Innovative Renewable Energy Education Using the World Wide Web

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INTRODUCTION

The World Wide Web is a powerful tool for education. Educators can, with the touch of a few keystrokes, have access to contemporary information and materials to assist them in the teaching and learning process. Yet many teachers find the world wide web a daunting maze full of dead ends and unrealised opportunities despite the best efforts of search engines to locate the most appropriate sites.

Most teachers do not have the skills or the time to view and evaluate even a small fraction of the results from search engines, let alone adapt these materials so that they are suitable for classes which they teach.

The situation is often worse for school children searching for materials for school projects and science fairs or information to help them with their homework. The students are bombarded by the results of search engines, unaware of the reliability issues of the sites they visit and frustrated by highly technical jargon. To complicate matters further, the needs of teachers and students are rarely the same. Despite these substantial problems, there are many sites that are excellent sources of information and materials for teachers and students. Locating them is often more a case of good fortune than good planning in the selection of key words and phrases.

A considerable effort has gone into creating sites to assist renewable energy educators and their students, but there is no overview available to guide beginners to the best sources. It is wasteful of time and resources for energy teachers and students to have to search the whole World Wide Web to find the best sources, although for advanced or esoteric subjects this may still be necessary. One possible solution to this problem is a one-stop shop for teachers and students. This could be single site with an index and links to major World Wide Web resources. The framework for this project already exists within ISES. WIRE, the World-wide Information system for Renewable Energy could provide the host for this service to ISES members and users.

This paper aims to discuss what makes some sites more useful than others and provides examples of the types of information and sites which are most suitable for both teachers and students seeking resources on renewable energy, energy efficiency and global warming. We will also discuss some simple guidelines and strategies, which could be used to create sites and resources, which are suitable for use by educators and students to assist the integration of the World Wide Web into the renewable energy classroom.

THE WEB AS AN EDUCATIONAL TOOL

The internet, specifically the world wide web is a promising technology for use in all levels of education. Whilst some would say that the web is, and has been used as a resource for both teachers and students at all levels for several years, there is still no uniformity in the development of suitable materials for online renewable energy education. For example, a teacher looking for materials on renewable energy for use in the classroom may follow an almost infinite number of search pathways as indicated in figure one.

Although the use of a search engine that enables the user to refine search results there is still no guarantee that all of the refined results are suitable. For example an educator refining the search according to Figure 2 will return 80 sites, of which only three contain materials which are suitable for use in the classroom from that link. A further twelve sites contain links pages, which upon further investigation may or may not prove suitable for use in the classroom setting.

However, by the time the educator sorts through these 80 pages and evaluated them, however briefly, several hours have passed without locating more than a few crumbs of material which may be suitable.
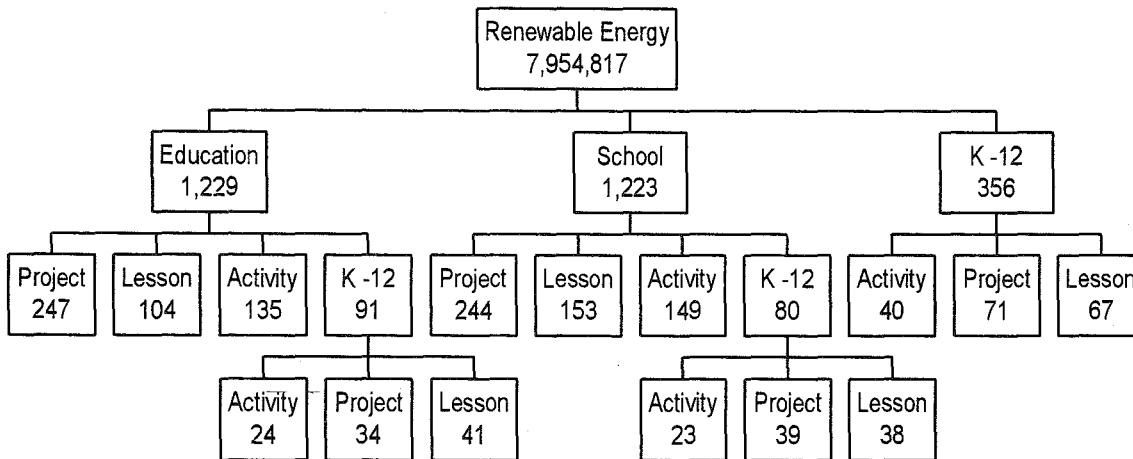
Search Pathways and No of Results Returned

