question: Is the Internet being used to its full potential in school by both teachers and students alike?

2.3 Usability & Navigation issues

Hirsh (1999) found that students did not make use of advanced search features, did not record useful URL's and started each search anew by typing in search queries. This method of starting a new search was also found in Wallace and Kupperman's (1997) study. Children in this study had limited success with their searches, with 76% of their time spent using repetitive keyword searches, natural language in search engines and making incorrect use of Boolean logic.

Fidel et al (1999) found that students made extensive use of the back button to return to relevant sites. This study also revealed that students used landmarks in the search process. For some students this was the results page and the students felt it was an important safeguard, i.e. it was their comfort zone. Sometimes these landmarks were identified through graphical cues, such as animations and easily identifiable pictures. Wallace and Kupperman (1997) also found that students used the back button as their primary means of navigation,made repetitive use of keywords for searching and used natural language to query search engines.

As the computer now plays an integral part in most classrooms is it not time for computer instruction (computer applications) to feature as an integral subject on the Junior and Leaving Certificate syllabus?

2.4 Plagiarism

Participants in Fidel et al (1999) study copied the relevant information from the web page directly to the place they were completing the task given to them.

A participant in Large & Behesti (2000) believed that by re-typing information found on the Internet and not simply cutting and pasting, that he was conforming to acceptable practice. This would make it obvious that plagiarism seems to be more tempting from web pages than other sources. This would conform to Large, Behesti & Breuleux (1998), who stated 'the temptation of plagiarism is greater when the storage medium is electronic and the content suitable for transference, unedited, into the students project, as in the case, say, of a children's encyclopaedia on CD-ROM'.

Burdick (1998) said 'technology allows students to get information, and use it without even reading it, much less understanding it'. Students can combine or copy the words physically, without comprehending, assimilating, or combining the ideas intellectually.

This research would concur that children lack the motivation to locate and evaluate information. This might be due to the fact that not all people are comfortable with technology as means for information retrieval. Technology allows students to assimilate information without reading it properly, less understanding it. The ease with which students can copy and paste information by electronic means does not challenge them intellectually. This begs the question as to whether the end objective of information retrieval is being defeated, i.e. broadening one's knowledge whilst learning to question theories, processes and reasons.

2.5 Frustrations & Success

A common source of frustration experienced by children retrieving information from the Internet is slow connect times (Hirsh, 1999). Students in this study also reported satisfaction with their searches, with one student in particular finding 999 pages of Internet links to his favourite sports star. He interpreted this as meaning the Internet had the most information on the topic, even though it did not provide him with the specific information he was looking for. This would suggest a certain naivety on the part of the participants.

Participants in J.S. Watson's (1998) study recalled particular delight with regard to browsing the World Wide Web and of finding information; one particular comment 'not knowing what you want to find out' comes to mind here. Another student from this study said patience was a virtue with regard to searching on the Internet, as he truly believed that the information he required was on the Internet somewhere. Participants in this study also reported impatience with lost search time and confusion about how to find information successfully from the Internet. Some participants were overwhelmed with the amount of information produced by Internet searches.

As mentioned previously the information needs of children are different from adults, it is no surprise that spelling has been identified as a major source of errors in the information retrieval process (Eastman and Agostino, 1986). Fidel et al (1999) also found that spelling difficulties prevented more than 50% of the participants progressing a search during observations.

The above findings could have implications for all research using children of a certain age group and one would have to question the negative outcomes of most of the research. Perhaps different research tasks more suited to their age group would have given more positive results?

2.6 Traditional Library Use

The children in a study carried out by Edmonds, Moore and Balcom (1990) preferred using information retrieval methods using the card catalogue rather than the OPAC. They were

also more successful in their searches using this method. A reason for this may have been that the design of the OPAC in question was a touch screen and required users to pass through at least 8 screens to reach their search destination. One error along this path would ultimately result in an error overall.

Large & Behesti (2000) study concluded that a role remains for print materials, because they are targeted at a young audience and states that the web needs a more straightforward interface and more information aimed specifically at a young audience before it can threaten traditional methods of information retrieval. Previous research already mentioned in this chapter has supported this.

Hirsh (1999) examined the strategies of students when looking for information in the library. Students typically used the book cover, book title, table of contents and the index in the back of the book to help make decisions about how useful a book could be. They flicked quickly through the pages to see if any of the contents caught their eye. Children generally favoured books with titles that clearly contained their specific athletes name rather than general compilations of sports stars. Interestingly, participants in Watson's (1998) study reported that they valued books in different ways than the Internet. Findings here suggest that books are a more pleasurable experience for the reader, and hold them in higher esteem as a result.

Fidel et al (1999) study revealed that most students at the end of the search process turned to books to complete their given assignments. They knew that certain resources in the library would help them complete their projects and that the print resources would compliment what they had already searched for on the web. However most of the students agreed that to research information in the library required considerable more effort than on the Internet.

