An Experimental Study of Students' Style in Using Internet Information to Assist Their Study and Learning

Philip Tsang
Open University of Hong Kong, HKSAR, China
Internet Special Project Group, Australia
drphiliptsang@gmail.com

Sui-Sang Mok
Open University of Hong Kong, HKSAR, China
ssmok@ouhk.edu.hk

Reggie Kwan
Caritas Institute of Higher Education, HKSAR, China
rkwan@cihe.edu.hk

Paul Kwok
Open University of Hong Kong, HKSAR, China
ckkwok@ouhk.edu.hk

ABSTRACT

Students today have grown up within a world of pervasive technologies including mobile phones, digital cameras, MP3, iPods and the Internet. They write blogs and compile social relations and connections on Facebook, play WiFi-enabled PSP and NDS games in immersive 3-D worlds, listen to podcasts, write instant messages to friends, listen to music and author their own videos for YouTube. Their default reference libraries for research have become 'Google' and other research engines. These technologies are new landscapes that prompt educators to consider different ways of interacting with or engaging students. One common trend is that teachers may relinquish their role of being an authoritative source of knowledge to the Internet, on which students can gain access to a massive and varied amount of information sources to assist their learning and study. But exactly how useful and effective this mass medium is to them depends on how they select and make intelligent and discrete use of the information they have gathered. In this paper, we (the researchers) discuss two experiments conducted with the aim to find out the style with which students select and apply Internet information to tackle the tasks of distinguishing similar terms or expressions given in a course assignment.

Our exploratory results suggest that questions which required subject Searching the net, demanded appropriate physical Involvement in the Reasoning process seemed to help the subjects draw a more reasonable answer.

Keywords: *Learning Theories, On-line Game, Web Game, Searching-Involvement-Reasoning (SIR), Blog*

INTRODUCTION

An Internet year is said to be of 55 calendar days (Rikhy, 2000). An ordinary year is approximately 6.5 Internet years. Through the Internet and the Web, we experience impacts of the information age in three major ways: a) compression of time, b) overcoming geographical separation, and c) restructuring of relationships. Time appears greatly compressed, since we can find useful information on the Internet very quickly. Geographical separation virtually disappears as information is often just a fingertip away and is globally available. Finally, human relationships within virtual communities differ to a large extent from traditional human relationships.

Social, global, cultural and educational competitiveness have changed the way they operate. A common theme among these changes is the diffusion of information and misinformation which affect the learning styles, duration and method of learning. In the one-room schoolhouse that dotted North American and Australian landscapes during the pioneer era, the responsibilities of teachers were challenging — to say the least. The teacher performed multiple teaching and non-teaching functions. It was obviously impossible for one teacher to provide constant direct instructions to 30 students in so many grades. Most of the learning in the one-room school took place as children in one grade worked in a peer–learning group while the teacher was providing direct instruction to children in another grade. These various teaching functions are now being replicated in a new "pioneering" context — that of online learning — to which this paper will also turn to.

There has been a paradigm shift in terms of teachers' roles. As facilitators of learning, they are no longer the authority, or the most knowledgeable of the knowledge they teach. Learners in the information age no longer take whatever it is from the facilitator. Through the ready availability of information from the Internet, they may get much more information than the teacher has on a topic. They may also build their communities of learning a particular area of skills or knowledge. People, children in particular, learn a lot of new skills, protocols and knowledge from the cyber space and make friends in the virtual global village. Academics are also making extensive use of e-libraries, search engines, e-journals and feeling the academic impact of *scholar.google.com.* It is here we see attention given to Computer Mediated Communications, CMC for short, and cognitive styles of human reasoning concerning task, context and contents are of paramount importance. The quantity of information instantly accessible on the net is astonishing. The net offers information and data from all over the world. Because so much information is available on the net, and because that information can appear to be fairly "causal and non- authoritative", students often lack the necessary skills to critically evaluate what they find. Some authors consider "Internet offers easy answers to difficult questions… It is filling but not necessarily nutritional content". (Sharma, 2008)

Interpretative and searching project will shed light to prepare us better in the information age. These projects will also assist us to work, learn, play and plan better in the new information era. This is the line of thinking this paper takes. In the following sections, we provide the theoretical framework of our *SIR* (*S*earching-*I*nvolvement-*R*easoning) experiments, experimental design, findings, discussion and conclusion of our exploratory experiments.