Figure 1. Search pathways for teachers looking for renewable energy education materials using a multilevel search engine
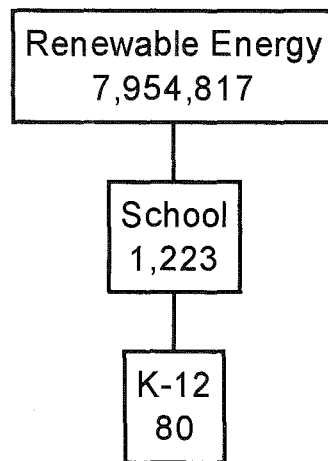

Figure 2. Sample search refinement pathway.

The time consuming nature of the internet is perhaps the greatest impediment facing the widespread use of internet technologies by K-12 educators. While the use of search engines which enable the refinement can reduce the amount of time spent searching for suitable sites, it is still none-the-less hit and miss as a certain amount of knowledge, particularly in the selection of search terms, is required to increase the chances of success in the searches.

INNOVATIONS NEEDED FOR EFFECTIVE ON LINE EDUCATION IN RENEWABLE ENERGY

Whilst the plethora of sites on renewable energy education on the web continue to increase in numbers, there is an urgent need for an integrated site, a one stop shop, for materials specifically designed for K-12 educators so that they are not discouraged from incorporating internet materials in their teaching. However, it is not adequate for a host to simply list a set of links, leading off to every website available. In addition to providing the links, an integrated renewable energy education site needs to provide a detailed classification and evaluation of the materials available from the site.

CLASSIFICATION OF MATERIALS

Prior to inclusion in the website, the materials need to be classified according to the following criteria:
* **Grade level**
What year levels is the material most suited to?

Is the activity/project/lesson modular in design such that advanced students can complete the some activity at a higher level.
*   **Type of material**
Which of the following resource types best describes the material:
General Information
Hands on activity
Complete Lesson
Student Project etc
*   **Themes covered**
What key areas does the resource cover?

A well designed, simple classification system that includes the above criteria will ensure that even novice internet users will be able to extract the information that the educator is seeking. Unfortunately, current generalist search engines do not supply enough information for a quick review of the educational suitability of the site contents, or type of material to be undertaken without the educator connecting to the site.

In addition to a broad classification of the site contents, an evaluation of the materials from both an educational and scientific perspective must be undertaken. It is not simply enough to evaluate the materials from either of the perspectives. Whilst an evaluation from an educational perspective may rate a site highly, there is the potential for the scientific and or technical content to be based on misconception, or incorrect. Similarly, a site which is evaluated from a scientific perspective may rate highly but the information may require significant adjustment prior to being utilised in a classroom situation.

At best, based on current search results returned from just one search engine, this process will need to be undertaken for each of the renewables education related web sites. If no new sites are established, it is reasonable to expect that over 3000 web sites need to be classified and evaluated. By no means a small feat!

CASE STUDIES OF EXISTING SITES
Energy Quest (California Energy Commission)
http://www.energy.ca.gov/education/
Whilst there are no shortage of information sites on renewable energy, the California Energy Commission's, Energy Quest site is one of the better sites for children, particularly young children. The site also has a number of simple science experiments listed under the science projects section, which can easily be adapted for use in classrooms. The site has been well designed and classified into a number of different sections, including: Science Projects, Renewable Road, Educational Resources. The material is not classified according to a suitable age, as much of the site is applicable to a wide ranging audience level.

Alliance to Save Energy - Educators Guide
http://www.ase.org/educators/lessons/index.htm
This site contains a number of well designed, well written hands on activities for use in the classroom and a comprehensive glossary is included in each activity. Unlike the Energy Quest site, this site has graded the materials according to broad classifications - elementary (K-3) and middle (4-7). No materials for advanced or secondary students are yet available from this site.

ACRESchools
http://www.acre.murdoch.edu.au/acreschools
We have been constructing their one website, based around the classification guidelines that we developed. The site has two distinct areas; a student's area which includes hands on activities and investigations for use in school projects, as well as factual information on a variety of renewable energy sources. There is also a site dedicated to teachers which contains background information on renewables, lesson plans, hands on and traditional activities as well as links to a variety of energy related sites.