2.7 Internet as an Information Retrieval Resource

According to Bilal (2001) 'unlike on-line catalogues, CD-ROM multimedia encyclopaedias and traditional print resources, the web is dynamic, heterogeneous, lacks structure and has unique navigational properties'.

Yang and Moore (1996) and McKenzie (1996) have identified some of the disadvantages of educational hypermedia;

- Users can get lost in navigation
- Too much information is available and can overwhelm the user
- Too many decisions and mental steps have to be made resulting in cognitive overload

According to Large, Behesti and Breleux (1998), 'the web presents students with new opportunities but also new problems. It represents on one hand an endlessly rich source of images, sounds and texts on myriad topics, all of which can be accessed from a single location. On the other hand it raises a series of questions about this information, including its reliability, suitability and retrievability'.

Information seeking tasks that are open ended and loosely defined are well suited for children's Internet searching. For tasks that are well defined and highly specific, however, the Internet may not be the most efficient resource to assist children with their information needs (Schacter et al 1998).

Reasons for researching information retrieval from the Internet are varied and many. It is expanding at tremendous rate, is not controlled for content and is readily accessible. According to Schacter et al (1998) 'searching for information in a full text database comprised of 20 billion documents, where the structure of information and the use and degree of hypertext links to inter-relate documents vary according to who has designed the web site, introduces new variables not yet studied in information science'.

A general consensus of participants in Watson's (1998) study revealed that reading was carried out 'less thoroughly on the Internet'. Pictures were also found to be a motivating factor for reading, as pictures intrigue them to read the text for information. Interestingly one participant reported that they read the information very quickly on the Internet due to the cost factor; 'you don't pay by the hour with a book'. According to Watson (1998) 'the lure of visually exciting screens does not offer a substitute for exercising one's imagination from reading stand alone text, whereby one employ's comprehension skills far superior to simple decoding or taking information from the screen'.

3 - Research Methodology

The research took place mostly after school in the evenings and at the weekends. The participants in the study were taken mostly from the boarding section of the school. The reasons for this included the following:

- The researcher worked as a housemaster in the boarding school for the previous three years and knew the students well.
- There were a wide variety of nationalities to choose from, to give as wide a range of sample size as possible.

- The students were motivated to undertake the research as it involved an hour's break from study!

- The researcher resided in the school so access to the participants was never a problem.

The school library and computer laboratory were located ideally for the purposes of this research i.e. beside each other in the main residential area of the school.

3.1 Computer Laboratory setting

The computer laboratory in the school was installed in March 2000. It has everything that a computer room requires, 30 Pentium III multimedia workstations networked with a laser printer, teacher's workstation and a Cisco router controlling Internet access. A multimedia projector is also available for teacher demonstrations and each student has their own ID and password. Students also save their work on the network to their own individual folders, which only the student in question and the system administrator have access to. An ISDN line is used for Internet access. The web browser used on the workstations is Internet Explorer and Office 2000 is the main software package used by the students.

3.2 Library setting

A full time librarian and an assistant maintain the library. It is open during the day for study periods and also after school for students. The books are categorised according to the Dewey classification system and magazines and current newspapers are also stored for reference.

3.3 Research Task

This research consisted of a comparative study of library and Internet use of secondary school children by setting tasks and gathering data on how the user solved each task. The tasks were of a factual nature and due to the time constraints on this study a research task with open-ended questions were not carried out. Tasks were designed to ensure the participants could find the answers from both resources. The tasks were set and data was then gathered on how the user solved each task. The actual tasks given to the participants were:

Task 1: Find the name of the only English Pope?
This is a religion-based question and involved a lot of searching in both resources to find the answer.

Task 2: What is the French word for witch?
This is a dictionary based question.

Task 3: Who was the English footballer of the year in 1979?

This was mainly a sport based question, and was used primarily to increase the motivation of the participants, as they all had an avid interest in sport.

Task 4: In what city was Otto Von Bismarck born?

This was a historical question, with Bismarck being a famous historical figure.

Task 5: Find a map of Co. Carlow.

This was a geographical, image based question.

The questions were varied from student to student i.e. they were asked in no particular order. Both the Internet and library tasks were undertaken in a random fashion also i.e. they did not carry out the tasks in a set pattern.

3.4 The Internet research process

Each participant logged into the teachers PC at the top of the room. They were then given the five tasks and told that they could answer them in any order that they wished.

Observations were made of the student's use of the Internet by the researcher using special templates designed for the purpose. The researcher also had a stopwatch, which was reset after a task was completed. The main items of interest were the following:

- Amount of time spent completing task
- The type of search strategy i.e. natural language or Boolean
- The amount of keywords used in each search
- Did the participant scroll to the bottom of each web page?
- How the navigation features of Internet Explorer were utilised i.e. back and forward buttons
- Were spelling difficulties encountered
- Was the hit list constantly referred to
- Was the search a success

These observations were then transcribed immediately so that as little information was lost during the process. It was intended at the start of this research to conduct analysis on 15 questions but after a couple of trial runs it was found to be too time consuming so it was narrowed down to 5 questions. It was decided that a higher sample size would be more beneficial to investigating the hypotheses.

