

# **The role of Digital Libraries in learning about environmental identity through solving Geographical problems**

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## **Abstract**

Environmental identity or how we orient ourselves to the natural world, leads us to personalize abstract global issues and take action (or not) according to our sense of who we are. Indeed, the often emotional nature of environmental conflicts can be associated with our sense of personal and social identity. Are we willing to give up our SUV for a more fuel-efficient car albeit our knowledge about the enhanced greenhouse effect? (Clayton and Opatow, 2003). In an era where web-based student-centred inquiry is gaining popularity as a mode of teaching and learning about environmental issues and potentially developing students' environmental identities, the role of digital libraries as delivery trucks (terminology by Clark, 1983) needs to be understood better. An obvious affordance of such a digital library is that it organizes information around themes for problems to be solved. A developmental project to build a first digital library for Geographical assets was undertaken. This digital library (G-Portal) serves an active role in a collaborative learning activity in which the students conduct a field study of an environmental problem, within a geospatial context – in this case, beach erosion and sea level rise. G-Portal not only functions as a digital library of information resources, it also provides manipulation and analytical tools that can be used on the information provided. The concept of personal project space allows individuals to work in their personalized environment with a mix of private and public data and at the same time share part of the data with their team members. This allows students to explore the information, process the information, solve the problem posed and perhaps even form new understandings and reflections of their role in the natural environment.

## **Background**

Based on the definition that environmental identity is how a person orients him/herself to the natural world, understands and personalizes abstract global issues and takes action (or not) according to their sense of who he/she is, then environmental identity constitutes environmental knowledge, understanding and actions.

While environmental identity provides the context for understanding human behaviour in response to abstract environmental global issues, environmental identity as such is not “taught” in the Singapore education system. Rather, it is “infused” within the curriculum. In fact, environmental education in Singapore is an informal entity within the education system in which knowledge, attitudes and skills associated with the environment are indirectly incorporated within the mainstream curriculum subjects, in particular, Geography.

As early as 1972, a first concerted international effort to promote environmental education emerged at the United Nations Conference on Human Environment at Stockholm. Recommendation 96 of the Stockholm conference called for the establishment of an international programme in Environmental Education as one of the most critical elements to address the world's environmental crisis. By 1975, the International Environmental Education workshop at Belgrade established an Environmental Education Charter which provided the global framework, goals, objectives and strategies for Environmental Education. The goal of Environmental Education was to “develop a world population that is aware of, and concerned about, the environment and its associated problems, and which has the knowledge, skills, attitudes, motivations and commitment to work individually and collectively toward solutions of current problems and the prevention of new ones”.

In particular, the fourth guiding principle of the Belgrade charter states that environmental education should emphasize active participation in preventing and solving environmental problems. The students' task in this study involves solving an environmental problem – impending coastal erosion at a local recreation area associated with global sea level rise.

In Singapore, environmental education is infused through the curriculum to attain three main aims of knowledge related to environmental issues, attitudes to develop a greater sense of personal responsibility and concern for the environment and to change their behaviour to include care and concern for the environment. The approach is still largely informal and the tasks within this study provide opportunity for these aims to be attained.

In addition, the International Charter on Geographical Education published by the Commission on Geographical Education of the International Geographical Union in 1992 (International Geographic Union, 1992) calls for Geographic Education to ensure that individuals become aware of the impact of their own behaviour and that of their societies, have access to accurate information and skills to enable them to make environmentally sound decisions, and to develop an environmental ethic to guide their actions.

An obvious affordance of a digital library to environmental education is that it organizes information around themes for environmental problems to be solved. Unlike learning management systems that allow the instructor to organize resources in a predetermined structure which prescribes a fixed learning strategy, digital libraries allow the users to take control of their choice of resources, choosing ways of representing and using the resources, creating new resources and even developing their own learning strategies. The G-portal developmental project was initiated as an attempt to improve on the existing capabilities of digital repositories and the move into multimodal representations, in that it hosts digital assets that will be used by students to solve an authentic problem based on real world resources. This allows students to explore the information, process the information, solve the problem posed and perhaps even form new attitudes and reflections of their role in the natural environment.

