

The Digital Water Library Project (DWEL): *A NSDL K-12 Collection*

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1. INTRODUCTION

"Imagine an interdisciplinary educational resource that allows you to rapidly discover the instructional materials you need; connects you to real-time or archived Earth databases; delivers resources in a format that can readily be used in your classroom, and includes the training you need to use these resources" (DLESE Community Plan, June 2000).

2. OVERVIEW

DWEL is the first major collection building effort to bring high quality, K-12 resources into the Digital Library for Earth Systems Education (DLESE). Efforts are currently underway to provide teachers, students and informal educators with easy, searchable access to over 500 exemplary digital resources related to the science, policy and economics of water by the end of 2003. A discovery tool will allow users to search the library catalogue by content area, grade level, resource type and the national science standards to obtain the resources they desire. The selection of these exemplary resources, which best support teaching along core science concepts, is being conducted by experienced, practicing K-12 teachers who best know the needs of their peers and their students.

3. THE DWEL COLLECTION

There are millions of digital science and education resources on the Internet. A few of these resources are excellent, many more are at best average, and some are simply terrible. For K-12 educators, students, and parents with little time and diverse needs, finding the high quality resources they need,

when they need them is often a difficult and daunting task. As National SMETE Digital Library (NSDL) efforts evolve, there is an urgent need to build a prototype collection of digital resources that complement existing collection efforts, but focus specifically on the needs of K-12 users. The three primary goals of the DWEL project are:

- Goal 1: Create a collection of approximately 500 'exemplary' K-12 water resources (scientific, economic, and policy) that can be used to investigate and learn about important water concepts, processes, and issues.
- Goal 2: Develop and test a model for the adaptation, enhancement, inclusion, and support of existing curriculum resources in DLESE.
- Goal 3: Conduct research on collaborative collection processes critical to building high-quality, user-friendly K-12 collections.

4. WHY WATER?

One of the stated goals of the NSF's NSDL collections efforts is to promote cooperation with other collection projects and with the Core Integration project. A water theme was chosen because:

- Water has relevance across all the sciences, geography, and engineering.
- Water concepts and issues are central to science and geography content standards.
- Water has important societal implications in terms of economics, policy, and the environment.

4.1 Water in the Content Standards

Water concepts, processes, and issues are central to K-12 content standards in the physical, life, and earth and space sciences (NRC, 1996), as well as geography (Bednarz et al., NGS, 1994). For example, in the early grades, students learn about water in its liquid, gas, and solid states, study floating and sinking, observe clouds and weather, and learn that water is a basic need of animals and plants. In later grades, students learn about the water cycle, the role of water in ecosystems, and water as a natural hazard. Older students investigate

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more abstract water-related concepts like evaporation and condensation, porosity and permeability, and water as a solvent. Water is also an ideal topic to engage K-12 teachers and students in field-based projects that have a web-based component like GLOBE, River Watch, or the Jason Project. Plus, when students measure, calculate, and predict such phenomena as regional variations in rainfall, groundwater use and recharge rates, and sea-surface temperature fluctuations, they learn core concepts and content standards in mathematics (NCTM, 2000).

5. SURVEY OF USER NEEDS

To ascertain what K-12 teachers want in a Digital Library, a survey of 179 elementary, middle, and high school science teachers was conducted at the 2001 NSTA meeting in St. Louis. Approximately 44% of the respondents were high school teachers, 39% were middle school teachers, 9% were elementary teachers, and 9% were administrators. Background data was collected on: (1) classroom demographics, (2) current teacher and student use of technology in the classroom, and (3) the types of resources teachers would like to be able to find and use on the Web. Teachers were also asked about the water-related resources they currently use in their classrooms.

The results of the survey include the following:

- 80 to 90% of K-12 students and science teachers have access to the Internet in their classrooms. A majority also has access in school computer labs and libraries.
- The resources most frequently used to teach and learn about water are textbooks and curriculum activity books, followed by project-based curricula like Project Wet, RiverWatch and GLOBE.
- Internet based resources including data and graphics are used in some classrooms with NOAA, NASA, USGS, and EPA being the most frequently visited sites for these resources.
- The majority of science teachers in all grades use the Internet less than 2 hours/week for instruction but more than 5 hours/week for personal use.
- 70% of students use the Internet less than 2 hours/week to do assignments.
- Content background information (92-98%), lesson plans or units (74-85%) and data for students to use (74-81%) are the most commonly searched for resources on the Web by science teachers at all grade levels.
- Good graphics and animations available on the Internet are used by 50% of elementary teachers, 64% of middle school teachers and 75% of high school teachers.
- Elementary and middle school teachers have a greater interest in web-based teaching tips and pedagogical strategies (54-57%) than do high school

teachers (41%), while high school teachers have a greater interest in web-based professional development resources (49%) than middle school (36%) or elementary (23%) teachers.