Each student was allowed a time of 30 minutes to conduct each search on the Web. They were told that it was not a test or anything whatsoever to do with school. They were also told that if the answer to a certain question could not be found, to move on to the next.

The students were not given any instruction whatsoever on what techniques to pursue their searches in either of the resources. They were given a completely free reign to carry out their own methods of information retrieval, and told to ask the researcher for help if they became confused at any stage.

3.5 The Library Research process

Similar to the Internet research process, each participant was timed on each task. The students were given the research tasks and told they had to find the answer to each task using the library as a resource. The researcher followed the student around the library, recording the data on a template designed for the purpose. Each participant was timed as in the Internet process on each task. The main items recorded were as follows:

- The time taken to complete a task
- The amount of books referenced during each task
- The features of the book that were utilised i.e. the cover, title, table of contents and the back index
- Was the card classification used to find a book
- Did the student wander from section to section in an unorganised manner
- Did the participant flick through the pages to find the answer to the task
- Was the search a success

Finally the students did not receive any instruction from the researcher in relation to information retrieval skills, whilst using the library or the Internet.

3.6 Interview Research Process

The students were then asked some questions about their experiences in an interview in order to identify their attitudes towards both resources as a means of information retrieval. These sessions were held after the tasks had been completed using both resources. These were audio taped and subsequently transcribed for analysis.

4 Analysis of data *From All 5 Tasks*.

To analyse the data as a complete section; the transform feature was used within SPSS. All the relevant data was computed to new variables e.g. (Internet search time 1+ Internet search time 2 + Internet search time 3 + Internet search time 4 + Internet search time 5) / 5 = Average Internet time.

This facility was used to compute the following new variables:

- Total spelling mistakes on Internet
- Overall success of Internet
- Overall success of library
- Total no of searches for Internet
- No of books in Library search
- Total times search button used
- No of times back button used
- No of times forward button used
- Boolean searches used
- No of keywords used
- Total amount of links
- Scroll to bottom of web page?
- Times book cover used
- Times book title referred to
- Times table of contents referred to
- Times back index referred
- Card classification referrals
- Average time on Internet
- Average time for Library

The summary statistics for these new variables are located in table 4.6.

- As can be seen from the table, the mean time for all Internet searches is 3 minutes 38 seconds, while the corresponding figure for the library is 3 minutes 9 seconds. This would suggest that the library is marginally faster overall than the Internet.

- The mean overall success of the Internet is 2.95 while the mean overall success of the library is 3.53. This would suggest that the overall success rates of the library are significantly better than the Internet search.

- The amount of searches in the Internet had a mean of 16.05, while the mean number of books in the library search was 9.35. This would suggest that the amount of effort taken by the library search overall is significantly less than the Internet.

Table 4.6 Statistics for all 5 tasks

	N	Minimum	Maximum	Mean	Std. Deviation
Total spelling mistakes on Internet	43	0	9	0.93	1.61
Overall success of Internet	43	0	5	2.95	1.33
Overall success of library	43	1	5	3.53	0.80
No of searches for Internet	43	5	49	16.05	8.57
No of books in Library search	43	5	16	9.35	2.44
Total times search button used	43	0	5	0.70	1.32
No of times back button used	43	0	46	12.35	10.10
No of times forward button used	43	0	22	1.44	3.87
Boolean searches used	43	0	5	0.77	1.36
No of keywords used	43	6	74	24.63	12.39
Total amount of links	43	4	56	23.00	11.96
Scroll to bottom of web page?	43	0	4	1.02	1.12
Times book cover used	43	0	3	0.72	1.03
Times book title referred to	43	3	5	4.40	0.69
Times table of contents referred to	43	0	7	2.33	1.46
Times back index referred	43	0	4	1.91	1.27
Card classification referrals	43	0	2	0.47	0.70
Average time on Internet	43	00:42	05:59	03:38	01:17
Average time for Library	43	01:39	05:26	03:09	00:48
Valid N (list wise)	43				

To investigate the above hypothesis, a paired samples t-test was conducted to provide proof that the above statements were true. (Table 4.7)

Table 4.7 Analysis of time, success and number of searches for the 5 tasks

	Paired Differences			t	do	Sig. (2-tailed)
	Mean	95% Confidence Interval of the Difference				
		Lower	Upper			
Average time on Internet - Average time for Library	0:00:28	0:00:03	0:00:54	2.257	42	.029
Overall success of Internet - Overall success of library	-.58	-1.03	-.13	-2.627	42	.012
No of searches for Internet - No of books in Library search	6.70	4.06	9.34	5.123	42	.000

A 95% confidence interval was constructed and the following information was obtained:

The t-test for the times compared gives a significance of .029. The null hypothesis that there is no difference overall between the time taken for the Internet search and the library search can be rejected, as .029 is less than .05. Thus the time taken for a library search is significantly less than an Internet search.

