Reflections on web-based inquiry learning in Geography classrooms in Singapore

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Reflections on Web-Based Inquiry Learning in Geography Classrooms in Singapore

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Abstract

We often presume that when we engage a student in a web-based inquiry learning activity, the student will learn more effectively, become more motivated, and attain higher-order learning outcomes. To date, little empirical research has been published to confirm these assumptions. In particular, web-based inquiry in the form of WebQuests™ is widely practiced by teachers in Singapore, largely due to a pervasive evangelistic movement by the educational technology branch in the education ministry. This article puts together reflections about the use of web-based inquiry in the Geography classroom based on some empirical findings. The empirical study which examined how students use the web for an inquiry-based learning activity was conducted within the framework of an activity system, which investigated how the student (subject) interacted with the web (tools) in the learning process (production) to generate the observed learning outcomes (object). This involved the views of teachers as stakeholders (community) and the way the students worked in a group (division of labour). The findings involved issues with student motivation, information seeking behaviour, web access, learning outcomes, cooperative learning, and views of stakeholders. Amidst the range of issues raised from the results, the findings do provide useful information on how future web-based inquiry learning activities, such as the use of WebQuests™ (Dodge, 1997), can be designed to better support teaching and learning in the Geography classroom.

Background

In Kent’s (2002) article on a formative evaluation of online learning, he concluded that the students had a "positive" experience using online learning. The article also highlighted as part of the recommendations based on his find-
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Ident in a web-based inquiry effectively, become more motivated. To date, little empirical evidence exists. In particular, web-based learning is widely practiced by teachers in the Geography classroom and study which examined how learning activity was conducted. This article puts together the learning process (productive) and the way the students involved issues with structure, web access, learning outcomes. The study which examined how learning activity was conducted investigated how the study which examined how learning activity was conducted. This involved the student and the way the students involved issues with structure, web access, learning outcomes. Amidst the range of web-based technologies for teaching and learning Geography, the study which examined how learning activity was conducted. This involved the student and the way the students involved issues with structure, web access, learning outcomes. The study which examined how learning activity was conducted investigated how the study which examined how learning activity was conducted. This involved the student and the way the students involved issues with structure, web access, learning outcomes.

Reflections on Web-Based Inquiry Learning

When using online learning, better support teaching and learning outcomes that online experience should be structured and its pedagogical approach varied. The findings were "tentative and interim" as Kent stated modestly in his article (Kent, p. 41). However, even such "tentative and interim" work based on some empirical research is uncommon in the literature. At the International Geographic Union, Commission on Geographical Education (IGU-CGE) symposium held in Brisbane in June 2006, a total of seven papers (out of 102) were presented about the use of web-based technologies for teaching and learning Geography. Out of these seven, only four were based on empirical findings.

The web has grown unprecedented in terms of rate and scale. As of 31 March 2006, 1,022,863,307 people used the Internet (World Internet Usage Statistics and Population Stats, 2006) and the number of websites grew to 9,04 million sites by 2002 (Online Computer Library Center, Inc., 2004). Today, the number of web sites is still growing. This vast ocean of information is used for a number of purposes, including web-based learning where it has the potential to supplement and complement classroom learning and this has implications for learning. Do web-based learning activities result in higher order learning outcomes, for example? What about its effect on student motivation, the way learners use the web, and how students' learn together? The study was undertaken to answer some of these questions.

Different people define web-based learning differently. The scope involved in defining the term web-based learning is probably far too wide for a holistic definition to emerge. Indeed, web-based learning includes beyond a learning or instructional phenomenon occurring within a specific context. The web's ability to mediate various technologies provides many strategies which students can utilise for learning. Essentially, a variety of learning-related tasks, such as acquiring information from a static web page, the use of web applications such as e-mail, internet relay chatting, instant messaging, and other computer applications such as databases, resource portals, and digital libraries can all be seamlessly integrated into a single web page.

Working on the web also affords the luxury of time and processing power in performing tasks of manipulation. Direct manipulation and hence
working with the web renders simulation, which then aids in the visualization and understanding of the subject matter. In addition, the web is capable of providing "rapid, compelling interaction and feedback" to the student (McIntyre & Wolff, 1998, p. 257). The web also offers access to a rich pool of information, from anywhere on the planet and is a revolutionary medium of information dissemination. These capabilities of the web may be used to support learning which, ranges from plain fact memorization to deeper cognitive skills, and from intended to unintended learning. In particular, the web supports inquiry-based learning through its rich source of information and various technologies that can be used for manipulation of such information gained.

As an old Chinese saying goes, "tell me and I forget, show me and I remember, involve me and I understand," the last part of this statement encapsulates the essence of inquiry-based learning. Inquiry entails participation that leads to cognitive processes such as understanding. Further, inquiry implies using skills and examining attitudes that allows the learner to reconcile with issues as new knowledge is being constructed. This is also in accordance with constructivist learning which focuses on the student constructing knowledge with the information they encounter. While it seems logical that web-based inquiry, utilizing the capabilities of the web and the pedagogical advantage of inquiry-based learning, will result in better learning outcomes, how this actually works is something that needs to be examined with reference to a real-life authentic situation—hence the need for such an empirical study.

This article puts together reflections about the use of web-based inquiry in the geography classroom based on some empirical findings. The findings involved issues with student motivation, information seeking behaviour, web access, learning outcomes, cooperative learning, and views of stakeholders. Amidst the range of issues raised from the results, the findings provide useful information on how future web-based inquiry learning activities, such as the use of WebQuests™ (Dodge, 1997), can be designed to better support teaching and learning in the Geography classroom.