Although the literature in environmental education refers to knowledge, attitudes and behaviour, this paper re-examines attitudes and behaviour as understanding and actions. While actions clearly indicate behaviour, attitudes may not be directly observable or measured. It is the understanding of environmental issue that will lead to creation of environmental attitudes. Indeed, the test items in Tan (1996) that are classified as attitudes can be aptly described as environmental understanding. Hence, this paper will examine the students' environmental identity through environmental knowledge, understanding and actions that arise when they are

asked to perform a task using G-portal. In addition, the capabilities that support the formation or reinforcement of environmental knowledge, understanding and actions will also be discussed.

## **Method**

The central research question for this study was “How do students acquire environmental knowledge, understanding and behaviour while using the G-portal in their task?” A qualitative methodology to describe how the students using G-portal acquire the knowledge, attitudes and behaviour consistent with the goals of environmental education is used. The students were given a task of using available geographic data to solve an authentic problem for a resort development consultancy. The detailed task is given in Figure 1 below.

As part of your familiarization with using the G-portal, please complete the following task:

You have been asked to examine Profiles 6IV, 6V, & 6VI by a resort development to assess the state of this stretch of beach at ECP. In particular, why do you think the beach profiles looks different at different times of the year? Investigate this question using the G-portal and other online resources. Present your report (using MS Word or MS Power Point or any other supporting software) to explain your findings. You should include visuals where necessary to illustrate your point. Visuals can be gathered form the G-Portal and from the internet. Remember that your target audience is the developer of the resort.

While working on the task speak aloud and verbalize your thoughts on what you are thinking on doing, what you are doing etc.

You will have 40 minutes to complete the report.

**Figure 1: Task given to the students to use G-portal to solve a real life geographic problem.**

The learning artefacts, which are the MS Word or PowerPoint documents, collected were then analysed for the following:

1. knowledge related to environmental issues
2. an understanding that leads to attitudes that develop a greater sense of personal responsibility and concern for the environment
3. changes in actions and behaviour that indicate care and concern for the environment

From the students studied, in-depth interviews for two groups were conducted to examine the following areas:

1. How would you describe your degree of knowledge in relation to the environmental problem presented in the task?
2. Do you think your views (understanding) towards the environmental issues presented in the task have changed after the activity?
3. Has the way you use space at the ECP study area differed after the task?
4. What is your overall view about the environmental condition of the ECP study area?

In particular, we were looking for environmental knowledge, understanding resulting in attitudes and actions that are indicative of changes in environmental behaviour.

## Findings

The artefacts were coded for and the following Table 1 summarises the number of cases where there is presence of environmental knowledge, attitudes and behaviour.

**Table 1: Incidence of environmental knowledge, attitudes and behaviour in learning artefacts**

Number of groups	8
Number of groups with presence of environmental knowledge	7
Number of groups with presence of environmental understanding	3
Number of groups with presence of environmental action	0

While it is trivial and even naive to compute a percentage of each category to the total number of groups, the sample in Table 1 does indicate that environmental knowledge is possibly more easily attained with the G-portal task than environmental understanding. Given this possible indication, a logical consequence was to interview those groups with environmental understanding to discover reasons for this occurrence. It is also interesting to note that none of the groups demonstrated any evidence of actions in relation to environmental concerns in relation to the G-portal task. This indicates either a general lack of progression from environmental knowledge through understanding and then action, or a less than perfect task design that does not activate the student's environmental behaviour.

A closer examination of the eight pieces of learning artefacts reveals that the sequence in which environmental knowledge, understanding and action for the groups differ. Moreover, three possible patterns emerge from the examination of the sequence of information presented in the artefacts.

**Table 2: Summary of information sequence in the learning artefacts.**

Group	Types of Slides
1	K,K,K,K
2	I, I, I, I, I, I, K, I
3	I,I,K,I, K,I,K,U
4	I,K,K,K,K+U,I
5	I,I,I,I,I,K
6	I,I,I,I,I
7	I,I,K,I,I,I,I
8	I,K,U,U,U

where

I=**Information** not directly related to environmental issues presented

K= Information and conclusion on environmental **knowledge** presented

U= Information and environmental **understanding** presented

A = Information and environmental **action** presented

The learning artefacts show one of the following three broad patterns of information sequence:

1. A series of information that does not relate to environmental knowledge, understanding or actions
2. Information presented for most of the slides with only the last few slides showing environmental knowledge

- Information presented preceding and to support slides showing environmental knowledge. These artefacts usually end off with a slide showing environmental understanding.