The t-test for the overall success rates compared gives a significance of .012. The null hypothesis that there is no difference overall between the success rates for the Internet search and the library search can be rejected, as .012 is less than .05. Thus the success rate for a library search is significantly better than an Internet search.

The t-test for the amount of searches in each gives a significance of 0. The null hypothesis that there is no difference overall between the amount of searches for the Internet search and the library search can be rejected, as 0 is less than .05. Thus the amount of searches for a library search is significantly less than an Internet search.

5 Other Survey Data

Another component of this research was the construction of an online web voting form. It was designed as part of the computer applications module that the researcher taught in the school. Its function was to enable the students to nominate their favourite educational web sites for each class subject and also their favourite search engines on the Internet. The data obtained from this part of the research was used to investigate the hypothesis that school children believe that the content of a web site is directly related to its domain name.

The voting form was hosted on the schools web site and was available for all users to access. The data was then sent to the researchers email address.

The Votes were entered into SPSS and gave the following results:

- One of the most popular votes for business was www.business.com
- The two top votes for German were www.german.com and www.germany.com.
- www.music.com was nominated for music.
- www.body.com was one of the top three nominations for biology.
- www.france.com was the most popular vote for French.
- www.irish.com was the second most popular vote for Irish.
- One of the joint second places in chemistry was www.chemistry.com.
- The two joint second places in Maths were www.maths.com and www.algebra.com
- www.history.com was one of the joint winners for History.
- www.english.com was voted the clear winner for English.
- www.art.com was the clear winner for Art.
- www.accounting.com was the clear winner for Accounting.
- One of the votes for Economics was www.leavingcerteconomics.com.

These sites were then investigated as to their content and the following was discovered:

- www.german.com is in the German language and gives information on Internet security and firewalls. There is certainly no reference to leaving cert German!

- www.germany.com gave a page display error.

- www.business.com is called the "business search engine" and appears to be a good resource.

- www.music.com is more or less a general information site on most types of music. Its relevancy to leaving certificate music has to be questioned however.

- A page display error was given for www.body.com

- www.history.com is a film archive site, of no relevance to leaving certificate history.

- www.france.com appeared to be a general information site on tourism in France. Hotel and train information were available. It would be some help however as there were some good links to French historical figures and culture.

- www.irish.com links directly to www.getmusic.com, a music site.

- www.chemistry.com is a job recruitment site for the pharmaceutical industry.

- www.maths.com gave a page display error.

- www.algebra.com is an excellent site for maths.

- www.english.com is an educational site, however it is not yet fully functional.

- www.art.com was redirected to www.allwall.com, a site selling paintings.

- www.accounting.com is a recruitment site for the financial services industry.

- www.leavingcerteconomics.com gave a page display error. When investigated further it was discovered that the domain name is still available for registration.

As can be clearly seen from the sites above, the participants place a lot of emphasis on domain names. Unfortunately most of the more popular English names are now being used for business, not educational purposes.

It has also to be said that either one or all of www.leavingcert.net, www.scoilnet.ie and www.brittanica.com featured high for each subject.

6 Data Support for hypotheses

Each of the 7 hypotheses listed in section 1 will now be examined in relation to the test results in order to determine whether they are founded or unfounded. This will be done by using the following evidence:

- Observations recorded while the participants searched the Internet and the library.

- Interview data.

- Web voting form data.

Table 6.1 Summary of section 4

Hypothesis One*:   Without proper guidance schoolchildren have difficulty using the Internet effectively as an information retrieval tool.*

The participants in this research as previously stated had no specific training in information retrieval methods in either the Internet or the library. As can be seen from table 6.1, the library was faster in two of the tasks and had a higher success rate in three of the tasks.

	Faster	Higher Success Rate	Less Searches
Task 1		Internet (95%)	
Task 2	Library (99%)	Library (99%)	Library (99%)
Task 3	Library (95%)	Library (90%)	
Task 4	Internet (90%)		
Task 5		Library (95%)	
Overall	Library (95%)	Library (95%)	Library (95%)

In addition to this (see table 6.2) the use of the back button and the amount of spelling mistakes would suggest that the participants were not effective users of the Internet. This evidence would support the hypothesis that without proper guidance schoolchildren have difficulty using the Internet effectively as an information retrieval tool.

Table 6.2

	Back button (mean)	Spelling mistakes (mean)
Task 1	2.02	0.16
Task 2	2.95	0.12
Task 3	2.86	0.30
Task 4	1.88	0.09
Task 5	2.63	0.26
Overall	2.47	0.19

The following were observations noted during the research which further support this hypothesis:

- A spelling difficulty arose in this research, when a participant typed www.antarctica.com in the address bar (obviously a reference to www.encarta.com) as he heard it was a good encyclopaedia site. It instead brought him to the homepage of an American beer company.

