

A Digital Library For Geography Examination Resources

Lian-Heong Chua
Environmental and Water Res. Dept.
School of Civil and Environmental
Engineering
Nanyang Tech. University
Singapore 639798
clhchua@ntu.edu.sg

Dion Hoe-Lian Goh, Ee-Peng
Lim, Zehua Liu
Centre for Adv. Info. Sys.
School of Computer Engineering
Nanyang Tech. University
Singapore 639798
{ashlgoh, aseplim,
aszhliu}@ntu.edu.sg

Rebecca Pei-Hui Ang
Psychological Studies
National Institute of Education
Nanyang Tech. University
Singapore 637616
phrang@nie.edu.sg

ABSTRACT

We describe a Web-based application developed above a digital library of geographical resources for Singapore students preparing to take a national examination in geography. The application provides an interactive, non-sequential approach to learning that supplements textbooks.

Categories and Subject Descriptors

H.3.7 [Digital Libraries]: *Systems issues, User issues*; K.3.1 [Computer Uses in Education]: *Computer-assisted instruction*.

General Terms

Design

Keywords

Geography, Education, Examination, Digital Libraries

1. INTRODUCTION

Students in Singapore undergo four or five years of secondary-level education after which they take the Singapore-Cambridge General Certificate of Education 'Ordinary' (GCE 'O') level examination. This is an annual national examination covering a variety of subjects such as mathematics, the sciences, literature, geography etc. Depending on the results obtained, students are then admitted to various higher-level educational institutions such as junior colleges and polytechnics [4].

Students studying geography are assessed on their ability to correlate different topics rather than being able to regurgitate the contents of a textbook. They are required to demonstrate reasoning skills, have the ability to select, organize and interpret geographical data, recognize patterns and deduce relationships. It is also hoped that the geographical training will help students make judgments that demonstrate sensitivity and concern for the environment.

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee.

JCDL'02, July 13-17, 2002, Portland, Oregon, USA.

Copyright 2002 ACM 1-58113-513-0/02/0007...\$5.00.

The instruction of geography is currently textbook-based supplemented with electronic resources. In addition, students are particularly interested in working on past-year examination questions and perusing their solutions. With these, students are able to see examples of the types of questions typically covered in the GCE 'O' level geography examination, look at possible solutions, judge the relative importance of certain topics, and even spot "trends" in the types of questions asked.

Past-year examination solutions are currently sold as books organized by year and/or topics. While relatively popular, these solutions have several shortcomings. In particular, students try to determine important areas in the examination and then focus only on them. As a result, students become "exam smart", knowing only how to answer certain questions but not necessarily demonstrating an understanding of the subject. Further, because these solutions are produced by independent publishers, some answers may not be correct. Teachers are usually not able to discover all errors due to the range of publications available. Consequently, students who are not discerning will simply accept all solutions as correct.

Nevertheless, past-year examination solutions when properly used with existing teaching materials can be a useful educational resource. For example, teachers could first locate or author acceptable solutions and supplement them with related topics for students to explore. We are investigating such an approach to geography education by developing a Web-based application containing past-year examination solutions supplemented with additional geographical content. This application is built above G-Portal [3], a digital library providing services over geospatial and georeferenced resources.

2. THE COLLECTION

The GCE 'O' Level geography examination is broadly classified into the following three themes, namely *Physical Geography*, *Human Geography*, and *Map Reading and basic techniques* [2].

The current version of the digital library focuses on two areas in Physical Geography: *weather and climate*, and *natural vegetation*. Examination requirements for these areas are broad, and solutions and their associated resources are developed in cooperation with experienced geography teachers who know how much depth and breadth to provide for each question.

We utilize G-Portal's *projects* and *layers* to populate the digital library. Projects are user-defined collections of related resources. Resources within projects are further organized into layers which

allow finer grained organization of content. Typically, projects are first created for each examination question and solutions are authored. Next, supplementary resources providing sufficient breadth and depth of coverage are located on the Web or created if necessary. Resources are then organized into appropriate layers and associated with spatial attributes if they will appear on G-Portal's *map interface*, or inserted into a solution-specific classification scheme for those that will appear on the *classification interface*. Projects are tested and finally published into G-Portal, after which students will be able to access them.

3. ACCESSING EXAMINATION SOLUTIONS

We discuss how a student would use G-Portal as a tool for studying geography by considering the following two past-year examination questions (with solutions) found in G-Portal's collection of examination questions. Due to space constraints, only a brief description of each question will be given.

