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Finding and Evaluating Curricular Resources on the Web for Teaching Junior Certificate Mathematics

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Abstract

This study addresses the difficulties of locating quality curricular information on the WWW focussing on the Irish Junior Certificate Mathematics curriculum.

In the development of efficient searching techniques, an examination of efficient search / metasearch engines, directories, education sites and the Invisible Web was undertaken. The techniques developed aim to provide an overall searching strategy for educators on the WWW. An initial selection of relevant material was located on the World Wide Web and selection criteria were applied, providing predictive ratings by one of the authors. A key element of this study is the development of an adaptive, on-going peer review of the initial selection of resources. Evaluation of the resources based on predictive and or interpretative (observed use) use by educators is invited. A Mathematics resource page supporting the Irish Junior Certificate was developed and published on the World Wide Web (www.iol.ie/~jcmaths) The effectiveness of the searching techniques and the evaluation framework is assessed by teachers.

Introduction

The use of technology in second level schools in Ireland has increased in recent years because of major investment. It is now possible to use technology as a teaching tool to potentially enhance learning in our classrooms. The use by teachers of the Internet in classrooms is in the early stages of development. Like any other teaching tool, use and appropriate use of the Internet as a teaching tool do not necessarily concide: '*There is evidence that it is not easy to make good use of books in classrooms, so it would not be surprising to find that the same is true of new technologies*' (Somekh, 1997).

Mathematics information, matching sections of local curricula, can be found on the Web. Some of these resources are excellent, others are of very poor quality. Research in recent years indicates, however, that Internet use by Mathematics teachers is extremely poor: '*Perhaps the most interesting finding in this section is the sharply lower measures of Internet use and perceived value held by math teachers compared to every other group*' (Becker, Jay; 1998).

Why this is the case is not clear. The literature on the process of integration indicates a complex set of steps in professional development by teachers. The first step in integrating technology in classrooms may include learning to use technology and discovering how it can be used to support the traditional curriculum (Norton &

Wiburg, 1998). Hence, there exists a need by teachers to be able to access easily appropriate curricular resources on the web suitable for classroom use. Some suitable resources for second-level teachers of the Irish Mathematics Junior Certificate curriculum are available on the Web, but not in any structured fashion. This, and the difficulties of locating such resources in the first place for use in classrooms, provided the basis of this study. Consequently, this paper discusses a framework for finding and evaluating curricular resources on the web suitable for the Irish Mathematics Junior Certificate curriculum.

This framework, which forms the remainder of this paper, is outlined below:

> - Developing and evaluating a searching strategy
> - Locating and evaluating suitable Resources
> - Development and Promotion of a Web Resource page
> - Evaluation, Analysis and Results

1. <u>Developing and Evaluating a searching strategy for Educators</u>

Although the information available on the web is increasing daily, the quality of the information is not guaranteed: '*Searching now is at best unreliable. The searcher almost always feels as if they are missing what is really out there that is relevant'* (Jiran, 1999).

Search tools, of which there are many, help to locate information on the World Wide Web for the user. Each search tool has particular advantages and weaknesses:

' *… searchers trying to locate any kind of information on the world wide web are advised to use a variety of tools …'* (Wishard, 1998).

Providing this variety of search tool demands the examination of what tool is 'best' for a given search or situation. This information changes frequently as search tools are updated and become more efficient and productive. Search engines can be loosely divided into a number of main categories, as follow:

> - Single Search Engines,
> - Metasearch Engines,
> - Subject Directories,
> - Educational Sites and the Invisible Web.

A *search engine* is a program that finds other web pages that match user-defined criteria. Each search engine uses a robot or spider to examine web pages and to build up its own database. The information available is restricted to web pages that can be located by a robot. A *metasearch engine* uses a number of search engines to perform the search, simultaneously returning a relevant number of sites from each of the engines. Usually, the most relevant sites are returned from each search engine. A *subject directory* is a categorised list of links selected by individuals expert in the subject area. Specialised *education sites* are web sites which contain information

directly related to educators. The ***Invisible Web*** is directed mainly at researchers and educators. It is a collection of searchable databases in which, up to recently, search engine robots were unable to search. A ***resource page*** contains information and links to related sites containing further information on a specialised topic. The main advantage of resource pages is the ease of access to information focussing on one particular area of interest to the searcher.

The overall searching strategy developed for this study includes five steps.

Step 1 which recommends the use of a single search engine for a typical topic where a wide variety of suitable pages is required.
Step 2 recommends the use of a metasearch engine if Step 1 does not find the information required.
Step 3 recommends when to use and how to use Subject Directories.
Step 4 recommends how and when to use Education web sites
Step 5 recommends how and when to use Directories of searchable databases.

In choosing the top performers in each category for inclusion in the five strategies in this study, up-to-date information on the efficiency and effectiveness of each tool was examined. The top performers were as follow:

- Single search engines: *Google, Altavista, Northernlight and Infoseek*.
- Metasearch engines: *Ixquick, Metacrawler,* and *Ask Jeeves*.
- Subject directories: *Yahoo, About.com, Argusclearinghouse* and *Looksmart*.
- Educational sites: *Scoilnet, Becta, Europeanschoolnet, Searchopolis, Education World, Awesomelibrary* and *Educationindex*.
- The Invisible Web: *Invisible Web, Direct Search* and *The Internets*.

