Search for Educational Intelligence in the Web Universe

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Introduction

One of the many ways of using the Internet for learning is to consider the Web as a vast universe of educational material, and to search and obtain material from there. Some of the Web material is made for permanent on-line communication, and some to be downloaded for off-line use. Through a distance education distribution chain consisting of on-line components (downloading) at educational centres and off-line components (CDs, traditional transportation) locally, benefits of the networked world can be enjoyed also by the large number of students who either don’t have an Internet connection at all or whose Internet connection is too slow for permanent on-line use. In fact, some of the Web-originated learning material can be brought to students who don’t even have computers, through printed hardcopies.

In this paper we concentrate on “intelligent” learning material. By intelligence we mean material which has sophisticated information content combined with versatile student interaction (free text, multiple choice, gap filling, graphic evaluation, sound evaluation etc.). We will use the attribute CAL (Computer Assisted Learning) for this kind of intelligent material. We exclude pure documents and textbooks, if they don’t have interactive properties, and we also exclude material providing students with only one type of interaction. For example, “e-learning environments” consisting of only PDF or DOC documents are excluded, and also “interactive study groups” whose only activity is email exchange, are not considered intelligent in this paper.

The problem with the Web is the overload of educational material. There is so much material that it is very difficult and time-consuming to find the suitable ones. To address this problem, we apply Drake’s equation, the simple mathematical tool well-known in cosmology, to determine the probability of finding suitable material for specific educational situations determined by local requirements. Instead of the physical universe, our search territory is the Web universe, and the original cosmological variables of Drake’s equation are translated to variables with educational meanings. We present a case study from a globally typical situation where secondary schools need computer assisted learning material to add value for mathematics and science curricula, and the material is required to be free-of-charge and off-line.

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Selection Process for Learning Material

Educational material obtained from the Web can add value for learning but can also become a failure if the wrong material is selected. Users can enjoy wonderful science simulations and intelligent exercises with fantastic tools for producing them, but also waste their time with technical problems, meaningless mouse-clicking and irrelevant exercises. Relevance of material depends heavily on local conditions, and often materials made for certain environments do not work in another environment. For example, a sophisticated interactive exercise environment which contains sending answers on-line for feedback is a failure for users who don’t have a permanent Internet connection. Failures often feed negative attitude against all computer assisted learning material.

Good learning material is there but it is hard to find. Only a very small fraction of available material is relevant for specific needs. Educational planners are in trouble, and often they solve the problem by giving up search of new materials altogether, and by sticking to well-known old materials. If the laborious task of proper selection of material is done systematically, the process can contain several steps: initial search, pre-assessment, downloads, pre-selection, evaluation and final selection.

Initial search, pre-assessment and downloads can be done by teacher, student, educational planner, school administrator or actually almost anybody who can qualify and disqualify material according to initial criteria. For example, if the required material must be free-of-charge, all materials with a price are omitted without further consideration. If material is needed only for certain language, materials in other languages are omitted. Also, if the material is used by students off-line, materials that require on-line activities (for example interactive exercises that have to be answered on-line) at the user level are omitted at an early stage.

The initially selected material is evaluated thoroughly by a number of curricular experts who get to know the material well and go through various evaluation criteria, often written in the form of a checklist. Many educational authorities have published their evaluation checklists (see e.g. References, Ed’s Oasis) containing items for basic facts and also advanced pedagogical and curricular properties of the material. Before the actual evaluation, it may be useful and time-saving to do pre-selection in a small group of experts so that the material is analysed using basically the same criteria as in the main evaluation, but less thoroughly, and so that only the best materials are accepted for the main evaluation.

The basic facts contain information on price, dependency on Internet connection, instruction language, type (game, quiz, simulation, tutorial, exploration, other), media (text, audio, graphics, animations, music etc.), and suitability for individual students or groups. Evaluators investigate whether the learning materials have been arranged according to any pedagogical purpose, what kind of tracking system there is for exercise scores, what feedback students obtain, and whether the teacher can modify the content. User-friendliness is a central issue, and evaluators observe properties like whether instructions are easy to obtain and understand, whether the material and its parts are easy to start, whether it is easy to move from one part to another saving previous work, whether it is easy to quit and save previous work, and if the program is self-explanatory or not. Evaluators also determine the curriculum area, the subject, the topic or competence, the grade, and assess the relevance of the material to the local curriculum. What complementary material to the taught topics or competencies does the material offer? What information is provided more effectively by the Web material compared to classroom learning? What controversial cultural issues does the material possess? Evaluators observe if authors are claiming to achieve certain objectives, and assess if those objectives have really been achieved, and also assess if any other objectives have been achieved. Shortly put, evaluators assess to what extent the material has "intelligence". Finally, evaluators write overall comments such as "recommended", "recommended with reservations", "not recommended" etc.
Drake's equation