THEORETICAL FRAMEWORK

There are three reasons why we began the paper with a look back at the Internet history and pioneer period schooling. The first reason is very much the quotation "*If we know history, we will be prepared for the future*". The second reason is that it serves as an analogy to the time consuming, multi-tasks and often frustrating experience of twenty-first century "pioneer teachers" and "learners" in online learning communities. The third reason, which is more from the learners' perspective, is the fast diffusion of information and misinformation which affect the learning styles, duration and method of learning. It is our belief that the *SIR* type of learning is important in the information age. As such, it is important that we be able to see things in the right perspective and right premise. We begin this section with another quotation which is not from others but from us:

> "*If one knows history, **sees things in the right perspective** and **right premise**, one will be better prepared for the future in the information era*."
>
> Internet Special Project Group

In the previous section, we looked at the Internet history, and in the next two subsections we touch on the major disciplines that help us to put things in the right perspective and to see the right premise. These include: concepts of computer-mediated communications, learning style theories, and reasoning.

Seeing Things in the Right Perspectives

In the context of this paper, several important concepts may assist us to see things in the right perspectives. These are computer-mediated communications (CMC), learning style theories, virtual community and virtual gaming.

CMC and learning style theories

In the past few years, CMC, especially Internet communication, has emerged as a fast-growing area of research. It and its related disciplines such as e-learning and virtual communities have also attracted the interest of academic scholars from various fields, including communications, law, business, and computer science, among others. Game experimenters and educators are in a position to make a unique contribution to online communications, since games and language are involved in Internet CMC in the most fundamental way. CMC is comprised overwhelmingly of textual representations of language and is the common denominator for the majority of the Internet communication. Games, which make use of technologies such as artificial intelligence, simulation, video and audio, are becoming increasingly important in virtual communities.

In the literature, a number of systems exist for describing learning styles. Kolb (1984) suggests that there are four stages that follow on from each other to complete the cycle of learning: concrete experience, reflective observation**,** abstract conceptualization**,** and active experimentation**.** Honey and Mumford identify Activist, Reflector, Theorist and Pragmatist as the four main learning style preferences.

Most students have elements of more than one learning style. With the formation of virtual communities, what becomes the natural style of the learners is closely related to their community of learning — and many Internet learners are pragmatic. Of particular relevance to our online learners is the pragmatic style of learning. Pragmatic learners are eager to try things out. They like concepts that can be applied to their job. They are practical and down to earth.

Virtual communities and computer gaming

Typical virtual communities include those formed by using Internet Mediated Communication tools/systems such as MUDs (Multi-User Dungeon), MOO (*MUD object oriented*), IRC (Internet Relay Chat), chat rooms and electronic mailing lists, discussion forums, Weblogs and Wiki.

A MUD is a multi-player computer game that combines elements of role-playing games, hack and slash style computer games, and Internet messaging chat rooms. In the world of MUD, residents read descriptions of cities, objects, events, and computer-controlled creatures or non-player characters. They may interact with each other with their own coined words and phases that resemble natural language. MOOs, as a variation of MUD, are popular in open education as exemplified by the Diversity University and research work done by our Internet Special Project Group colleagues in Australia. In the early days of the Net, virtual communities as exemplified in MUSH/BUD/MOO that combined elements of role-playing games, computer games, and social chatting halls.

Today, "virtual community" is more loosely used and interpreted to indicate a variety of social groups connected in some ways by the Internet.

More recently, another form of virtual community has formed. This is known as Weblog, which is often shortened to blog. Blogs often provide commentary or news on a particular subject, such as news, specific topics or personal online diaries. Most blogs are primarily textual links to other blogs, web pages, and other media related to its topic. The communication that takes place in the virtual communities could be in simplex (one way), half-duplex (one way at a time) or in full duplex (simultaneous) mode.