- The site map was widely misinterpreted in the hit results page. For example when "map of Carlow" was inputted into the search, the resulting hit results page gave some links with the words "site map" underneath. This was then clicked as a map of Carlow was expected. This was obviously the incorrect thing to do and would suggest that the participants lacked the dialogue of the Internet which adult users take for granted.

- One participant kept clicking on a certain section of hypertext. He explained that the hyperlinks were not working. The truth was that they were not hyperlinks in the first place and the participant did not know the difference between ordinary hypertext and a hyperlink.

- Many participants entered "Football" in the search engine while attempting task 3. The search should have been more specific as every type of football in the world was displayed, when English football or soccer would have been more appropriate, as it would have narrowed the hit list considerably.

Hypothesis Two: *Students are not critical enough of the information they find on the Internet.*

The participants in this research rarely scrolled to the bottom of the web pages they were viewing. On average this occurred once in every five pages. Also when the mean amount of pages visited (4.6) is divided into the mean time taken per search (3min 38 seconds), this gives a figure of 47 seconds spent on average per web page. This would indicate that the participants skimmed through the information on the Internet without allowing enough time to properly assimilate the information there.

It also emerged in the interview that 16.3% of the participants trusted the information found on the Internet more than the traditional print resources.

Furthermore, it was observed when participants were completing task 1 they typed in "English pope" into the search engine. This in turn gave links to Alexander Pope, the English poet. This was the answer provided by a lot of the participants, even though it was the incorrect answer.

The results of this hypothesis are deemed to be inconclusive, as not enough evidence was found to support it.

Hypothesis Three: *Investigation of two information sources a) the Internet and b) the book to determine which is better for secondary school usage.*

As can be seen from table 6.1, the Library has been proven to outperform the Internet in three of the tasks. The Internet outperforms the library on the other two. However closer investigation of task two would reveal a bias in favour of the print resource over its Web based counterpart. Dictionaries would be more familiar to schoolchildren in print format as opposed to the Web format. To state that one resource is better in general over the other would be incorrect, as both resources have advantages in certain areas. One could suggest that the library is better for dictionary based questions, although this would require further testing.

There is not enough evidence to support the hypothesis that one resource is better than the other as a whole.

Hypothesis Four*:* Use of the Internet in secondary schools is leading to an increase in plagiarism.

The interview statistics showed some interesting figures (see table 6.3,6.4,6.5).

Table 6.3

	Yes %	No %
Have/would you plagiarise from the Internet?	53.5	46.5
Have/would you plagiarise from a book?	44.2	55.8

Table 6.4

What are the advantages of websites?	%
Copy and paste information	4.7
More Information	14
Accessibility	14
Quicker	9.3

Table 6.5

What are the disadvantages of the library?	%
Too much manual work	41.9
Slow	25.6
Not enough information	9.3

A higher majority of participants stated that they would plagiarise from the Internet (53.5%) than from a book (44.2%). When asked what advantages the Internet had over books, 42% of the participants stated that it was easier to copy and paste, had more information, was more accessible and was quicker. These statements could indicate that the format of web pages is leading to an increase in plagiarism.

The students were further asked to comment on their views on the disadvantages of the library. The majority mentioned the manual nature of searching for information, slowness and lack of information. This would further support the argument that the format of the Internet is leading to an increase in plagiarism in secondary schools due to copy and paste functions and specific sites which encourage plagiarism e.g. www.schoolsucks.com.

Hypothesis Five: *Secondary school students believe that the content of a web site is directly related to its domain name.*

The data obtained from the web form as mentioned previously in chapter 5 gave some interesting results. Quite a high percentage of the participants in this part of the research linked an obvious domain name to the content of a site. It can be seen from table 6.6 that the participants in this research clearly believe that the domain name of a Web site is related to its actual content. As mentioned previously in chapter 5, the above domain names have absolutely nothing to do with the Leaving Certificate subject that they are matched with.

Table 6.6

Leaving Certificate Subject	Suggested Domain Name	Percentage
German	www.german.com	44.4
Music	www.music.com	11.1
Biology	www.body.com	20.0
History	www.history.com	16.7
Irish	www.irish.com	10.0
Chemistry	www.chemistry.com	16.7
Maths	www.maths.com	16.7
Art	www.art.com	42.9
Accounting	www.acounting.com	28.6
Economics	www.leavingcerteconomics.com	14.3

The following observations were also noted which further support this hypothesis:

- Some of the participants entered www.englishpope.com and www.religion.com when attempting task1 without any positive results. This would indicate a lack of proper search techniques and the participants believed the domain name was the secret to success.

- www.carlow.ie and www.ireland-map was entered in the address bar to find a map of Carlow. This would also indicate that the name of the web site contained the answer to the task.

This would support the hypothesis that secondary school students believe that the content of a web site is directly related to its domain name.