Overview of the Study

To obtain its empirical data, this research developed and implemented a web-based educational activity for geographical education into two classrooms in Singapore. The topic on Green Revolution in Agriculture was selected for this study as it would require that students know something about the concepts of agricultural processes, world population trends, and technological advancement, or at least one of these concepts. When new
Reflections on Web-Based Inquiry Learning

In the visualization aid, the web is capable of providing feedback to the student. It offers access to a rich pool of information and is a revolutionary medium. The web may be used to augment memorization to deeper cognition. In particular, the web's source of information and-upulation of such information

I forget, show me and I learn part of this statement encapsulates. Inquiry entails participation in the learner's understanding. Further, inquiry allows the learner to reconstruct. This is also in accordance on the student constructing the meaning of the text. While it seems logical that the web and the pedagogical theories are used in better learning outcomes, the need for such an empirical the use of web-based inquiry is essential. The empirical findings provide use-based learning activities, such as designed to better support learning.

The first school, Redhill Secondary School. It is a small school of about 800 students. It is a neighbourhood school in Singapore that is unique in that it has a high percentage of foreign students. The Secondary Three students reading Geography Elective are small in number and two classes have combined to form this one class of Geography Elective students. The other two halves of the classes take History Elective. The total number of students in the class is 18 and the teacher had already formed six intact groups each of three students at the beginning of the year. In one group were Grace, Gary, and Ming and in the other group were Nicole, Chieh, and Hubab.

The second school, Peace Secondary School, has more students (about 1000 students). It is another neighbourhood school and has the typical catchment of a public housing estate. The class chosen for this study has 40 students and the teacher had formed eight intact groups of five students at the beginning of the year. One group was made up of all boys, namely Dan, Zaini, Boon, Desmond, and Ping. Another group was formed entirely by girls Yani, Zinnira, Fazilla, Siti, and Murshidah. The students are all between 14-15 years of age and come from a diverse ethnic background (as represented from their pseudonyms). Note that all names have been changed to protect the identity of the students.

The cooperating teachers have both graduated from the teacher training institute where I worked and were both taught how to use WebQuests during their undergraduate teacher preparation programme. This meant that the intervention could be carried out without the need to re-train the teachers. The

The topic “Green Revolution in Agriculture” is taught in Secondary Three of the Singapore Geography Curriculum, the subjects of this study will be Secondary Three students about 15 years of age. According to Creswell (1998, p. 114), it is important that the sites selected have an intact “culture-sharing group” that has shared values, beliefs, and cultures.

Based on this criterion, two Normal Academic Geography Elective classes were chosen. At upper secondary levels, and in particular, at the General Certificate of Education ‘Ordinary’ (GCE ‘O’) Levels examination, all Singapore students are required to take the subject Combined Humanities. It is essentially a subject with two examination papers. One paper is on Social Studies and another on either, Geography, History, or Literature. The second humanities paper in this subject is called an Elective. Hence, we refer to the Geography component of the Combined Humanities when the term Geography Elective is used.

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The information is obtained, the learners can then construct their understanding of what the Green Revolution is all about, in that while Green Revolution intends for agricultural production to be increased through technological advancement, the result of such practices may not always be desirable. Since the topic “Green Revolution in Agriculture” is taught in Secondary Three of the Singapore Geography Curriculum, the subjects of this study will be Secondary Three students about 15 years of age. According to Creswell (1998, p. 114), it is important that the site or sites selected have an intact “culture-sharing group” that has shared values, beliefs, and cultures.

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design of the activity was introduced to the teachers before hand and the teachers were then asked to solicit volunteers from their classes (taking note of their intact groups).

**Learning Theory**

The central research question of “How do students use the web to learn geographical ideas and concepts given the rapidly expanding web phenomenon?” should be examined within some learning theory. Certainly, some intuitive sub questions that can arise would include how students interact with the web and what they learn from the web, to name a few. The learning theory used must support the investigation of these various aspects of the learning activity. This is where activity theory might prove useful. Authors such as Jonassen and Rohrer-Murphy (1999) and Lim and Chai (2004) suggested that activity theory potentially provides a lens for us to analyze learning processes and outcomes, especially in a web-based environment. Modern activity theory has its roots in the works of Vygotsky in the early twentieth century and later developed further by Leont’ev (Engeström, 2001).

The modern equivalent is essentially a reformulation of Vygotsky’s conception of response, stimulus, and mediated act into a model of subject, object, and mediating artifact. Indeed, activity theory conceptualises learning as involving a subject (the learner), an object (the task or activity) and mediating artifacts (tools like the web) (Issroff & Scanlon, 2002). Using the concept of an activity system, the web is the tool, which is used in the process within certain constraints (restricted by technological factors) and the community of other learners. It is within the activity system that the questions of interaction between the subjects, object and tools, learning outcomes, motivation, and opinions may be examined. Indeed, other authors such as Lim (2002) have used a similar approach in studying Information and Communication Technology (ICT)-based lessons in school.

In this diagram (Figure 1), web-based inquiry learning (production) is viewed as the process of allowing students (subjects) to construct meaning out of the information and having learned something (object). This is achieved through the web using tools such as search engines and scaffolds such as WebQuest™. This study occurs within the web (community) and incorporates some collaborative learning as the students work in groups. The idea of students learning collaboratively is not synonymous with the idea of division of labour. Indeed, it refers to, in addition to division of labour, an understanding of the process of how students work in a group, such as the roles they assume. However, the original terminology of division of labour used in activity theory will be used to represent this idea.
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Thus, with the above inter-related activities as a framework, four main research sub-questions arose, namely:

1. What are some observable learning outcomes of this activity?
2. How motivated are the students and what types of motivation are present?
3. How is the web used for learning?
4. What are some processes operating within the group?