Seeing the Right Premises

We are constantly bombarded and overloaded with information (which stretches across the spectrum from spam to highly relevant) from traditional media and the Internet. We consume, file, and discard information every second. We search, collect, filter, analyze, interpret, decide, conclude, and select daily. As such it is of paramount importance in understanding the reasoning related to tasks, as we shall see in the following sub-sections.

Human Reasoning Related To Task

> *"How do people solve problems?" "Why is psychology unable to explain how people solve problems? Perhaps it is because psychologists have not yet identified the problem that needs to be solved in order to answer this question."*
>
> Margolis (2000)

Over the past few decades, reasoning has been the focus of enormous interdisciplinary attention, attracting interest from philosophers, psychologists, advertisers, marketers, and even education managers. The widespread interest in the topic reflects the central status of reasoning in human affairs and the competitiveness in the information society. How do people solve problems? There are the linear (Newell & Simon,1972) and the parallel models (Prudkov & Rodina,1999).

Modern logic provides accounts of both interpretation and derivation, which work together to provide abstract frameworks for modeling the sensitivity of human reasoning to task, context and content. The pragmatic learning style of learners — together with the semantic distinction between descriptive and denontic rules — interacts with the task specifics to provide certain insights in our exploratory study of meanings of the following duples [(Online Game), (Web Game)] and [(research), (experiment)].

Wason's Selection Game

Wason's game is probably the most intensively studied task in the reasoning literature. The original Wason's selection game as it was quoted in Stenning and Lambalgen (2003) is repeated below:

Here are four cards, of which you can see only the exposed face but not the hidden back. On each card, there is a number on one of its sides and a letter on the other.
Cards: **A K 4 7** Also below there is a rule which applies only to the four cards. Your task is to decide which of any of these four cards you must turn in order to decide if the rule is true. Don't turn unnecessary cards. Tick the cards you want to turn. Rule: If there is a vowel on one side, then there is an even number on the other side.

Figure 1: The Wason's Selection Game

In essence, close to 50% of his students (Approx 50) chose to turn A and 4. Only 5 of the subjects chose to turn A and 7. Wason (and the great majority of researchers up to the present) assume that correct performance is to turn the A and 7 cards only. In later section, another view of the 'correctness' will be presented as the game has continued to draw debates among researchers and scholars. For our readers who are formal logic oriented, the following translation makes the game rule and question more precise.

1. $F(x, y)$ `x is on the Front side of card y'
2. $B(x, y)$ `x is on the Back side of card y'
3. $O(x)$ `x is a vowel'
4. $E(x)$ `x is an even digit'

and the rule is then translated as the following pair

$$\forall c\,(\exists x\,(F(x, c) \wedge O(x)) \rightarrow \exists y\,B(y, c) \wedge E(y))$$
$$\forall c\,(\exists x\,(B(x, c) \wedge O(x)) \rightarrow \exists y\,F(y, c) \wedge E(y))$$

From Premises To Conclusion

Most reasoning studies are interested in how subjects chose action from premises in the process of selection. But premises have to be interpreted before any conclusions can be drawn. Although premise interpretation has received recurrent attention, the full range of dimensions of interpretation facing the subject has not been considered in the online environment. Our general thesis is that integrating accounts of interpretation with accounts of derivation could lead to deeper understanding of life-long learning in the online environment.

What Is the Caveat?

When one is making a decision or selection of choices, formal logic suggests one should be concerned with reasoning about the natural language conditional "if ... then'. The selection task assumes that the logical form assigned to such IF THEN conditions should be the connective → with semantics given by propositional logic. That is what Wason used to derive his answer in section 2.2.2 of this paper. Stenning and Lambalgen (2003), however, take an opposite position on the subject and play down the complexity approach of assigning logical form in the process.

They argued,

> "*It does not make sense to determine a priori what is the right logic. This depends on one's notion of truth, semantic consequence, and more. But once these parameters have been fixed, logic as the mathematics of reasoning systems, determine what is and isn't a valid consequence*."