Hypothesis Six: *Students are being overwhelmed by Information Technology and as a result automatically believe the Internet to be superior to print media for information retrieval.*

It can be clearly seen from table 6.7 above that the Internet was the resource most favoured by the participants in this research. These statistics are interesting in that although the majority of participants state that the Internet is easier to use, easier to read, better overall and faster, this research has shown this not to be the case. Referring back to table 6.1 the library at a 95% significance level, was shown to be significantly faster, took less searches and had a higher success rate than its Internet counterpart. This evidence would clearly support the hypothesis that students are being overwhelmed by information technology and as a result automatically believe the Internet to be superior to print media for information retrieval.

Table 6.7

	Yes	No
Which resource is easier to use?	Internet [72.1%]	
Which is easier to read?	Internet [58.1%]	
Which is better overall?	Internet [76.7]	
Which resource is faster?	Internet [88.4%]	
Which resource do you prefer to use?	Internet [79.1%]	
Which is more fun to use?	Internet [88.4%]	
Do you need special skills to use search engines on the Internet?	[32.6%]	[67.4%]

Hypothesis Seven: *There is a need for an information retrieval skills module to be introduced to the secondary school curriculum.*

A module in which students are taught how to use both the library and the Internet as resources for information retrieval is a proposal that could be considered for the Irish curriculum.   Participants in this research were shown to have limited knowledge of the navigation features of Internet Explorer, rarely formulated an effective search query and only 10% of all searches using the library used the card classification index.   These are all issues that suggest inefficiencies and ignorance in the use of these resources and the introduction of a module to teach correct methods to change perceptions about the library would address these.   The perceptions that the participants had concerning the library can be found in tables 6.8 and 6.9.

Once the negative perceptions about books and the library can be addressed then both resources could be used more effectively in secondary schools.

Table 6.8

What are the disadvantages of the library?

	%
Old information	[20.9]
Dated	[7.0]
Slow	[25.6]
Manual nature	[41.9]
Not enough information	[9.3]

Table 6.9

Which is more fun to use?	Library [7%]
Do you read books?	No [32.6%]
Which resource do you prefer to use?	Library [18.6%]

7 Suggested Technical Solutions

This chapter involves proposing technical solutions to the problems uncovered by this research.   Technical solutions will interest computer scientists and engineers, who are interested in the area of fixing problems and improving existing resources.   It might also be suggested that the following ideas and features are relevant to problems uncovered in previous research for adult users also.

7.1 Proposed technical solutions to information retrieval problems related to secondary school children.

The participants in this study outlined some of the technical difficulties that they encountered with using the Internet as a form of information retrieval. They made the following recommendations:

1. Improve the success rates of existing search engines
2. Make the Internet faster
3. Remove irrelevant information
4. Improve usability
5. Less advertisements
6. Improve the area of natural language queries
7. Have search engines that do not give thousands of results for a query.

They were further asked to outline the disadvantages of the Internet. These included:

1. Slowness
2. Too much irrelevant information
3. Problems with search engines
4. Too many search results
5. Hardware instability
6. Advertisement issues.

The above issues can then be summarised into the following technical areas that the Internet needs to improve:

- Search engines
- Speed of Internet
- Internet content

7.1.1 Search Engines

Even though search engines designed for kids already exist, they also have their shortcomings (Bilal 2001). A possible solution to these might entail the design of a user-friendlier search engine designed for children's needs. This new system should make the search process as simple as possible to use and children should be used in usability tests during the development of the prototype. The following problem areas that were identified were as follows:

- Typing
- Spelling
- Vocabulary

- Search methods

If this search engine incorporated the following features then maximum success might be affected:

1. A spell checker beside the search bar.

2. A thesaurus to help explain complex words.

3. A help menu to explain how the search engine works.

4. A natural query option as well as keyword only queries

5. Information to be classified in a standard way i.e. the Dewey classification system for libraries is an example. Another possible improvement would be to structure the information categories in alphabetical order and use vocabulary specifically targeted at children.

6. Online prompts to be given.

7. Graphical cues should be used to guide children in the right direction.

8. The hit list should be set to a maximum figure as previous research has shown that most users only look at the first page of results. Participants in this research referred the hit list an average of .18 times per search. This would indicate that they were disillusioned with the huge amount of results when they entered a search.

7.1.2 Speed of Internet

1. The slow speed of the Internet was a common source of complaint both from the participants in this research and in previous studies as mentioned in chapter two. Schools should be provided with the proper financial assistance to install high-speed connections such as ISDN, DSL or satellite connections.

2. If students are using the Internet as a means of textual information retrieval they should be made aware that graphics greatly slow down the speed of the Internet. The graphical feature can easily be switched off in Internet Explorer and students should be taught how to carry out this procedure. (It is presumed Internet Explorer is the most common web browsing software available in schools).

3. There are numerous software downloads freely available from the Internet which claim to improve the speed of the Internet. The network administrator could test these as to their real effectiveness.

7.1.3 Internet Content

1. Web site designers should note that the home page of a site dedicated for children is very important, as children often evaluate a website on the first page that they see.

2. A feature could try to be incorporated by web browsers to eliminate all advertisements from web sites viewed. Some of these are already in existence i.e. Junkbuster and AdSubtract software products (CNN 2001).