In the first type of information sequence, environmental knowledge, understanding and actions are all absent. Although there was only one instance of such a pattern, it is still important to document and consider this one possible outcome of the task.

The second information sequence type is one in which information not directly related to environmental knowledge, understanding and actions is first presented in a series of slides. The final or last but one slide then presents some relevant information indicating environmental knowledge. This type of sequence is also relatively rare in the eight cases studied but nonetheless a potential outcome.

The third and more common (among the eight) information sequence is one in which information is presented prior to, as well as provides support or evidence to slides that contain environmental knowledge or understanding. In other words, these artefacts use geographical information like graphs and beach profiles to present the situation in a preceding slide to one which explains or discusses some environmental problem.

Common to all three types of information sequence is the extensive use of G-portal resources in the artefacts. Indeed, most of the information not directly related to environmental knowledge, understanding or actions were graphical and numerical resources from taken the G-portal, often in their original form. These resources have not been transformed or processed but are merely cut-and-pasted from the G-portal. Hence the support that G-portal gives for environmental understanding, as far as the evidence from the learning artefacts is concerned, is limited to being solely that of a digital library. Evidently, G-portal provides support at least in terms of access to information and resources to student in this task. While G-portal affords access and manipulation of resources it does not necessarily result in environmental knowledge, understanding and actions. The potential pathways by which this can happen was seen in most cases (seven of the eight). Clearly, a further study can examine how the type of information sequence relates to the quality of learning and hence environmental awareness and identity.

However, artefacts are static representations of what the students have learnt and may not capture the learning process in detail. Hence two in-depth interviews were conducted to explore how the G-portal has contributed to their environmental identity. Table 3 below summarises the findings of the interview analysis.

**Table 3 Summary of interview findings**

<b>Components of Environmental Identity</b>	<b>How G-portal supports environmental identity</b>
Environmental <b>Knowledge</b>	Mostly helps to confirm what they already know Also helps them visualize the geographical processes.
Environmental <b>Understanding</b>	Allows comparison with field data and hence improve understanding Resources in G-portal enable consolidation and illustration of examples
Environmental <b>Actions</b>	Environmental actions are present but the link between G-portal and the actions are only through the completion of the task.

The responses from the interviewees, Adrian (A), Daniel (D), Roonie (R) and Stephanie (S) indicate that they were able to describe the environmental problems related to the task. However, most of their environmental knowledge existed before the task and the role of the G-portal was to confirm what they already knew. In interview extract 1, Stephanie told the Interviewer (I) that the G-portal and the task confirm her knowledge about the erosion problem at the East Coast Parkway (ECP) beach.

**Interview extract 1**

S: I think it actually reaffirm my knowledge of what I have before I came here doing the g-portal thing because it's like for our (.3) module, right, there're also doing on (.) on vulnera, vulnerabilities of the ECP. [I: Mm, mm, mm. Mm, mm, mm.] So it's like [I: Mm.] We have at least the past data [I: Mmm.] and what we are doing now. So it's like, when we compare right, is about similar and we even learn more ...

Indeed, the students have already done some field studies at the neighbouring sites and have learnt some knowledge about the erosion problem. Adrian actually states that the task has “reaffirmed” what they already knew.

**Interview extract 2**

A: I would say that the task for the g-portal, it actually reaffirm what we already know. Alright. =  
I: = Mm-hmm. =  
A: Because erm, prior to this we have actually done studies, case studies on the east coast itself. Alright? We have seen, how should i say? we have seen the coast retreated and receded.

It is unclear if the G-portal enables the students to develop further knowledge about the problem but Stephanie suggested that the G-portal might have helped them think about the problem in terms of time scale.

**Interview extract 3**

I: S:o you still think it is an important =  
S and R: = Yes. =  
I: = Yeah, ok. Er (.5) er. =  
S: = Because you got to think of it as a long term plan. =

However, the G-portal does allow and enable students to visualise the data better which, in turn, adds to their knowledge base about the environmental problem of erosion. The same concept of time scale was better understood using the resources from the G-portal as beach profiles for different time periods were accessible. In interview extract 4, Stephanie explains that the G-portal allowed her to conclude that the changes have been “constant” between 2001 to 2004.

**Interview extract 4**

S: I think it should be sufficient because according to the profiles and the thing is being given, from year to year, like from 2001 to 2004, we can see the (.) the constant changes.