They presented the reasons that it is of fundamental importance in determining the type of quantifiable characteristic or feature that goes into the definition of what a logical system is, and, of course, the psychological purpose that might lead subjects to choose one or another setting in their reasoning. There is a different purpose and thus important distinction between following the case of "reasoning *from* an interpretation", and "reasoning *for* an interpretation."

The crux of the matter lies in natural language formation of the premises that lead to potentially different interpretations of the given "facts" and "intended task"

Evaluation of meanings on the Web

In our semantic and pragmatic Internet experiment, instead of being given concrete premises or definitions, subjects of our experiments have to search the net for meaning of the words under study (more in Section 3). They turn to the Net for information. Given the wide range of other meanings of the words, the subject must read and bracket his or her own most prominent meanings for the key concepts involved. However, the "bracketing" process is what subjects with little logical training typically found hard to do.

While traditional knowledge is crafted on a dictionary, the web provides a totally different game and challenges this concept.

The thesis is that the new generation has a much greater dependency on the web for knowledge and meanings. They will continue to coin new terms and the diffusion rate will be fast. While we see meanings of "research" and "experiment", but as users we depend on the net for information and draw conclusions based on it, we see a new virtual society with its own meanings. In the following we report on two exploratory studies into how students' reasoning tasks occur in an online environment.

EXPERIMENT

Determining what the appropriate logical form is in a given context involves as much reasoning in itself as does the selection of the task. Aiming to encompass the great variety of logical systems, the literature has two popular approaches: syntactic and semantic. On the syntactic approach (see Gabbay (1993)), a logical system is defined by a derivability relation between sentences satisfying certain minimal properties.

In our case, instead of giving our subjects concrete premises or definitions, they had to search the net for the meaning of the two words under study. Just like many in the information generation will do, they turned to the Net for information. To explore how learners find out new concepts related to terminologies, —and draw conclusions — two experiments in online settings were conducted. The authors asked undergraduate students in a network programming class to use the web for two tasks: (1) to find definitions of "online game" and "web game" and then categorize two games (which were given as part of the task, and accessible via web browser) as one or the other; and (2) find a definition of "research" and "experiment" and describe how the two concepts were related by classifying it into one of the five relations investigated.

Method

Participants and Design. The subjects were 159 undergraduate students in a distance learning class of 189. Based on a certainty factor of 95% and an acceptable error of .10, this sample size is acceptable. The response rate was 84% with 159 students attempting the tasks assigned. The experiment was conducted in five groups and the tasks were given as part of their Tutor Marked Assignment (TMA) in 2007-8 presentation. Students downloaded the TMA from the course Open Learning Environment with IBM's Lotus Notes as backend server.

Materials and Procedure.

The last question (question 4) of the TMA reads as:

Instruction This question is related to one of the network games exercises that you will encounter in later TMAs.

(a) Use your favorite search engines/electronic resources to find TWO definitions of 1) "Online Game" and 2) "Web Game". (Please bookmark the urls /sources as you will need to access the same pages again in your next TMA). Compare and contrast "Online Game" and "Web Game".

(b) Compare the two games illustrated in Figure 4.1 and Figure 4.2. Which one is an online game and which one is a Web game?

