Defining a research agenda for Geographical Learning Tasks with the G-portal Digital Library.

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Abstract

For many years learning management systems have been focused on providing resources for students. More recently, the growth of digital repositories has provided resources that can be tagged and searched independently of a course structure. G-portal provides resources specifically tagged for geographical learning tasks and provides a project space in which students can collaborate, create resources and share these resources amongst themselves. This paper reviews the research issues surrounding G-portal using activity theory as a framework and defines a research agenda based on the capabilities of G-portal. In particular, issues of information organisation, issues of usability, search strategies and retrieval techniques, multimodality of representation, transduction of information and representation of geographic and spatial information will be examined. The research agenda focuses on three areas: information organisation and representation; the capabilities of the G-Portal application and its ability to integrate and retrieve information and geographical task; and the ease with which students are able to undertake and complete learning tasks about geographical phenomena.

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.

G-portal was developed as an extension to existing digital library formats. Although information stored in digital libraries can be easily accessed with less time and location restrictions, as compared to traditional libraries, the level of the support given to the user is typically passive in that,

1. Digital libraries usually provide information without the necessary support for users to access, transform and construct meaning out of the information;
2. Digital libraries are usually designed to support a narrow set of generic tasks;
3. Digital libraries are not personalized to meet the learning needs of different users;
4. Single-directional delivery of information in digital libraries does not necessarily support collaborative learning or the sharing of constructed interpretations.

In the original framework, digital assets were organized by geographical location (G-Portal) within the digital library. The research and development team sought to expand this approach to ensure that the G-portal provides more than just a spatial context for accessing Geographic
information. Indeed, G-portal can be developed to provide additional affordances that traditional digital libraries do not.

**A basis for the research agenda**

The research agenda of the project is discussed in terms of developing a theoretical framework for this project, and exploring research questions for the project. Indeed, a few papers on the G-portal have already been written. However most of these were discussed within the framework of human computer interaction rather than its pedagogical aspect (Lim, 2002; Liu, 2003 and Ismail, 2003). The main impetus of the extension and improvement of the G-portal is to introduce it to learners in school and study how the G-portal supports their learning of Geography. Hence, it is important for the research to move away from simply exploring HCI issues to focusing our research on the learning itself.

**Activity Theory and Tools**

But just how does a learner engage in learning through mediation of the G-portal? This is where activity theory might prove useful. Activity theory has its roots in the classical German philosophy of Kant and Hegel (Jonassen and Rohrer-Murphy, 1999), which emphasized both the historical development of ideas as well as the active and constructive role of humans. Unlike the mentalist and idealist views of human knowledge that learning must precede activity, activity theory focuses on materialistic view that activity and consciousness are dynamically interrelated. Activity Theory emphasizes that human activity is mediated by tools in a broad sense. Tools are created and transformed during the development of the activity itself and the use of tools is an accumulation and transmission of social knowledge. Tool use influences the nature of external behaviour and also the mental functioning of individuals. Indeed, conscious learning emerges from activity and not the other way around. “Activity theory focuses on the interaction of human activity and consciousness within its relevant environmental context…Activity theory cannot be understood or analysed outside the context in which it occurs” (Jonassen and Rohrer-Murphy, 1999:62).

![Figure 1: Proposed conceptual framework](image-url)
In the activity system (Figure 1), the top triangle represents the production of some object within an activity. The subject (person, team, etc) uses some tools (methods, software, etc.) to produce the object (product, report, etc). The tools can be anything from a hammer to even activity theory itself! The G-portal provides the tools necessary for the production of the object as a learning activity within the activity system framework. The employment of activity theory as an explanatory framework for the roles of ICT in education has been increasingly used, see for example, the study by Issroff & Scanlon (2002).

In this model, web-based constructivist learning (production) is viewed as the process of allowing students (subjects) to construct meaning out of the information and hence having learnt something (object). This is achieved through the web using tools such as search engines and scaffolds within the G-portal. This study occurs within the web (community) and incorporates such aspects as collaborative learning with students working in pairs (division of labour). Clearly the focus is on the top triangle of the activity system framework. In particular, G-portal's capabilities (tools) will be explored to determine how they potentially support the learning activities.

**Capabilities of the G-Portal**

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. An important research question that may arise will be “How do students use the personal project management tool in performing the task given to them?”

**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. A potential question may be “How do spatial tools within the G-portal support students in performing the task given to them?”
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. Hence “How does the layer management tool within the G-portal support students in performing the task given to them?”

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 objects 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. Another research question may be “How does the schema and resource management ability of G-portal support students in performing the task given to them?”

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.