Adrian also acknowledged that it is the graphical representation of some of the resources that helped them visualise the changes to the beach profiles. In interview extract 5, Adrian explains that the resources were also readily accessible through a simple “double-click”.

**Interview extract 5**

A: Ya, yup. so through the g-portal itself, we could actually see it accurately and ya, we can actually do something ( ) about this space with the information found in the g-portal.  
I: So the g-portal provides you with information, the data,  
A: Yup  
I: er how was this data presented to you? do you recall?  
D: if I could recall, if it was presented in =  
A: = the g-portal?

I: mm-hmm  
D: graphical  
A: Yeah, based on the whole shore, the coast line right? =  
I: = Mm-hmm. =  
A: = of erm, east coast park, then we just, double click, then like access the profiles ah.

The G-portal supported the development or confirmation of pre-existing environmental knowledge, through its range of resources such as graphs, maps, beach profiles and numerical data. The interviewees also appreciated the ease of access to the information and the way the G-portal helped them visualize the problem.

In addition to visualization of the problem, the G-portal also supported the students' learning in terms of consolidation of information and its visual representation. In interview extract 6, Roonie explains that the graphical resources in G-portal allow them to "present" their ideas clearly to the developer, as required by the task.

**Interview extract 6**

R: = I think with, with this task, (.) the charts, the graphs are there, so it'll be (.) clearer [I: Mm-hmm] when we present it to the developer.

This contributed to the students' understanding beyond environmental knowledge. Indeed, G-portal allowed the students to compare and relate to the field studies they had conducted as part of their environmental understanding of the problems at ECP. Adrian, for example, was able to explicate the problems of erosion in relation to the potential impacts by tourism and on tourism. He explained the irony that more tourists visit areas where beach nourishment is most practised (or where erosion is more severe). Certainly Stephanie (see interview extract 7) understood why some parts of the beach had to be cordoned off to visitors, after she had visited the site and performed the G-portal task.

**Interview extract 7**

I: Has, has the way you, you use space (.) along this stretch of the coast changed after doing this task?  
S: I think, it's still the same but as compared to last time when, because I, I didn't go to East Coast.=  
I: = Before? =  
S: = Not say before but erm, (.) before coming into this course (.) and I remember East Coast from the past is that, I didn't know that, the thing has already been retreated so [I: Yes.] so far back. [I: The, the, the that side.] Yes, that's why they put the barricades. I think [I: Yes.] they have some barricades over there.

Environmental understanding was aided by the way G-portal supports environmental knowledge and the students' comparison between the portal and their actual field experience on the site. Environmental action was indicated by what the students thought they would or would not do. From the interviews, we recognised that the statements about the students' actions or inactions does not necessary translate into observable behaviours. However, these proclaimed actions certainly reflect the environmental attitudes of the students. Apart from stating that they will not litter, in view of the problem with pollution from littering, the only respondent to suggest a relevant action was Daniel (see interview extract 8). Daniel states that he will be careful when he does field work at the site in future. He realised that he had been stepping on the berm<sup>1</sup> of the beach when he was previously conducting profile measurements. He said that he would refrain

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<sup>1</sup> The berm of a beach refers to an accumulation of sand (often manifested as convexity in the slope) landward of the beach face.

from doing so in future, now that he had seen the vulnerability of the berm. This conclusion was not directly supported by the capabilities of the G-portal but the entire experience of using the G-portal to complete the task did contribute to Daniel's conclusion.

#### **Interview extract 8**

D: well if I can, now that you ask me this question, I mean I guess the only area I would change would be, hey! I will be more consideration in my actions. in the sense, littering is one thing, in the context hey should I walk, how should I walk, will it affect the coast , I don't think that would be, I don't think that part will actually come into my mind.

I: ok

A: ( ) yeah. really?

I: Ok, tell us about it.

D: I think it's like the problem is eroding, so when I do studies there, I try not to step on the edge of the berm because it helps the erode of the slumping of the

I: ok, that, that's fair enough.

D: ok er, I usually don't do that before so now, yeah

To summarise the various aspect of environmental identity supported by the G-portal, it supports the formation or confirmation of pre-existing environmental knowledge, through its range of resources. G-portal provided ease of access to these resources which in turn aided the students' comparison of their environmental knowledge to their actual field experience on the site and hence developing environmental understanding. The entire experience also enabled the students to declare some environmental actions that they will perform when they next visit the site.