Learning Outcomes

When we refer to learning outcomes, we may be referring to the desired capabilities of a lesson, or performance categories of students. These performance categories indicate conditions most favourable for the type of learning outcome observed. This concept is similar to that of instructional objectives as proposed in the Taxonomy of Educational Objectives, Handbook I: Cognitive Domain (Bloom, 1956). It presented a classification with which subject matter or content might be processed, aimed at helping curriculum builders “specify objectives so that it becomes easier to plan learning experiences and prepare evaluation devices” (Bloom, p. 2). While this taxonomy has been wisely used in vernacular classroom practice since
the 1950s, it does not mean that it should be the only way learning objectives can be formulated.

Krathwohl (2002) suggested a critique and revision of Bloom’s original taxonomy in which he suggested that instructional objectives were constructed around descriptions of intended learning outcomes arising out of the prescribed instruction. In that, these statements of objectives are constructed based on subject matter content and a description of what is to be done by the student with this content. As a result, the statements typically consist of nouns or noun phrases with a verb or verb phrase, corresponding to the subject matter content and the cognitive processes, respectively. For example, a statement such as “The students will be able to remember the cycle of cultivation in traditional wet rice farming” is framed around the noun phrase “cycle of cultivation in traditional wet rice farming” and the verb phrase “to remember,” reflecting the content knowledge as well as the cognitive process.

In Bloom’s taxonomy, the categories proposed incorporate one or both of content and the cognitive aspects. A distinction between the two concepts is not present in these schemes. Krathwohl’s (2002) critique is that this unidimensionality causes categories within the taxonomy to be inconsistent as some categories represent both content and process while others simply refer to cognitive processes. In using only one of the dimensions proposed by Krathwohl—the cognitive processes dimension, we clarify that it is the cognitive aspects of the learning outcomes that we are interested in. Indeed, Krathwohl proposes the following cognitive categories:

- **Remember**: Retrieving relevant knowledge from long-term memory
- **Understand**: Determining the meaning of instructional messages, including oral
- **Apply**: Carrying out or using a procedure in a given situation
- **Analyze**: Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose
- **Evaluate**: Making judgments based on criteria and standards
- **Create**: Putting elements together to form a novel, coherent whole, or make an original product.

There are further sub-categories but for the purposes of this study, these cognitive processes were divided into the broad areas of “Recalling,” “Cognitive Strategies,” and “Creating” to identify lower to higher order learning outcomes.
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Motivation

Motivation theories are rife, and vary across behavioural to cognitive and social approaches. However, the subjects within a social context are often influenced by the type of motivation reinforcement and the expectancy and value of goals. Motivation can be thought of as being either intrinsic or extrin­

sic, while the factors affecting motivation may be said to be due to a learner’s level of mastery or goal orientation in their performances. Hence one can examine these two main types of motivation as well as a tendency towards goal theories in explaining motivation.

The Web for Learning

Web information science research mostly concentrates on developing sophisticated search tools and technologies rather than exploring and developing effective human search strategies. The current research, however, was interested instead in understanding how humans interact with a web-based information environment. One way to do this is to think of user skills as moving up a developmental ladder, from comparatively simple information handling skills, to much more strategic approaches. Ellis (1993) defines six characteristics of information-seeking behaviour, without typifying them as stages: Starting, Chaining, Browsing, Differentiating, Monitoring, and Extracting.

While the web may be considered as a medium which provides certain advantages, the concept that will be used for this study is really that of a tool, namely WebQuest™. Within the activity theory framework, the web provides a learning environment in which a tool like WebQuest™ provides the enabling context, resources, information-seeking capability, and scaffolds that assist a student in the learning activity.

Collaborative Learning

Within a learning context, students are often put into groups whereby some form of collaborative learning is desired. When students are put into a group, one cannot assume that they automatically take on their respective roles and produce the expected learning outcomes. Indeed, Johnson and Johnson (1999, p. 57) suggest that “[s]imply placing students in groups and telling them to work does not in and of itself result in cooperative efforts,” let alone generate any cooperative results. Their approach proposes the five essential elements of positive interdependence, face-to-face promotive inter-
Table 1

Categories of information search patterns. (Adapted from Ellis, 1993).

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>Starting</td>
<td>Activities characteristic of the initial search for information</td>
</tr>
<tr>
<td>Chaining</td>
<td>Following chains of links or other forms of referential connection between material</td>
</tr>
<tr>
<td>Browsing</td>
<td>Semi-directed or semi-structured searching in an area of potential interest. E.G. Broadening, narrowing, coordinates or word form changes.</td>
</tr>
<tr>
<td>Differentiating</td>
<td>Using differences between sources as filters on the nature and quality of material examined</td>
</tr>
<tr>
<td>Monitoring</td>
<td>Maintaining an awareness of developments in a field through the monitoring of particular sources</td>
</tr>
<tr>
<td>Extracting</td>
<td>Systematically working through a particular source to locate material of interest</td>
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action, individual accountability, social skills, and group processing. Assuring that these elements are present will tend to increase the success of the cooperative activities involving working in a group.

But do these elements work in an inquiry-based learning activity? How should these elements be embedded in the design of the inquiry-based learning activity? Intuitively, the scaffolds of the inquiry-based learning activity should describe the roles and procedures for working in a group and encourage elements such as positive interdependence, promotive interaction, and social skills. When these skills are perceived as pre-requisite "knowledge" for students to work in a group, the Johnson and Johnson (1999) approach may be understood within the context of inquiry-based learning activity. In particular, the issues of learning together are investigated to determine how theory is translated into practice.

Methodology

In essence, a Creswell (1998) and Guba and Lincoln (1989) adaptation of the Wolcott (1983) conception of a quasi-ethnography was used as the qualitative methodology to study these four areas of interest. The method includes collection of information using various means such as observations, interviews and documents to explore rich, descriptive data about the contexts,
adapted from Ellis, 1993).