From the preceding discussion, four possible research questions appear to be:

1. How do students use the personal project management tool in performing the task given to them?
2. How do spatial tools within the G-portal support students in performing the task given to them?
3. How does the layer management tool within the G-portal support students in performing the task given to them?
4. How does the schema and resource management ability of G-portal support students in performing the task given to them?
**Emerging Research Questions**

However, these questions appear to be essentially about how the capabilities of the G-portal can support students in performing the learning task given to them. The activity theory framework is not solely focused on the tools of the activity. The subjects, objects, process and collaboration in the activity are also important components to be considered. Indeed, the set of questions derived from the discussion about tools can be extended by looking at the remaining components of the activity framework. Thus, four research questions that arise from reviewing the framework would be:

1. How can we organise information within the G-portal so that it may be retrieved easily by students to construct meaning of it?
2. How does the G-portal function as a tool in knowledge production?
3. How does the G-portal’s various design capabilities support the students in performing the task?
4. What are some forms of observable learning outcomes?

This set of questions emphasizes the students’ knowledge construction process but requires, in addition a fuller description of the learning task As the proposed approach to these questions is based on the learning ecology of design experiments (Cobb et al., 2003), the context of the activity should be firmly placed, in this case within the discipline of Geography. Thus, the research and development team will work with some undergraduate students from the CAG233 Coastal and Ocean Systems module at the National Institute of Education. This module traditionally requires the students to investigate a stretch of the local coast and solve some geographical problems resulting from the investigation. An introduction to the G-portal will given at the beginning of the module. The students then access the information via the G-portal throughout the semester.

The investigation by the students will take place along a stretch of the east coast parkway coast. The main foci of the tasks are to identify coastline changes and the resulting impacts on the environment. Thus the G-portal will be used to complement fieldwork in terms of identifying, describing and even measuring coastline changes as well as identifying, explaining and measuring related physical and socio-economic impacts.

Among the type of information collected from the G-portal will be satellite imagery, historical changes in coastline, beach profiles and photographs. Based on these resources the steps that students are expected take may be:

1. Overlay all sources of coastline changes such as satellite image, aerial photos and coastline maps, using GIS
2. Compute the average rate of retreat for a period of time
3. Cross reference erosion areas to beach profiles of those areas and associate the observations with theoretical knowledge
4. Make educated guess on the causes of erosion

In sum, the research agenda focuses on the three areas of information organisation and its tagging; the design of the application and its ability to integrate and retrieve information for geographical task; and the ease with which students are able to undertake and complete studies of
geographical phenomena. Given the research questions, the issues that are of specific interest in terms of student processes will include:

1. **Usability issue** — Can students use the G-portal to effectively find, retrieve and create information about the Geographical task?

2. **Search Strategies and retrieval techniques** — Does the G-portal support effective search strategies well?

3. **Multimodality of representation** — Can the students use tools within the G-portal to represent information in various modes such image and numerical data?

4. **Transduction of information** — Can students more easily comprehend the data and its representation through the transductive capabilities of the G-portal?

5. **Representation of Geographical and Spatial Information** — Does the G-portal support students’ spatial understanding of the information?

Indeed, these issues can be organised around the tools of an activity framework that has been proposed. The usability, search strategies, multimodality, transduction and representation of spatial information are all part of how G-portal functions as a tool within the learning activity.

Another research focus is on the observable learning outcomes—the object in the activity framework. While the object of the activity is produced through an interaction between the subject (learner) and the tools of the framework, the outcomes of learning may be studied in terms of the types of outcomes observable. Although the concept of specific behavioural objectives is definitely not part of a constructivist learning framework, the outcomes of learning are describable and classifiable. It will be useful to determine the outcomes of learning in relation to the way tools are used.

Hence the research agenda of this study focuses on the tools and the object of the activity system in understanding how G-portal can support learners in their learning task.

**Conclusion**

Stewart (2003) suggests that “textbooks are not ideal for teaching science. They are often out of date soon after they are printed; they tend to be very expensive; and they tend to be organized by scientific topics instead of being organized around important problems. The emergence of digital libraries is solving the problem.” Although some of the reasons suggested are not entirely convincing, the last point about printed resources being organized around themes and not around problems to be solved, is highly relevant to teaching and learning Physical Geography. The G-Portal resolves this difficulty in that it 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. It allows information to be searched, multiple modes of representing information, transduction of information from one mode to another, and most importantly representation of information within spatial and geographical context that is more relevant to solving real life problems and hence a more authentic understanding of geographical issues. An examination of these issues within the conceptual framework of an activity system reveal two areas of research foci, namely, the capabilities (tools) of G-portal and the type of observable learning outcomes.
References