WHERE TO FROM HERE?
Five key stages in the review process have been identified:

Review Stages
1. Identification of key search terms
Renewable energy, alternative energy, solar energy, wind energy etc.
2. Search engine survey (mulitple search engines)
3. Review of each of the sites

Does the site contain educational materials?
4. Classification of materials
5. Evaluation of materials

Whilst we have commenced a systematic review of web sites on renewables education, new sites are coming on line each day and the end is a long way away and it is reasonable to expect that the number of websites on renewable energy education is likely to double before the evaluation is completed for the K-12 sector. In the future, the same review must also be undertaken for the other key education sectors: Community, Technical and Tertiary.

One could be forgiven in thinking that the review process would continue in definitely, as the rate of site development surpasses the rate of review. Because of this, it is essential that the developers of new websites servicing this market should be aware of the framework so that they can create better sites, which are more suitable and easier to access for educators.

It is no longer enough for developers to believe that their websites will be used once found using a search engine. Indeed, it could be perceived that by listing with a search engine is the only way to guarantee that your site will not be found unless keywords are carefully selected and matched to what educators are seeking.

CONCLUSIONS

Current search engine technology does not allow for educators know how useful the contents of websites returned by a search engine are going to be without visiting the site, examining the materials and making a judgement on how suitable the contents are for the situation which the educator wishes to use the materials. Whilst it would be almost impossible for an educator to know whether the materials are ideal for their particular education setting without visiting a site containing potential materials, getting there is more than half the problem. External pressures in teaching mean that time is precious and that devoting several hours searching the net 'just in case' there is something out there is a luxury that many educators would not have. As a result, existing web pages, no matter how popular they are, how many 'hits' they get each day, or how user, particularly novice, friendly are under utilised because the page didn't return as one of the top results from a search.

As it is unlikely that significant changes to search engines, or the use of keyword meta tags are to be made, there is a definite need for global coordination and linking of renewable energy education websites. Several possible alternatives for this situation exist; Web chains, such as those available through geocities, where a number of sites with information on the same theme, ie solar energy are linked in together. Therefore, an educator needs only to find one of these sites to access the rest. Alternatively, a single site (with mirror sites around the world) with links direct to the others such as a tree could be established.
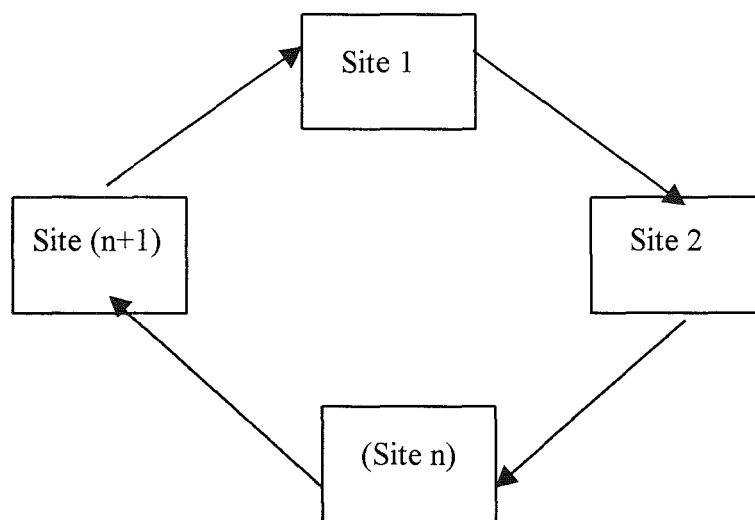

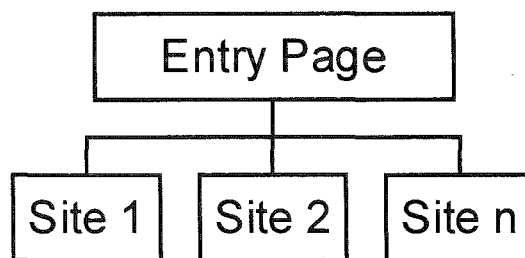**Figure 3.** Schematic of a Web Chain

Figure 4. Schematic of index or links type main page.

Whilst either of these options are available, simplicity should remain the key, and a index type page which includes the results of the classification and evaluation of the linked sites would provide the simplest and easiest to maintain site.

ACKNOWLEDGMENTS