## ***Discussion and Conclusion***

As a preliminary study, both the analyses of the artefacts and the interview have suggested that the G-portal was useful in providing resources to support the students in the formation and confirmation of environmental knowledge. While the artefacts suggested pathways through which students developed their environmental understanding and the interviews indicated that students were able to develop environmental understanding and actions through comparing the information on the G-portal with their field experience. Indeed, G-portal provides resources far beyond the digital resources related to their task. There are other capabilities and tools of the G-portal which remain to be studied.

One of the unique features of the G-portal is Personalized Project Management. In G-Portal, a personal workspace is provided to each user (or group of users) to build his/her (or their) own collections of resources and annotations in form of personalized projects. A personalized project has the same basic attributes as any project in G-Portal including name and description. The unique attribute of a personalized project is the accessibility, which can be private or public. A private project is visible and accessible to the creator only and a public project is accessible to all the users.

Personalized project management module in G-Portal enables the users to create, manipulate, export and delete their own projects. The capabilities of the personalized project management module can be further classified into five groups:

### *Project management*

To create a new project, user specifies the basic attributes of the project including name, description, and whether the project is private. The creator can also alter these attributes or delete



a personalized project. This essentially provides an area within the G-portal where students can organize and transform the information gathered. Transduction of text into images or other modes of representation may also be possible within these personal projects. This tool potentially supports the students in better environmental understanding.

#### *Built-in tools*

Some built-in tools such as zoom and measurement tools allow the students to query the data spatially. Essentially this allows users to select data by non-linear methods and encourage inquiry based on some analogy of the real world spatial context – the map. A certain degree of manipulation and consequent analysis of the data using these tools may support the learner in constructing meaning of the information. . This tool potentially supports the students in better environmental understanding too.

#### *Layer management*

Within a project, layers can be defined to maintain resources in different logical groupings. Properties including name, description and type (resource layer or annotation layer) are specified for each layer. Within a personalized project, appropriate layers can be defined to group resources logically. Note that the layers and the assignment of resources to layers can only be updated by the corresponding project owners. Indeed, the project layers emulate what a Geographic Information System does; it represents real world objects in layers. The information on each layer can then be used for comparison and analysis. For example, patterns may be described when objects across various layers are toggled “on” or “off”. Similarly, this tool may or may not support the learners’ efforts well. . Apart from generating new environmental knowledge about the issue, this tool potentially supports the students in better environmental understanding.

#### *Schema and resource management*

Every resource in G-Portal is created using a resource schema that serves as a template. In a personalized project, schemas can be user-defined to meet the needs of a learning activity for a user (or team of users). In a personalized project, resources are either entirely created by the user or copied from the other public projects, e.g. the master project created by a teacher for students’ reference. In a collaborative learning setting, it is also quite likely to have multiple users exchanging resources among their personalized projects. Essentially the schema and resource management allows the users to re-use objects that have been created by others. While recognising the degree of reliability may differ for object created by different users, such as instructors versus students, the reusability option may support student learning in that new meaning can be constructed out of existing pieces of information, represented as objects in this case.

#### *Personalized Project Export*

By providing each user a personalized workspace in G-Portal, the management of the resources (information) becomes much easier for each learning activity. This allows users to produce the object of the learning activity into a documented artefact. This is connected in to the previous tool in that it provides the objects that will be reused. The sharing of the resources can lead to new environmental knowledge and understanding being created as well.

At the time of writing, the research team has only been able to analyze the artefacts and interviews of the students using the G-portal. Video recordings (screen capture of activity on G-portal and headshots of students' expressions, actions and conversations) are being analysed. The various tools and capabilities of the G-portal can only be better understood when this phase of the data analysis is complete. However, the preliminary data analysed so far have shown promise. G-portal provides resources that support students' environmental knowledge and they were able to develop environmental understanding and actions through comparing the information on the G-portal with their real-life field experience.

In the report on a national survey on environmental knowledge, attitudes and behaviour of Singapore youth conducted by the National Youth Achievement Award Council (Tan et al., 1996), the report recommended that there should be more hands-on educational field trips and opportunities for youths to be involved in environmental projects. The combination of G-portal and authentic real life challenges provide the potential for the learner to achieve this understanding. While we cannot be sure that environmental identity will result in better environmental practises, but we can expect environmentally more aware and sensitive individuals.

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