3. The usability of children's sites should try and be improved, such as always having the search button on the home page (Nielsen 2001). Furthermore this feature should not be placed on the bottom of the home page, as it was observed that only 20% of searches involved the user scrolling to the bottom of a web page.

8 Suggested Teaching Solutions

This chapter involves proposing teaching solutions to the problems uncovered by this research. These solutions are in the view of this researcher logical and feasible to implement. These are of relevance to teachers, curriculum designers and educationalists in general. It might also be suggested that the following ideas and features are relevant to problems uncovered in previous research for adult users also.

1. Participants in this research were asked if they thought that special skills were necessary to use the Internet effectively. 77.4% replied no. This would indicate that students have little understanding of search strategies and methods. A module could be introduced in Computer Applications to teach the following topics:

    i. How to formulate a proper search query.

    ii. Search methods e.g. Boolean.

    iii. The difference between a search engine and a search directory e.g. the differences between Google and Yahoo.

    iv. How to use natural language queries effectively.

2. The Back button was the feature utilised most by the participants in this research. In one question it was used nineteen times during the search process. This would indicate that students are unfamiliar with the navigation features of Internet Explorer and this area could also be addressed in a computer applications module i.e. how to utilise the navigation features of Web browsers.

3. The amount of keywords used in the Internet searches varied in number from 1 to 33. Students should be taught how search engines actually work and how they use keywords to rate sites etc.

4.   Teachers must be taught how to incorporate the Internet more effectively into the classroom.   Useful educational sites and skills to teach the above issues should be incorporated here.

8.1 Schoolchildren do not evaluate information found on the Internet properly.

1.   Students should be taught about manipulation in the media and shown how easy it is to put a website on the Internet. Anybody with a computer and Internet access can post a website, and they do not need to have the following to do so:

- Credentials
- Qualifications
- Identification
- Extensive resources

Students in secondary schools should have to design their own web sites and post them to the Internet. Once they have completed this procedure I believe from my experience in teaching computer applications that the students are amazed how easy the whole procedure is and as a result might evaluate in greater detail the information they find on the Internet.

2.   Crank sites and sites which display false information could be outlined to validate these claims.

3.   Assignments should be given by teachers that require the students to organise and structure the information found on the Internet.

4.   Literacy skills should be promoted so that students read with more accuracy and detail. It was noticed in this research that the participants moved so fast between web pages that they actually missed the correct answers to some questions.

5.   The online voting program that was incorporated into this research could be used by all schools so that teachers and students alike have a readily accessible database of sites from which to choose from when undertaking class assignments.   This would eliminate wasting valuable computer contact time.

6.   Children should be encouraged to take their time and not to aimlessly move from page to page like some of the participants in this research.

8.2 Students' perceptions that technology is the answer to everything.

1.   In this research the participants were asked the following questions about use of the Internet and traditional print resources:

- Which resource do you prefer to use?

- Which resource do you consider to be better overall?

- Which is faster?

- Which is more fun to use?

The vast majority of participants replied the Internet as their answer to the above questions. An information retrieval module should be introduced in either primary or secondary schools to show students that the Internet is not better than the traditional print resources for everything. This research has shown that Questions two, three and five were answered more successfully by the books found in the school library. Assignments should be given so that students can realise for themselves what areas each resource is most suited to.

2.   Increased financial resources should be made available to schools to help them update libraries and to encourage students to utilise them better.

8.3 Credibility issues of information retrieval.

1.   In the post task interview, the participants in this research were asked if they had in the past plagiarised from either the Internet or a book. 53.5% of participants said they had using the Internet, while 44.2% said they had using a book. This would support the findings of Large and Behesti (1998) as mentioned previously in chapter 2. These findings indicate that students must be taught the serious implications of doing such acts and shown how to properly cite and reference material taken from electronic resources.

2.   17.3% of the participants in this research said in the interview that they trusted the information they found on the Internet more than the book. Even though this is not a significant figure, it would support the findings of previous studies (Schacter et al 1998; Small and Ferreira 1994). Students should be referred to sites that are not genuine and shown just how unreliable this information can be.

3.   A related part of this research consisted of the construction of an on line voting form for students to nominate their favourite site for each subject that was available in the

school. As already discussed in chapter five, the students nominated sites even though they had absolutely no reference to school subjects e.g. www.music.com etc. Students must be shown that anyone with Web access and a credit card can register a domain name, and that these names have nothing to do with the actual content of the web site.

9 Further Work

The following areas are worthy of future research:

Hypothesis One: To further investigate hypothesis one, students could be taught a module on information retrieval using either the Internet or the library. Statistics could then be compared on the pre and post task effectiveness of this module.

The levels of anxieties that students and teachers have with technology are worth investigation, as this may have a detrimental effect on the life long learning habits of the current generation of secondary school children.

Hypothesis Two: The actual difficulties that people have with reading text in electronic environments is a topic worth of investigation, as the participants in this research skimmed from page to page without assimilating the information properly.