- **Question 1.** An image with two forest profiles is shown. Forest A has a dense vegetation growth, consisting of thick underground growth, trees with thick trunks, closely spaced with heights ranging from 15m to 45m. Forest B is comparatively more open and less luxuriant, with little undergrowth and the tree trunks are more slender. The heights of the trees are between 12m to 35m. Students are required to identify the forest types and suggest possible locations of such growth. They are also required to describe the main differences between the two profiles in terms of forest structure and tree type.
- **Question 2.** A list of features is provided and students are required to identify which are characteristics of the natural vegetation found in equatorial rainforests.

In a typical usage scenario, solutions are first retrieved through the classification interface which provides a topical listing of available examination questions. When the student selects a question (e.g. Question 1), G-Portal loads the associated project and displays the resources either on the map or on the classification interface depending on the nature of each resource. As discussed in [3], G-Portal provides two interfaces for visualizing resources. The map interface displays resources with spatial attributes while those without spatial attributes are displayed using the classification interface which categorizes and presents resources using project-specific classification criteria. The map and classification interfaces are synchronized so that when a resource on one interface is accessed, related resources on the other interface can be displayed.

By convention, projects have a separate *solutions layer* containing the answer to the examination question, with supplementary resources in other layers. For Question 1, the solutions layer identifies regions such as Central and South America, Africa, and Southeast Asia as those with tropical rainforests (Forest A) and countries such as Australia, India, Bangladesh and China as those with tropical monsoon forests (Forest B). At the same time, the classification interface presents general characteristics of these forests as part of the solution, for example, tall trees with a continuous canopy and little undergrowth.

Supplementary resources such as those describing the climate types where tropical rainforests and tropical monsoon forests are found are displayed in separate layers for the student to explore.

Note that these resources are determined by teachers familiar with the topic as well as the GCE 'O' level geography syllabus.

G-Portal provides several map-based navigation tools such as zoom and pan for browsing. Using these tools, the student explores the map, viewing the various resources available. Since layers may be shown or hidden, the student may first choose to hide all layers except the solutions layer. After viewing the answer, the student displays the other layers, thus presenting the examination question within the context of the topic of vegetation types and the climatic regions they grow in.

Relationships may also be drawn across examination questions when a resource for a particular solution contains a reference to another examination question. In the scenario, the student viewing a resource about equatorial climates (where tropical rainforests grow) notes that it contains a reference to a question about the characteristics of equatorial rainforests (Question 2). Upon following that reference, G-Portal loads and displays the project associated with that question. The ability to find related information including examination questions provides a further benefit to students over print versions of solutions. With print, students tend to study solutions in isolation. Using G-Portal however, students are able to gain a broader perspective of the geography examination as well as the subject itself.

4. CONCLUSION

A major difference between our work and other geography-oriented digital libraries such as ADEPT [1] is that we aim to promote learning through a "bottom-up" approach in which we first assist students with examination revision, and then provide related concepts for them to investigate, allowing students to draw associations between various geographical issues and developing their reasoning skills. We are hopeful that this project will not only serve as a means to assist students in their study of geography, but also as a generic interface for other academic subjects.

5. ACKNOWLEDGMENTS

This work is funded by SingAREN Project M48020004. The work was conducted when Ee-Peng Lim was a visiting professor at the Dept. of Systems Engineering and Engineering Management, Chinese University of Hong Kong.

6. REFERENCES

- [1] Coleman, A., Smith, T., Buchel, O., and Mayer, R. Learning spaces in digital libraries. In *Proceedings of the Fifth European Conference on Research and Advanced Technology for Digital Libraries* (Darmstadt, Germany, September 2001), 251-262.
- [2] Geography: Singapore-Cambridge GCE Ordinary Level (Subject 2232). <http://www.moe.edu.sg/exams/syllabus/2232.pdf>.
- [3] Lim, E.P., Goh, D., Liu, Z., Ng, W.K., Khoo, C., Higgins, S.E. G-Portal: A Map-based Digital Library for Distributed Geospatial and Georeferenced Resources. To appear in *Proceedings of the Second ACM+IEEE Joint Conference on Digital Libraries* (Portland, Oregon, July 2002).
- [4] Ministry of Education: Secondary Education. <http://www1.moe.edu.sg/secondary.htm>.