• initial search for information
• other forms of referential
• refereed searching in an area of
• narrowing, coordinates
• access as filters on the nature
• of developments in a field
• of a particular source to locate

and group processing. Assuring
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What were the subjects required to do? The learners in this task were
asked to enact a decision making process in a wet-rice farming family. The
farmers were recently asked to consider taking up the government grants to
modernise their farms. Based on gathering information from the web about
the advantages and disadvantages of green revolution farming practices, the
learners had to decide whether to adopt or reject the offer.

For this activity, the search for a web-based instrument that allows scaf-
dolding within inquiry-based learning led to the website of San Diego State
University. The scaffolding for this activity is provided by WebQuest™. A
WebQuest™ is an "inquiry-oriented activity in which some or all of the
information that learners interact with comes from resources on the internet,
optionally supplemented with videoconferencing" (Dodge, 1997). The
model was first developed in 1995 at San Diego State University by Bernie
Dodge with Tom March. Today it is widely used as a web-based learning
tool. The WebQuest™ was designed by the researcher using the current syl-
labus for Secondary 3 Normal Academic stream (equivalent of 8th grade,
marginally below average ability students) Elective Geography. The
researcher consulted classroom teachers and a Geography educator with
instructional design training. The design underwent several revisions, based
on comments and suggestions by these professionals. The content material
of the final design of this activity was considered relevant and suitable by
these professionals. The only concern left is whether the design will engage
the students effectively in making their own meaning out of the information
that they will gather and use.

According to Creswell (1998, p. 120), although the technique by which
data is collected in qualitative research is diversifying, there are essentially
three basic types of data to collect:

1. Observations
2. Interviews
3. Documents (historical and constructed).

Descriptions of behaviour through observations, interviewing, docu-
ments and artifacts are commonly collected for ethnographic studies
(Hammersley & Atkinson, 1995; Spradley, 1980). However, video recordings of the observations were also included in this study as a fourth form of data collection so that an even more reliable quasi ethnography may be constructed in which each type of data served to triangulate and add on to the reliability of the analysis.

**Observations**

Observations are a primary means for the researcher to collect information about the learners' behaviour in the field. This is a means for the researcher to be "immersed" into the culture of a group in pure ethnographic studies. Since the site, the gatekeepers, and key informants have already been decided, the remaining two issues to consider were to determine the role of the observer and to design the observation protocol. The researcher took on the role of a participant observer, and an observation protocol was designed with the research questions in mind so as to guide the observation process.

Furthermore, a second, independent observer used the same protocol in writing the observations from the videos recorded of the sessions. This also allows a comparison between the two observers' notes. A further procedure was employed to code the video clips captured according to the various elements of the activity system. After an initial viewing, the researcher generated a generic set of codes. Finer details were added as the coding progressed.

**Interviews**

The interaction between interviewer and interviewee produces an active construction of their version of reality with regards to the person being interviewed and the context of the question (Silverman, 1993, p. 90). It is through this interaction that we can collect data that will provide an authentic insight into people's experiences. According to Silverman (p. 91), the main ways to achieve this are unstructured, open-ended interviews usually based on in-depth prior participant observations. These interviews were conducted after the last WebQuest™ session; recorded with a tape recorder, and later transcribed using the standard notation from Sacks Schegloff, & Jefferson (1974). The tape recorder method was used as it was "undeniably more objective than one's own notes" (Seldon & Pappworth, 1983, p. 71). A generalized list of questions was used during the interviews in an attempt to solicit general comments. An interview protocol was first designed to direct key questions to the subject during the interview. Then questions pertaining to detailed information were next asked while interacting with the respondent, as and when it deemed fitting. In this way, the interviewee was given
However, video recordings as study as a fourth form of data ethnography may be construct- and add on to the reliabil-

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time and the opportunity to express views besides those pertaining to the questions posed.

Documents

In order to provide further data for triangulation and ensuring reliabi-

ty of the data collected, five types of documents were used to support the information collected by observations and interviews.

1. Track of the sites visited based on tracking software called PlanBee™; activated by the students
2. Student log entries
3. Reflections written as part of the WebQuest™ activity by the students
4. PowerPoint Slides of the presentation
5. Researcher Reflections.

A track of the sites visited by the students during their search sessions was obtained using software called PlanBee™. This software basically tracks the websites visited and records the Uniform Resource Locator (URL) on a track map. The students activate this software just before their search sessions and the researcher can trace the navigation using the same file at a later date. As the researcher intended for the students to perform information seeking on the web outside the classroom (in their own group meetings, etc.), each student was provided a diskette to record their tracks. Note that this was a voluntary action and that the researcher had explained clearly to all students involved, that since they had agreed to volunteer for the project, they needed to provide all the tracks of the sites they had visited.

Students were also asked to keep a log of their thoughts or feelings during the course of the project. They were allowed to practise during the trial sessions. The researcher asked the students to write down their activities, feelings, and thoughts on a set of log sheets. They were also given a soft-copy of the log sheet to reprint.

Questions

The WebQuest™ activity was designed to conclude with a short reflection based on three questions:

1. Write down three things that you find interesting about this learning activity
2. Name two things you have learned about using WebQuest™ to study Wet Rice Green Revolution that you will share with a friend

3. What is one thing you have learned from this WebQuest™ that you will certainly do in the future?

These three questions served as additional data used to triangulate and increase the internal reliability of some of the findings gathered from the other data collection methods. Further, it allowed the student to pen down any further thoughts he/she might have missed in the student log entries.

The PowerPoint slides provide the most concrete evidence as to what has been learned during the entire activity. This learning artifact supports the observations that have been made during the presentation sessions as well as other types of learning outcomes that have been noted through the other forms of data collection. A slide-by-slide description of the presentation was analysed with reference to the sites the students visited. This will provide a glimpse into how they transform the raw information collected into their final product.