Hypothesis Three: The issue of graphics as an aid to the information retrieval process is worthy of investigation, as search engine designers could incorporate the results into a prototype aimed specifically at the younger generation.

The whole search process of children is worth investigation. How information is used and assessed, do children actually learn during the search process are topics which have not been covered in detail in previous research.

Hypothesis Four: A detailed survey could be carried out on students in secondary and third level to investigate their attitudes to plagiarism and are they aware of the serious consequences of doing so.

Another interesting area worthy of investigation would be to find out if students are being taught how to cite and reference material properly found in books and the Internet. One suspects that this is rarely taught in secondary schools.

Hypothesis Five: Since the participants in this research were taken from an all boys fee paying school, future studies in this area might consider taking the participants from different socio economic and gender backgrounds.

Hypothesis Six This hypothesis could be further investigated by carrying out more detailed research on why the domain name of a site is linked to its content.

Hypothesis Seven: The search strategies formulated by students is another topic worthy of further research. The effect of proper methods i.e. Boolean on search success could be incorporated here. This results of this hypothesis, if found to be positive, would greatly support the views outlined in this research that a proper module for information retrieval should be introduced into our schools.

A study on what topics impact children's success on information seeking using different resources would greatly help teachers and educationalists to utilise both the Internet and library to their full potential.

10 Conclusion & Recommendations

This study adds to previous ones that show that the Internet has enormous potential as an information retrieval tool for secondary school students. However for this to effectively happen users must be taught the relevant skills and teachers taught how to utilise the Internet and library resources effectively.

This study presented the findings of an original research project that investigated seven hypotheses while observing the searching behaviours of secondary school children in using the Internet and the library to answer five set tasks.

Evidence was found to support the following hypotheses:

- Without proper guidance schoolchildren have difficulty using the Internet effectively as an information retrieval tool.
- Use of the Internet in secondary schools is leading to an increase in plagiarism.
- Secondary school students believe that the content of a web site is directly related to its domain name.
- Students are being overwhelmed by Information Technology and as a result automatically believe the Internet to be superior to print media for information retrieval.
- There is a need for an information retrieval skills module to be introduced to the secondary school curriculum.

Not enough evidence was found to support the following hypotheses:

- Students are not critical enough of the information they find on the Internet.

- Investigation of two information sources a) the Internet and b) the book to determine which is better for secondary school usage.

The library was found to be faster, more efficient and more successful than its Internet counterpart as a means of information retrieval for children in this age group. Since only five tasks were completed these results are deemed inconclusive.

The Irish central statistics office (March 2001) produced a report that stated " The number of Irish households with access to the Web increased by more than 400 percent between 1998 and 2000. The results of the Central Statistics Office's survey found that 262,700 Irish homes had a computer connected to the Internet by the end of 2000, up from 61,100 in 1998. This translates to a home Internet penetration rate of 20.4 percent for the country." Furthermore 81% of these homes stated that the primary use of the computer was for educational purposes. Surely it must be a priority to incorporate proper and efficient usage of the Internet into secondary schools so that these students will not develop life long bad habits in the use of the Internet?

Since the Internet is available in most schools in Ireland and so much money has been spent on educational technology, more knowledge about how search engines actually work should be taught. Boolean searches, the difference between a search engine and search directory, efficient use of keyword searching are all areas that were highlighted in this research that need attention.

It should also be noted that in order for the students to be taught the correct and efficient means of information retrieval, teachers themselves need to given expertise in the area. So far a series of basic general computer skills has been available to teachers but the area of information retrieval has not yet been fully addressed.

This research has also proposed technical solutions to problems observed by the participants while the five tasks were completed. These solutions are of relevance to search engine designers, school administrators and web site designers especially.

Overall there is room for improvement in the use of both the Internet and the library. Both these resources have advantages over the other with regard to special topics. One of the most striking replies to one of the interview questions was that libraries would be obsolete in ten years time. This hopefully will never happen, and as this research has shown, the Internet still has a long way to go before it overcomes the library as a means of information retrieval. Teachers and pupils should be taught how to use both resources to their maximum potential and not disregard one to the neglect of the other. Both still have a vital role to play together as a resource in today's secondary schools.

10.1 Limitations of the Study

The participants in the research were all boys, and would not be representative of all pupils in secondary level education.

The facilities for information retrieval in the school in which the research was conduced were excellent. Not all schools would have such facilities especially the non-fee paying ones, and consequently would not be representative of secondary schools in general.

Only five tasks were set to the participants in this research. This in reality was not enough. An increased number of tasks would increase the validity of the hypotheses.

A software package designed to log the keystrokes and mouse movements would have been a more accurate way of obtaining the research data.

The fact that the researcher was both teaching and residing in the school may have influenced the participant's answers and performance. A researcher that was unknown to the participants may have eliminated any bias.

The participants may have performed better using both resources if they chose the topics themselves to search for information.

The actual query terms used by the participants were should have been recorded to gain an insight into their cognitive processes.

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