For the SETI (Search for Extra Terrestrial Intelligence) research, one of the theoretical starting points is Drake's equation, a simple tool for estimating the probable number of civilisations (communities with intelligence) in the universe,

\[ N = n \times p \times l \times i \times c \times t \]

with variables

- \( n \) = number of stars in the universe
- \( p \) = fraction of stars having planets
- \( l \) = fraction of planets supporting life
- \( i \) = probability of intelligence developing on a life-supporting planet
- \( c \) = probability of intelligence communicating with us
- \( t \) = probability of a civilisation overlapping in time with us

Drake’s equation is a popular tool in cosmological discussion, and the obtained results for \( N \) fluctuate heavily, usually between one and one million, depending on values given to the variables.

Instead of the physical universe, we apply Drake’s equation to the universe of educational material on the Web. Concepts of "star", "planet", "life", "intelligence", "communication" and "civilisation" will have new meanings relating to properties of the educational material. The meanings can be chosen in a creative manner useful for a specific situation, and in some cases it may be necessary to use more variables which would then become additional coefficients on the right side of the equation.

A natural way to choose educational meanings for the variables would be to identify stars with main pages of educational websites, and planets with linked pages to the main pages. The natural meaning for the concept of life would be the "living" educational content on a webpage, i.e. the real educational "beef", something more than just titles, subtitles and links to other pages. Intelligence is the most important concept, which in educational application would mean possibilities for user interaction, feedback, various types of communication, and actually all the properties that evaluators look for during the earlier mentioned selection process of educational Web material. Instead of only one variable for intelligence, we could also do a more detailed analysis and use several variables, more or less corresponding to items in evaluation checklists.

The concept of communication would have the natural meaning, i.e. the material would either communicate in a desired language or not. The concept of civilisation could mean for example some existing curriculum, and overlapping could mean matching it. All the remaining properties of the material such as price, on-line/off-line usability etc., would have to become additional variables in Drake’s equation.

A Case Study: secondary education in Sri Lanka

A hands-on case study was done during the SEMP (Secondary Education Modernisation Project, funded by Asian Development Bank and Nordic Development Fund) in Sri Lanka, where off-line free-of-charge mathematics and science computer assisted learning material for grades 10–13 in Sri Lanka secondary schools was required. The material was required to be intelligent in the sense of versatile student-machine interaction and sophisticated multimedia presentation of science topics, and to communicate in English, Sinhala or Tamil.

In the Sri Lanka context it is essential that the selected CAL material works off-line, since the Internet is practically not used at all in schools, but off-line computer centres have been established in hundreds of schools already. In the SEMP project, one of the components is to collect free-of-charge off-line CAL material from the Internet, select the best ones, and distribute them to schools on CDs.

Using Drake’s equation, we tried to estimate the probable number of CAL packages on the Web suitable for requirements of the SEMP project. We considered the equation in the following form,

\[ N = C \times O \times F \times I \times E \times S \]

Where the new meanings for the variables are formulated so that they correspond as much as possible to the needs of the Sri Lankan situation, and they are closely related to the checklists in the earlier mentioned selection process:

- \( C \) = total number of CAL material packages on the Web
- \( O \) = fraction of off-line CAL material
- \( F \) = fraction of free-of-charge CAL material
- \( I \) = probability of CAL material having intelligence in the sense of versatile student-machine interaction and sophisticated multimedia presentation of science topics
- \( E \) = probability of CAL material communicating in English, Sinhala or Tamil
- \( S \) = probability of CAL material matching with the up-to-date Sri Lankan curriculum of mathematics and science for school grades 10-13
Note. Naturally these educational meanings of the variables in Drake's equation are only one suggestion trying to match the specific situation in Sri Lanka, not necessarily for any given educational situation. Even for the Sri Lanka case, different definitions for the variables are of course possible. For other situations, meanings of the variables should be determined case by case, although one may actually find educational environments especially in the developing countries and NIC (nearly industrialised countries) that may not differ much from the Sri Lanka setting.

Obviously, none of the values for the variables were precisely known, but during a workshop we tried to find estimations that we believed were close to reality. As a result of discussion with national and international experts, we decided to use the following values:

\[ n = 1,000,000 \]
\[ p = 0.5 \]
\[ l = 0.5 \]
\[ i = 0.01 \]
\[ c = 0.4 \]
\[ t = 0.02 \]

Substituting these values, the equation gives the result 20 for the number \( N \). This means that the estimated number for CAL materials on the Web suitable for the requirements of the SEMP project would be around 20. We also tried some slightly different values, and reached the conclusion that a correct result would be a number between 10 and 100.