Finally, the set of researcher reflections is the single most important document that shows the researcher's biases, thoughts, and feelings through the entire project, especially when he is a participant observer. Validity of the researcher's interpretation can be established when the various thought processes that influence the interpretations are clearly transparent.

These various types of data serve as written documentation for the web search strategies and patterns, opinions, and reflections of the students, learning artifacts from the activity and the researcher's thoughts, and biases as the project progressed. They are important in establishing reliability and validity in the study.

Research Results

The results of this study were reported in greater detail in the dissertation (Chang, 2005) on which this paper is based. This paper reports the research observations for student motivation, learning outcomes, using the web, and learning together.

Student Motivation (Subject)

Two very general aspects of motivation were examined in this article: intrinsic and extrinsic. The results showed that aspects of intrinsic motivation came into play only for some students. The interviews showed that while some of the students claimed to be interested (overall motivation) in the proj-
ed about using WebQuest™ to that you will share with a friend
ational data used to triangulate and the findings gathered from the
WebQuest™ that you will provide a glimpse into how
ed the student to pen down any the student log entries.
Concrete evidence as to what has from this WebQuest™ provides the obser-
nation sessions as well as other by the other forms of data presentation was analysed with
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were examined in this article:
ements of intrinsic motivation:
terviews showed that while (overall motivation) in the proj-
ect (nine students), there were others who declared themselves to be uninterested (seven students). Such disinterest was clearly observable in the field and on the recorded video clips as well as from the interview transcript, providing various sources of data for triangulation. Seven students claimed to be uninterested in the activity and their observed behaviour confirmed what the students have declared—that they were not interested in the activity at all. Moreover, four of those who claimed to be interested were not always observed to be interested. Of those who were interested, the opportunity to learn more about the topic was cited as the main reason for their motivation, in addition to working with friends and finding out more about peoples' livelihood (a topic of the lesson).

Outside of the learners' own intrinsic motivational factors, it appeared that assessment marks were an important extrinsic motivation for the students to engage in the task. But beyond such predictable performance-driven motivational factors, the researcher was also interested in any effects the learning environment, namely its web-based nature, had on learner motivation. The extrinsic effect of the web on their motivation was unclear as several students claimed that it did motivate them positively, while several of them thought otherwise.

The actual mechanisms for the manner in which using the web might have influenced motivation which was observed in this study are not immediately generalisable. Whether the web influences only intrinsic or extrinsic motivation or both is also not clear. What is clear is that using the web seems to produce some degree of frustration, which could erode the students' motivation to engage in the learning task. These sources of frustration are dealt with in the section below on using the web.

**Learning Outcomes (Object)**

The question emerges: What is the relationship between a learning activity designed around inquiry-based learning, and the types of learning outcomes it achieves? In a traditional instructional design framework there is supposed to be a close correspondence between the desired learning outcomes and the design of the learning activities. But does this logic apply in the same way within this activity theory framework?

On the whole, the types of learning outcomes that can be observed from the current study show that, while recall of information is the most common cognitive outcome, there were also instances of analysis, application, evaluation, and creation of attitudes. It is interesting to note that the 'recall of information' discussed above does not suggest there were any particular types of
knowledge, which were primarily learned. Indeed, students demonstrated that while they generally were able to recall domain/content knowledge, they also indicated they learned how to understand others’ feelings and develop attitudes toward the farmers’ use of artificial fertilizers (these are some of the contents of the lesson). The researcher could distinguish between content-specific and non-content-specific knowledge which has been learned.

The non-content specific knowledge that students acquired was incidental learning; unintentional or unplanned learning that results from other activities. In general, much of such incidental learning, far from being considered as an unimportant by-product of a lesson, has been shown to be related to increased competence, better attitudes, and improvement in interpersonal skills, improved self-confidence, and self-awareness (McFerrin, 1999; Mealman, 1993). However, not all unplanned learning is effective. For example, Ford and Herren (1995) discussed the uncertain “hit or miss” nature of incidental learning. For example, one girl has learned a new skill in relation to surfing the internet—to bookmark the pages she has visited. This was probably an intellectual skill learned. However, the skill was not content specific but it does indicate that the student has acquired a new technical skill. Another student felt that he was able to learn more about a real life job, given the fact that his grandfather was a rice farmer. He also commented that it was a hard job and he now understands why his grandfather closed the farm. These are just two examples of increasing computer competence and examining attitudes.

So, returning to the question of the relationship between inquiry-based learning activities and desired learning objectives, the argument is not that instructors or designers of web-based inquiry activities should design the activities to emphasize incidental learning. (An “intention” to produce “incidental learning” would almost be a contradiction of terms.) Rather, the learning activity must include school systemic parameters of assessments, marks, exams, and other types of performances linked to learning objectives. Thus, activities should be designed to meet that broad range of expected or intended learning outcomes. The point is that web-based inquiry learning activities can potentially result in incidental learning outcomes which are also of benefits to the subjects of study.

This use of inquiry-based learning to achieve incidental learning outcomes is especially interesting in Singapore where the government has enthusiastically promoted lifelong learning, a philosophy of adult education which puts much of the responsibility for managing one’s own learning path onto the learner themselves (mirroring the self-regulatory mechanisms operating in many inquiry-based learning environments). Although lifelong learning includes directed learning based upon clear desirable learning objectives,
indeed, students demonstrated that in addition to content knowledge, they also developed feelings and attitudes (these are some of the contents between content-specific and content-learned).