A single web page on the Resource page for mathematics developed for this study provided links from the five main steps to each search tool, with recommendations on formulating search queries and advice on suitable keywords to use with each of the steps. Other links to pages, containing detailed information on each search tool used, were also provided. The searching strategy was piloted and evaluated by practicing second-level teachers.

2. Locating and evaluating suitable resources

A needs analysis was undertaken to examine the technology resource needs of Irish mathematics teachers. A focus group interview, with practicing teachers, was chosen as the most appropriate data collection instrument due to its flexability. The focus group interview emphasised the need for easily accessible resources. The results of the focus group interview also emphasised the need to provide *quality resources*. Consequently, key features of the resource page are :

- Quality information
- Development of searching techniques
- Professional on-going peer review of resources to be included in the site.

A thorough search of the literature and a trawling of the Internet by the first author above resulted in the detection of more than 500 sites of potential interest to teachers of Junior Certificate Mathematics. Using an evaluation scheme developed by her based on the literature and on her extensive experience of teaching Mathematics, these sites were evaluated and the most suitable chosen to be included in a list as a resource page for teachers. The criteria included were those that were important to teachers as indicated by the literature and the focus group interview. The evaluation criteria (defined for the study) chosen were:

- Content
- Presentation
- Closeness to the Curriculum (Irish Junior Certificate Curriculum)
- The level of Interactivity
- Learning Style
- Software Style

The resources to be included in the Resource Page consisted of those sites that matched in some way the Irish Junior Certificate curriculum. The resources also matched some or all of the above criteria and the 'best' of resources available on the web at the time of writing.

3. Developing and promoting the Web Page

The aim was to provide educational information via a web site. The design of the web site was influenced by the focus group interview and the literature.

Figure 1. Home Page

Recommendations from the focus group indicated that the resource page should initially be aimed at teachers rather than students or parents at first.

The page was developed using Macromedia Dreamweaver 3, which is a web authoring tool designed to write the HTML necessary to produce a web page. The use of Flash (for multimedia) was used in the design of the web page to make the page more attractive. The screen captures show the Home Page (Figure 1) and the initial Searching Techniques page Figure 2 (below).

Figure 2. Initial Searching Techniques Page:

This site was made available on the Web (at www.iol.ie/~jcmaths) and over 600 people and organisations were contacted, including every school in Ireland listed as having an email address. On-line questionnaires was made available through the site. Through these on-line questionnaires, personal contacts and mathematics groups approximately 50 results were completed.

4. <u>Evaluation</u>

Visitors to the site were requested to provide feedback on the searching techniques and the evaluation criteria. The on-line forms provided a mechanism for the collection of the data via e-mail. Possible ratings ranged from 'Excellent' to 'Poor'. Participants were also requested to apply the chosen evaluation criteria to a sample twenty one sites on the web and to provide predictive (how useful they thought a site might be) and/or interpretative results (actual observed use with students as to their suitability).

Participants were also invited to rate the importance to them of each evaluation criterion to be used on the sample set of sites. The scope of the questions asked sought to find out what was of prime importance to the practitioner in the classroom when choosing software resources. To collect qualitative data, text boxes were provided to allow participants to return their own views on the search tools and the evaluation criteria. The structure of the questionnaires provided for the return of both qualitative and quantitative data on the searching techniques and the evaluation criteria used in the study.

5. <u>Analysis & Results</u>

5.1 Searching Strategy.

The data returned on the searching techniques and the evaluation criteria were analysed separately. Ratings used in both questionnaires were assigned numerical values using a Likert scale for the purposes of quantitative analysis. The quantitative data were analysed using Microsoft Excel. Pivot tables (multi-dimensional cross-tabulations of the data) were developed allowing different categories to be examined separately or together. An example of the type of analysis performed is shown in Table 1 below.

The pivot table shows the responses on each of the search engines used by participants. The responses as can be seen from the table below ranged from 1 (which rated the search tool as '*poor*') to 4 (a rating of '*very good*'). A small number of returns were placed in a separate column and were given a rating of 3.5. It was unclear whether they were rated '*good*' or '*very good*' and so the average of these was taken. The pivot table includes a threshold rating for the number of participants (in this case four participants). This was done to make sure that at least that minimum number of people looked at the site in order to avoid an unrepresentative view of a site by a very few enthusiastic (or otherwise) visitors.

The average score achieved by each search engine is calculated and is included in the table. As can be seen from Table 1, the highest score was achieved by the single search engine 'Google' (3.13 out of 4) and the lowest score was achieved by Scoilnet (1.67 out of 4).

Three main themes arise from the data provided by participants.

- **Single Search Engines are favoured and Google is the most favoured**. In the qualitative data, 47% of the participants with prior searching experience specifically name Google favourably in the comments section. In the quantitative data, Google; a score of 3 represents a 'Good' search engine and a score of 4 is 'Very Good'.