The given estimations for the values of the variables are a crucial factor for the whole process. They are also a potential weak link, because they can also be far from being correct. With an accumulated amount of information on the Web it will be possible to obtain much more accurate values at least for the generally interesting variables such as the fraction of CAL material available in English and the fraction of free-of-charge CAL material.

In the Sri Lanka context, CAL material is very much needed for computer learning centres in schools. The estimation provided some perspective for the ongoing efforts and also provided background information for decisions on how to balance local CAL production with material downloaded from the Web. The local production has started, based on needs of material determined by local curriculum experts. The downloaded material has been evaluated continuously in workshops by local curriculum specialists, and, according to the latest information, until now 5-10 packages of material have reached the “recommended” status. These findings contain virtual laboratories at the Edmark.com website, the Hot Potatoes teachers’ tool and a cell biology software package at the Mypondsoftware.com website. All these plus some other materials among the pre-selected batch have been saved on a CD by the National Institute of Education, and distributed to schools, completing the "distance education chain" of on-line and off-line distribution components.
Conclusions

The Web can provide added value to curriculum, through excellent educational materials, and plenty of intelligent material is available also for those students who are not permanently on-line, and even for those who are totally off-line. Because the Web is overloaded with material and it is easy to obtain unsuitable materials from there, efficient evaluation and selection is extremely important. Evaluation criteria depend on characteristics of each situation. Our approach of estimating the number of suitable material for a given educational situation based on Drake’s equation can be used as a theoretical tool for selection of actually any material on the Web, and results can be applied to both face-to-face and distance studies. Obtained estimations provide some background information in the area where decisions are often based on vague intuition and individual experience. In some cases, the method may contribute in providing ways for using distance education components in off-line environments.

References


1. Desarrollo local sustentable
Del 2 al 27 de febrero
Objetivos:
Analizar experiencias nacionales y de los participantes en educación de adultos para el desarrollo local sustentable.
Capacitar en metodologías participativas de trabajo educativo con comunidades.

2. Formación de formadores
Del 8 de marzo al 2 de abril
Objetivos:
Ofrecer a educadoras y educadores formación actualizada, con perspectiva de aprendizaje a lo largo de la vida, centrada en el proceso de construcción de la identidad personal y profesional, liderazgo, manejo y resolución de conflictos para desarrollar el autoconocimiento, la creatividad, la convivencia, actitudes y valores.

3. Alfabetización y ciudadanía
Del 17 de mayo al 4 de junio
Objetivos:
Promover un espacio de reflexión en torno a las implicaciones de una visión amplia de alfabetización en el ámbito de la educación básica con personas jóvenes y adultas.
Apoyar la planeación, desarrollo y evaluación de proyectos que respondan a las expectativas de aprendizaje de las personas y comunidades en un marco de equidad y respeto a las diferencias.

4. Gestión de programas de educación básica de personas jóvenes y adultas
Del 7 de junio al 2 de julio
Objetivos:
Analizar los principios teórico-metodológicos para desarrollar, administrar y aplicar en programas en el campo de la educación de adultos.
Recuperar, sistematizar y proponer mecanismos para la socialización de experiencias educativas locales y nacionales.

5. Evaluación de la calidad educativa
Del 20 de septiembre al 15 de octubre
Objetivos:
Formar facilitadores de procesos de evaluación de la calidad en aspectos teóricos, metodológicos, cuantitativos, cualitativos y tecnológicos.
Desarrollar competencias en el diseño de estrategias de evaluación del impacto social de los programas educativos a través de metodologías participativas y con enfoque humanista.

6. Sistematización de la práctica educativa
Del 25 de octubre al 19 de noviembre
Objetivos:
Formar facilitadores de procesos de sistematización en aspectos teóricos, metodológicos y tecnológicos.
Analizar los procesos de transformación social e institucional involucrados en los procesos de sistematización de enfoques y prácticas educativas en el ámbito de la educación de jóvenes y adultos.

Las actividades aquí mencionadas están sujetas a cambios. El CREFAL se reserva el derecho de suspender la actividad académica si no se reúne un número adecuado de participantes.

EL CREFAL construirá propuestas educativas en conjunto con los países de América Latina y el Caribe. Las actividades mencionadas en este folleto forman parte del Programa Regular del Centro, en breve haremos llegar las correspondientes al Programa Abierto.

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