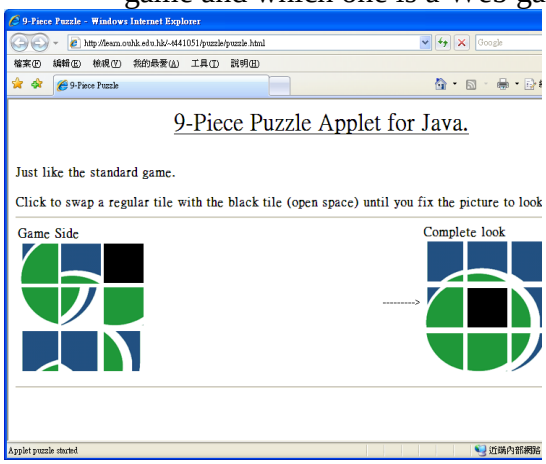


Figure 4.1 : Puzzle Design
http://learn.ouhk.edu.hk/~t441051/puzzle/puzzle.html

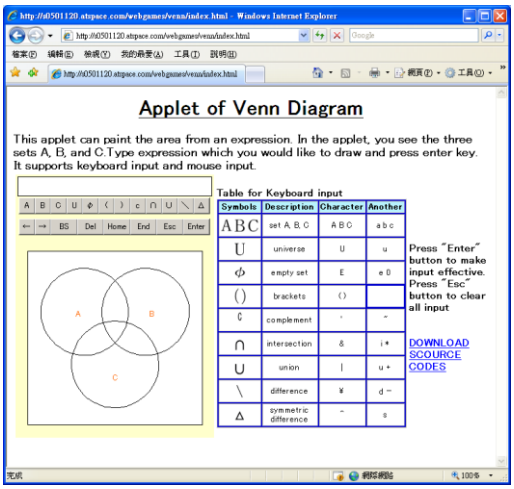


Figure 4.2 Applet of Venn Diagram
http://s0501120.atspace.com/webgames/venn/index.htm

(c) Use your favorite information resources to find FOUR definitions of 1) "Research"; 2) "Experiment".

(d) Based on your findings from question Q4.c, how are these two concepts related? Use "game research" and "game experiment" to support your discussion. Your discussion is likely to fall into one of the following five categories (See Figure 4.3). In your answer, you should state which category (i.e., 1, 2, 3, 4 or 5) you are supporting.

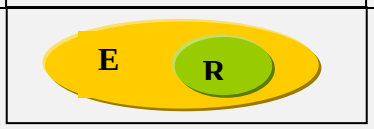
Cat	Description	Relation in E Venn Diagram	Mathematical Model
1	Research (**R**) and Experiment (**E**) are two distinct Concepts		$E \cap R = \varnothing$
2	Experiment is part of Research		$E \in R$
3.	Research is part of Experiment		$R \in E$
4.	Research and experiment are two different concepts but they do share common areas		$E \cap R \neq \varnothing$
5	Others: please illustrate with examples.		

Figure 4.3: The Interrelationship of "Research" and "Experiment"

The experiment attempt rate was 84%. The consolidated results are presented in the next section.

Results and Discussion

For the question comparing the two games (Applet of Venn Diagram and 9-piece Puzzle Applet

for Java), and selecting which one is an Online Game and which is a Web Game, the result of the groups are presented below:

	Order Pairs	**(O,O)**	**(O,W)**	**(W,O)**	**(W,W)**	**Others**
	Respondents	**3**	**23**	**19**	**110**	**4**
	N					
G 1	32	2	4	3	22	1
G2	33	0	4	4	24	1
G3	30	0	4	4	21	1
G4	30	0	6	3	21	0
G5	34	1	5	5	22	1
Total	159	3	23	19	110	4
		1.89%	14.47%	11.95%	69.18%	2.52%

Table 1: Raw results of the game experiment

The order pairs have the following meanings:

(O,O), Both are Online Game
(O,W), Applet of Venn Diagram is an Online Game and the Puzzle Applet is a Web Game
(W,O), Applet of Venn Diagram is a Web Game and the Puzzle Applet is an Online Game
(W,W), Both are Web Games

The modal response (70%) was (W,W). That is, both Applet games are Web games. The next most common answer (14%) was (O,W).

In the question of finding the relationship of the 2-tuple [(Research), (Experiment)] using Game Research and Game Experiment as a reference, the results are summarized in the following table:

		Category				
	Respondents	**1**	**2**	**3**	**4**	**5**
G 1	29	0	8	0	19	2
G2	31	1	9	3	12	6
G3	35	0	9	2	20	3
G4	32	1	5	0	23	3
G5	32	1	6	1	17	7
Total	159	3	37	6	91	21
		1.89%	21.89%	3.55%	53.85%	12.43%

Table 2: Raw results of "Research" and "Experiment"

The modal reply of the second experiment is that only 54% of the subjects got the "formal answer" — Category 4 — correct. The next most common answer was category 2.