It students acquired was incidentally, that results from other activities, far from being considered incidental, have been shown to be related to improvement in interpersonal awareness (McFerrin, 1999; Puchta, 1995). Learning is effective. For example, certain "hit or miss" nature of learned a new skill in relation to an actual job, given the fact that it was a hard job to do. These are just one of the key findings in examining attitudes. The relationship between inquiry-based activities, the argument is not that inquiry activities should design the "intention" to produce "incidence of terms." Rather, the learners' assessments, marks, and to learning objectives. Thus, a range of expected or intended outcomes which are also of benefit to achieve incidental learning outcomes which the government has enthusiasm for adult education which one's own learning path onto the story mechanisms operating in life. Although lifelong learning desirable learning objectives, there is also an acknowledgement, premised on adult learning models, that incidental learning has value (Rogers, 2003). While there is no explicit educational policy in Singapore which promotes "incidental learning," it would seem clear that the manner in which incidental learning occurred in this study would indeed be a useful contributor to lifelong learning. Simply put, web-based inquiry learning activities have immense potential for learning, especially so from the incidental learning perspective.

Using the web (Tools)

If the web can be considered a scaffolding tool, the construction of knowledge depends to a large extent on how the students use the tool. Given the predisposition of some students to be unmotivated by the task in the first place, any frustrations arising from the impatience with seeking and retrieving information on the web should cause some concern. This would indicate that closer monitoring of students using the web would be advisable for any benefits to accrue from scaffolding within the activity. Even in this activity where instructions were given for initial website references as well as what information should be sought, students still seemed to have difficulty in searching, retrieving, organising, and applying relevant information. This raises the issue of the effectiveness of the scaffolding provided.

Nine out of the 16 students interviewed felt frustrated waiting for web pages to load. Impatience with the wait time, when results are being processed by the search engine, is an area that is cause for concern on two counts. First, the search may not proceed very far before impatience stops the student from trying further. This has been observed during the video recording sessions. Secondly, information that is first available while searching may be considered readily due to impatience. There is sparse evidence to validate these observations presently, suggesting further research is necessary.

Another interaction between students and the web during such sessions is that they get easily distracted by more "interesting" alternatives such as online music and games. These distractions pull the students from their task and often reduce the efficiency of their work and largely interrupt their progress. When asked during the interviews, four of them admitted that they would engage in activities such as listening to music or checking e-mail, in addition to their assigned task. While it can be argued that students are increasingly able to multi-task, the argument is that these "distractions" divert students' attention from the principal task. At the National Education in Computers Conference in June, 2004, session speaker Tom March referred to the web as a "weapon of mass distraction." While the researcher is a strong
proponent of the potential values of using the web for learning, he did not deny the potential disadvantages of the web, as well.

In terms of seeking information, most of the students' search behaviours could be classified under the categories of starting and chaining in the Ellis (1993) model. Four students showed that they performed some “browsing.” There was very little evidence of the more sophisticated actions of differentiating, monitoring, and extracting.

Although Chandler (2003) suggested that WebQuests™ may be designed to help students sift through websites and thus focus on using information rather than searching for it, the research suggests that more training on information searching skills is required as well. Perhaps, the design of the WebQuest™ can be improved as well, specifically enhancing its scaffolding capabilities to give the students relevant and timely support in how to strategically search and use web-based information. Clearly the discussion of the web as a tool can now be understood from the perspective that it provides tools and opportunities in the learning task, even though students may not be very skilled at it. However, these tools become problematic as they also offer distractions, create frustrations, and result in less than satisfactory search results when used by an unskilled individual.

By comparing the results of the web-tracking with the analyses of the artifacts, it becomes apparent that the students were merely using a “cut-and-paste” strategy with the information they have gathered. In Table 2, the students' learning artifact was compared against the sites visited for the sources of information. From this example, the students simply “lifted” information from the textbook or the web to “cobble together” the presentation text. This reinforces the finding that the learning outcomes are largely limited to factual recalling.

**Learning Together (Roles)**

The interviews with students suggested that some enjoyed working in a group. However, some behaviours suggested they worked rather independently, showing a lack of group processing arising from a lack of positive interdependence and individual accountability. In other words, they were not really proficient working in a group. Group work is perhaps something they have not been taught. During other interviews teachers claimed that students had been taught how to work in a group and have been doing so at least for the last two years. This presents an interesting mismatch of teacher perception of how the students have learned to learn in a group, and how they were actually learning in a group. Some students were observed clustering together in smaller groups or pairs within their groups to work closer together.
he web for learning, he did not as well.

If the students' search behaviours taping and chaining in the Ellis ey performed some "browsing," phrased it. Examples were also taken from the same Textbook but seem to be irrelevant.

Students gave a brief history of Green Revolution. Facts were gathered and summarised from the Textbook: Interactive Geography Elective. Page 75. But the last paragraph was not known taken from which Textbook or other resources.

They presented the individual's views on whether to accept Green Revolution into 3 parts: Farmer's view. Children who agreed and disagreed. Information given by the student was original and was not quoted from any Textbook or other resources.

Information given by the farmer was original and was not quoted from any Textbook or other resources.

Information given by the student was original and was not quoted form any Textbook or other resources.

Table 2
Analyses of artifact of Group 4 from Peace Secondary School.