- Web-based information on Standards is of interest to 32% of high school teachers, 27% of middle school teachers, and 29% of elementary teachers.
- Teachers at all grade levels, whether they use the Internet a great deal or hardly at all, believe that the Internet is a valuable tool for finding effective teaching materials.

In written survey comments, teachers indicated that they wanted to be able to find free, high quality resources in a short amount of time, particularly in subject areas that they were not familiar with and which would help their students meet proficiency with district and state assessments.

6. WORK PLAN

6.1. TASK I: Creating the Collection

There are three basic tasks in creating the DWEL collection:

- Identifying Resources
- Reviewing Resources
- Cataloging Resources

Initial DWEL K-12 collection efforts focus on those resources identified by teachers in our recent survey, as being of greatest interest to them. These resources include:

- Content information (scientific, economic, and policy) on a variety of water concepts.
- Materials for teacher development (e.g. lesson plans, curricula, and assessments that are grade level appropriate and connected to standards, teaching tips and pedagogical "best practices" for using digital materials in the classroom).
- Data sets, images, simulations, and models that can be readily understood and used by students.

Collection efforts will be guided by teachers and scientists who participate in "working groups" for grades K-4, 5-8, 9-12, and informal science.

6.2 Reviewing Resources

All water materials recommended for inclusion in the DWEL collection will undergo a basic level of review. In addition, to mining existing digital collections, recommendations for "good" water resources will be solicited from teachers, students, parents, scientists, and social scientists (e.g. policy makers, and economists).

6.3 Level One Review Criteria: (Basic)

- Digital Format: All resources must be accessible on the Web
- Content Focus: All resources must be about some aspect of water science, policy, economics, and/or societal impacts.
- Audience Appropriate: All resources must be appropriate for students in grades K-12 or the general public.
- Accessibility: Resources must be freely available and easy to find and use.

6.4 Level Two Review (Advanced)

At the heart of the DWEL collection effort will be a rigorous review process that allows us to identify "exemplary" digital water resources at each grade level and in informal learning settings. Initially (i.e. during the first six to nine months), only selected water materials will undergo this more rigorous and time-consuming level of review. This will give us time to test and modify our review criteria and processes before applying this level of review to the remaining set of recommended resources.

While some variation exists depending on the type of resource being reviewed and the purpose for the review, the list developed for the DLESE Community Plan (2000) is a reasonable approximation of what many different groups consider to be important review criteria.

6.5 DLESE Review Criteria (from the DLESE Community Plan, page 30)

- accuracy, as evaluated by scientists;
- importance/significance;
- pedagogical effectiveness (e.g. is there evidence student learning has occurred?);
- well-documented (e.g. data shall have metadata, lessons shall have rubrics, etc.);
- ease of use for students and faculty;
- inspirational or motivational for students; and
- robustness/sustainability.

For the DWEL collection with its emphasis on K-12 resources 'grade-level appropriate', and 'connection to science standard(s)' will be added as important review criteria.

6.6. TASK II: Enhancement, Inclusion, and Support of Existing Curricula

Parallel to the collection, review, and cataloging of existing digital resources, we will develop a model for the adaptation, enhancement, inclusion, and support of existing

curricular materials in the DWEL Collection. This model will be based on National Science Education Standards and will provide an example of how originally non-digital materials can be adapted to a digital environment and integrated into the K-12 curriculum. NSTA, the premier national professional organization for science teachers, will lead this effort.

The NSTA publication, *Earth: The Water Planet* (NSTA, 1989) will be the starting point for this model. We will make use of *Atlas of Science Literacy* (AAAS, NSTA, 2001) and the *National Science Education Standards* (NRC, 1996) for content and structure.

6.7. TASK III: Research on the Collaborative Collections Development Processes

Participation of the science education community is crucial to the success of DWEL's community-led collections development effort. Therefore, one goal of the DWEL research is to understand community participation processes with respect to collection, review, cataloging, and adaptation of resources for inclusion in the DWEL collection. A more specific objective, is to identify features of DWEL community practice, in particular the roles of 'technology use mediators' and the recruitment of new volunteers, that will (a) be scalable and (b) be capable of autonomous growth.

7. CONCLUSIONS

Information about Digital Water Library Project as it develops can be found at:

<http://www.csmate.colostate.edu/projects/DWEL.html>

8. ACKNOWLEDGMENTS

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