- **The participants have great (but currently unsatisfied) expectations of Scoilnet.** The participants indicated great interest in the Irish site 'Scoilnet' but at present the site does not appear to satisfy the needs of these participants. The Scoilnet site was examined by 78% of the participants, indicating great interest in the site. It also received the lowest score of all twenty one search sites evaluated in the study.

- **The inclusion of searching techniques in the site was useful and appropriate.** The inclusion of searching techniques in the site has provided help for novice searchers of the World Wide Web. It has also alerted other participants to the availability of other search tools. This has been explicitly welcomed by 45% of participants.

Table 1 : Ratings given to Search Engines

5.2 Evaluation Criteria.

The data returned by participants with reference to the set of evaluation criteria used in the study also provided quantitative and qualitative data. Most of the responses were predictive in nature (rather than interpretative). The analysis produced some quite interesting results. Three sites were particularly popular:

Expertise = All								
Respondent Status = Teacher						**Min. No=4**		
\ Rating Site Name \	**1**	**2**	**3**	**4**	**F**	**Grand Total**	**Average**	
About		2	2			4	2.50	
Altavista	2	3	3		1	9	2.28	
Argus Clearinghouse		1		2		3		
Ask jeeves	1	2	1	1	1	6	2.58	
Awesome				2		2		
Becta	1	3	1	1		6	2.33	
Direct Search		2	1			3		
Education Index		1	1			2		
Educational World			1	1		2		
Euro School Net		2	1			3		
Google		2	2	2	2	8	3.13	**BEST**
Infoseek		1		2		3		
Ixquick		2	3	2		7	3.00	
Looksmart		1		1		2		
MetaCrawler		4	1			5	2.20	
Northern Light	3	1	3	1		8	2.25	
Scoilnet	4	4	1			9	1.67	**WORST**
Searchopolis		2				2		
The Internets		2	1			3		
The Invisible Web	1	2	1			4	2.00	
Yahoo		2	2		2	6	2.83	
Grand Total	12	39	25	15	6	97		

A+	http://www.aplusmath.com/
Accessone	http://www.accessone.com/~bbunge/Algebra/Algebra.html
Worksheet Generator	http://www.math.com/students/worksheet/algebra_sp.htm

Two of these sites were in the very early part of the list of sites provided, which was sorted alphabetically. It is possible, indeed likely, that a common electoral effect was in operation here: participants worked down from the top of the list of sites and as soon as they found a site acceptable to them, they finished the evaluation. It is also likely that the sample set of sites examined by participants was too large and required too much time for participants to evaluate properly. Other, equally good sites (in the opinion of the authors) were ignored. The exception was Worksheet Generator, the description of which was probably sufficient to arouse interest.

5.3 Importance of Evaluation Criteria.

Various analysis techniques were used to determine the importance of the various criteria which might be used in evaluating a site. Respondents had indicated how important they felt that each criterion might be in general. It was felt useful to examine these general attitudes to the various criteria against the actual value given for each site for each criterion by each user who examined a site. In other words, did a participant's perceived value of each criterion, given in the abstract, actually affect that participant's view of an actual site.

This comparison was carried out by producing pivot-tables for each criterion for each site and for each participant that visited each site. In most cases, the general attitude to the importance of a criterion was largely consistent with what the participants said about a site.

For example, if a participant had, in general, stated that presentation was important, in practice a site was rated as good by that participant only if that participant had actually given a good / very good rating to presentation to the site. On the other hand, the attitude to 'Content' in the abstract was inconsistent. A number of participants who had indicated that Content was important / very important rated the A+ site as 'good' or 'very good' when they had rated as 'poor' the content for that site

Examining both the quantitative and qualitative data returned by the participants shows positive results on the set of criteria used in the study. There is no evidence that any individual criterion was considered to be unnecessary when evaluating curricular resources for classroom use.

5.4 Instructional Style.

Looking at the Instructional Styles used, sites were categorised (by the authors) as Constructivist, Behavourist or Mixed (a mixture of Constructivist and Behaviourist). Participants had also chosen their teaching styles from Construcivist, Behaviourist or Mixed ; 'mixed' meant that they used both Construcivist and Behaviourist styles or were unsure as to which category was most appropriate for them. One intriguing result was that no Constructivist participant visited *any* Constructivist site although they all visited behaviourist and / or mixed sites.

6. **Further Work**

This is a work-in-progress. The site was originally presented to the teaching community as soon as it was ready, in Spring 2001; however, this was at the time of a teachers' strike and also at a time of year when there was a focus on examinations. In addition, teachers would not have been likely to modify their work so late in the school year in order to incorporate the use of the resources in the site. In summary, it was not the most appropriate time to garner responses.

It is intended, therefore, to make refinements to the site based on the responses that were received and to submit this to the Mathematics Teaching community during 2002.

Some of the refinements will include:

- Refinement of and addition to the list of sites currently included in the resources, based on feedback.
- Further evaluation of these resources
- Identification of new resources
- Emphasis on interpretative, rather than predictive, evaluation.

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