<table>
<thead>
<tr>
<th>Slide No.</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Cover Page: Green Revolution. A Brand New Modern Method</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Content Page: List of sub-titles.</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Definition of Green Revolution. Students got the text from the Textbook: Our World. Page 63 and paraphrased it. Examples were also taken from the same Textbook but seem to be irrelevant.</td>
<td>Factual information with some processing of information</td>
</tr>
<tr>
<td>4</td>
<td>Students gave a brief history of Green Revolution.</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Information gathered by the students was not known taken from which Textbook or Resources.</td>
<td>Original information</td>
</tr>
<tr>
<td>6</td>
<td>A Picture of Dr. Norman Borlaug was taken from <a href="http://www.emory.edu/carter_center/bio/borlaug.htm">www.emory.edu/carter_center/bio/borlaug.htm</a> (as reflected on the PowerPoint slide)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>A brief history of Norman Borlaug but was no known taken from which Textbook or Resources.</td>
<td>Factual information with some processing of information</td>
</tr>
<tr>
<td>8</td>
<td>A brief history of Norman Borlaug but was no known taken from which Textbook or Resources.</td>
<td>Factual information with some processing of information</td>
</tr>
<tr>
<td>9</td>
<td>This chart that shows the impact of Green Revolution has no titles, labels and the figures were not known. Factual information with some processing of information taken from which Textbook or resources.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Facts were gathered and summarised from the Textbook: Interactive Geography Elective. Page 74 - 75</td>
<td>Factual information with some processing of information</td>
</tr>
<tr>
<td>11</td>
<td>Facts were gathered and summarised from the Textbook: Interactive Geography Elective. Page 74 - 75</td>
<td>Factual information with some processing of information</td>
</tr>
<tr>
<td>12</td>
<td>The first 2 paragraphs were taken and summarised from the Textbook: Interactive Geography Elective. Page 73 (Its impact on rice communities in Asia. Paragraph 4 and 5). But the last paragraph was not known taken from which Textbook or other resources.</td>
<td>Factual information with some processing of information</td>
</tr>
<tr>
<td>13</td>
<td>They presented the individuals' views on whether to accept Green Revolution into 3 parts: Farmer's view. Children who agreed and disagreed. Information given by the farmer was original and was not quoted from any Textbook or other resources.</td>
<td>Factual information with some processing of information</td>
</tr>
<tr>
<td>14</td>
<td>Information given by the farmer was original and was not quoted from any Textbook or other resources.</td>
<td>Original information</td>
</tr>
<tr>
<td>15</td>
<td>Information given by the student was original and was not quoted form any Textbook or other resources.</td>
<td>Original information</td>
</tr>
<tr>
<td>16</td>
<td>Information given by the student was original and was not quoted form any Textbook or other resources.</td>
<td>Original information</td>
</tr>
<tr>
<td>17</td>
<td>The farmer's child reasoning for not using Green Revolution was quoted from the Textbook: Our World. Page 51 (Negative effects)</td>
<td>Factual information with some processing of information</td>
</tr>
<tr>
<td>18</td>
<td>Further reasoning was also given as she quoted them from the Textbook: Our World. Page 52.</td>
<td>Factual information with some processing of information</td>
</tr>
</tbody>
</table>

Table 2 (table continues)
Table 2 (continued)

<table>
<thead>
<tr>
<th>Slide No.</th>
<th>Description</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>19</td>
<td>The students concluded that they disagreed to Green Revolution. Texts were originally created by them.</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>List of the group members: Zinnura, Murshidah, Iryani, Fazila and Alwiyah acts as the Farmer, Wife, Children who agreed and the only child who disagreed respectively. End of Presentation.</td>
<td></td>
</tr>
</tbody>
</table>

Classroom observations suggested that while there were a few cases whereby group members take on one of the five elements of the "learning together model" (Johnson & Johnson, 1999), as an extra role when there was a need (positive interdependence, learning to lead in a group, learning to carry out the roles, learning to cope with uncooperative people, and exclusion from the group) this was not well-developed in the groups studied for this study. Furthermore, students also complained that time was a constraint. They usually had activities after school that hindered them from meeting for discussions or internet searches. These groups often not work well on WebQuest™.

There is also the knowledge that students and parents in Singapore generally perceive education to be a competitive endeavour in which there is a need to out-do their peers. Cooperation may thus be perceived as counterproductive to such competitive efforts. While this speculation requires further evidence, the existing study shows that cooperation is indeed lacking. If most of the basic elements of the Johnson and Johnson model, which is a very general and applicable model, are not well developed, then there is a problem with students working in a cooperative group setting.

Summary of Results

Students appear to be apathetic or motivated by a number of factors including the presence or lack of intrinsic motivation for the subject matter, grades, and marks as well as motivation arising from the use of the web itself. The lack of intrinsic motivation is also noted by the teachers. In fact, teachers strongly attributed this lack to poorer academic ability or the general lack of self efficacy. The strength of WebQuest™ is an observable learning outcome. Clearly, teachers feel that students were only able to recall information. However, they were also able to demonstrate varying amounts of frequency recalling, understanding, applying, analysing, evaluating, and creation cognitive processing in both learning content specific and non-content specific knowledge and attitudes. Four main issues arose out of studying the students'
while there were a few cases five elements of the "learning as an extra role when there was ead in a group, learning to carry active people, and exclusion from e groups studied for this study. me was a constraint. They usu­them from meeting for discus­not work well on WebQuest™. s and parents in Singapore gen­endeavour in which there is a us be perceived as counter pro­his speculation requires further ulation is indeed lacking. If most son model, which is a very gen­oped, then there is a problem setting.

Scaffolding

Scaffolding refers to the range of supports that learners receive in their interaction with "teachers, tutors, and different kinds of tools within a learning environment" as they construct meaning of the information gained (Halttunen, 2003, p. 376). But, scaffolds are not permanent structures and should be removed in the completing stages of the construction lest they impede rather than facilitate the final and finer processes in the learning.

This study has shown that the degree of scaffolding which accompanied an ill-defined problem was not sufficient in guiding students to really solving the problem. Teachers, students, and the researcher all felt that more guided instruction will likely improve the situation. While inquiry-based learning can vary between very ill structured to those with very fixed structures, the chal­lenge will be to design an inquiry-based learning activity where the scaffolds sufficiently guide students in their task while not changing it into a tradition­al instructivist non-inquiry activity. The view presented by Peterson, Caverly, & MacDonald (2003) that a WebQuest™ framework can engage “students in electronic primary source texts and guiding them to use those texts to draw conclusions that are not simply reported but explored and defended.” (Peterson, p. 39) is not clearly evident in these data. Apart from a lack of skill in searching for information, students did not show that they much went beyond reporting facts. While Bernie Dodge’s (1997) conception of WebQuest™ did not include scaffolding as an explicit item in its design, he has included the idea on the web page recently, and in the recent workshops that he has conducted. Certainly the original WebQuest™ approach has vast potential for using scaffolding to guide student exploration and inquiry. Perhaps, by explicitly including scaffolding as an important element of the WebQuest™, we could get students to report, explore, and defend the information they have found and the conclusions they have drawn.
Therefore, the improvement to the existing activity may take on a more learner-centred activity design or more structured scaffolding within the inquiry-based learning activity. In essence, the solution is to adopt a more reflective rather than prescriptive approach. Indeed, McAllister (1995, p. 404) suggests that “the teacher should be prepared to give his or her time with groups of inexperienced pupils, offering encouragement showing interest and asking questions. However, advice and direction should be kept to a minimum.” Clearly teacher intervention should be present, but it should not interfere with the students’ inquiry. Scaffolding is meant to be removed in stages through the progress of the activity. The proficiency in guiding groups will probably grow with practice. This is also a possible area for future research, especially in how task designs and group management influence learning.

Learning together?

Richards (2004) suggested that WebQuests™ provide contexts for students to “collaboratively or individually engage with the use of ICT for information resourcing”. While the teachers and students have strong claims on their group work abilities, the observations from the current study did not find any supportive evidence. In fact, the opposite seems to be true. The five elements of Johnson and Johnson’s (1999) model were not observed to operate with students in this study. The student group in this study generally showed a lack in almost all elements. While the element of positive interdependence was not observed in the groups, students were able to state that they had learned that “it was important to work in a group.” This learning outcome indicates that students had some awareness by the end of the activity; that it was important to have positive interdependence. However, there is still a need for teachers to monitor groups’ progress for these elements. Surely they can choose and use whichever cooperative learning structures they desire, but the key problem is that teachers assumed that students were proficient group workers. Students began the project believing that they were equipped with group work skills too. The unfortunate reality is that students were unable to demonstrate that they could work in a group and facilitation by the teacher was minimal. It is important to include monitoring and facilitation at each stage of the project. Perhaps the scaffolding structures within WebQuest™ can be used to this end.

Furthermore, at a very practical level, there is the perpetual problem of insufficient time after school for students to meet. This is not helped by the numerous activities in school after curriculum time, including, study hour, remedial lessons, co-curricular activities, and so on. While the ideal situation is
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for students to conduct their own research on their own time, this problem of time constraint may indicate the need to rethink the design of the activity so that at least some parts of the research and group work should be done during class time. Teachers may protest that this is not viable as there is already insufficient class time to cover the topics in the syllabus. Perhaps one viable recommendation is to incorporate such student-centred activities within curricular time.

Conclusion

In an article by Bopry and Hedberg (2005), a classroom scene from Chapter 12 in Rowling’s (2003) Harry Potter and the Order of the Phoenix was used to illustrate a point about learning. The students at Hogwarts School wondered why they had to sit and read a chapter in their textbook during each Defense Against the Dark Arts class. At one point, Hermione Granger asked what purpose did reading the textbook serve when the point about the class was to practise defensive spells. Professor Umbridge, the teacher, suggested that as long as the student has studied the theory hard enough, “there is no reason why you should not be able to perform the spells under carefully controlled examination conditions.” Harry Potter’s response of “And what good’s theory going to be in the real world?” was answered by “This is school, Mr. Potter, not the real world” (Rowling, 2003, pp. 244)

Much like the Hogwarts classroom, the real world contains many classrooms in which learning is assumed to occur when students follow some prescribed steps. Worse yet, some classrooms may still be typified by the reading from the book (author’s own terminology) pedagogy. Professor Umbridge’s stand that “As long as you have studied the theory hard enough, there is no reason why you should not be able to perform the spells under carefully controlled examination conditions” does not seem reasonable as we know many factors that can explain why studying theory alone will not ensure success in the practical application of theory, even in controlled examination conditions. However, these authors do not suggest a radical approach in which the learners are left on their own to explore and experiment, as well. In the story that follows the classroom scene above, students worked together by electing Harry Potter to impart his skills (Harry has demonstrated the ability to cast Defense spells in earlier books) through secret practical sessions. Perhaps students would benefit more if the teacher had adopted an inquiry approach which incorporates some degree of scaffolding and allows students to learn together.

Scaffolding and learning together are important issues to address when we translate theory into practice. Harry’s classroom has shown us that stu-
Dents do have their own concerns. No longer are students passive recipients of instructions, but they have great potentials in constructing knowledge from the information that they encounter. Stahl (2005, p. 1) suggests that even with all the advancements made in the conditions of life throughout the world ... most teachers in today’s world do not find their jobs easier or more personally satisfying than those who taught before them. For far too many teachers, their work today is no easier and is more complex than their work in past years. There are many reasons why today’s teachers have to work harder, more efficiently and more appropriately to help students attain and maintain the information, constructs and abilities that we want them to learn.

Indeed, the teacher’s role now extends beyond instructional facilitators to that of facilitators of inquiry. Without the facilitation that provides scaffolding and guidance to group work, the actual practice of web-based inquiry-based learning will not be implemented in an effective manner.

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beyond instructional facilitators: facilitation that provides scaffold-practice of web-based inquiry-effective manner.


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