Running a Chi-square test similar to that of Hattori (2002), $\chi^2(1, 151) = 23$, Ps=0.001 on the two sets of results of the two experiments, the difference in the 'logically expected' answer obtained

in the two experiments is statistically significant as the following Chi-square simulation indicates:

Correlations of Games and R&E

	Category 4	**Other Category**	**Total**
(W,W)	70	25	95
Not (W,W)	19	37	56
Total	89	62	151*

Degrees of freedom: 1
Chi-square = 23.0093
p is less than or equal to 0.001.
The distribution is significant.

* It is not 159 as some data were discarded

The result suggested a high correlation of the "correctness" between the answers to the two questions. Most students got both answers 'correct' followed by students getting both answers 'wrong'.

CONCLUSION

As the Internet has become an integral part of life, the public is becoming more and more dependent on the net for information and reference material that can help us to understand/interpret the meaning of a given premise when faced with a problem or question. In experiment conducted, the principle concept applied was "*SIR* — *S*earch, *I*nvolvement, *R*easonable-interpretation". In both the experiments, the types of characteristics of the online reference resources used by the subjects were widespread. It was found that "how" and "where" they "*Searched"* information does matter. For example, a few of the students searched WordNet for information. Other used the advanced Google techniques such as "define:" to find the meanings of the words "Research "and "Experiment". It is suspected (as one would normally assume), what reference they used affected how they understood the premise and drew conclusions.

From the exploratory results, it could be concluded that selection questions which demanded appropriate physical *involvement* in the reasoning process seemed to help the subjects draw a more reasonable answer as the case of two Applet games might have implied when compared to the more theoretical selection game of "Research" and "Experiment". This is in line with the general constructivist approach of learning, which argues that learners must actively "construct" knowledge by drawing it out of experiences and have meaning and importance to them (Dewey, 1996) (Roussou, 2004). The subjects (learners) in the experiments constructed their own knowledge by testing ideas and concepts based on their own or others' prior knowledge on the Internet.

When all the "incorrect" answers (in the case of Game Research and Game Experiments) were examined, at least 25% of these answers were worth giving credits. This is because accepting only the logical form as the basis for reasoning is not pragmatic. Subjects or learners should also be judged on the appropriateness of their selection based on any *reasonable interpretation* of the question.

Possibly Bernstein (2000) theory of pedagogical codes may offer some explanation. Students may interpret the context of the questions differently. They may interpret the two questions as something like an ordinary daily chat where their own opinion and beliefs are on the foreground. Without doubt, they can equally find some web-pages which contain opinions expressed similar to their own and may select these web-pages as their supporting evidence. On the other hand, there may be some who consider the questions using what Bernstein coined as extended pedagogical code. In such a way, the questions are requesting to find definitions that would be acceptable to the community with the same academic orientation. These students would likely select web-pages with a technical orientation and therefore be able to forward the "correct" answers. In brief, students are not only constructing the solutions to the questions, they are at the same time constructing the meaning of the questions and also the nature of the course/subject they are tackling. (Marton, 1997)

Throughout the study, it was found that educators can take home a variety of lessons from the outcomes obtained in this experiment. Since the manner and source used by subjects can affect interpretation, instructors can help their students to better understand assignment requirements. Put simply, educators may need to define the scope as well as the methodology (including the interpretation of the questions, the search engines, portals, and even parameter usage) to enable students to find the answers that are deemed "correct". Moreover, educators should be aware of their own academic orientation (pedagogical codes) and be prepared to accept as many answers as possible if such limitations on the front are not provided. Otherwise, the instructor can expect a lot of appeals and grade changes when those cases are successfully challenged by students.

From the perspective of Web development, attention must be paid to how end-users engage in the SIR process. This experiment was conducted using two simple words and yet it generated diverse interpretations. While it is true that the difference is small and there is room for reasonable judgment in this case, there are cases where only one logical form is acceptable. Medical terms and treatments are two such examples. Self interpretation and application can be disastrous. Perhaps, some form of industry standards may be appropriate to minimize the diverse results and interpretation that can be obtained.

Most of all, the experiment and outcomes show that the search for knowledge using the World Wide Web has a lot of room for improvement. In particular, advancement in the area of reasoning may require the combination of experts from all areas. Yes, the Web search process and term extraction can be made faster and more refined by information specialists. However, that does not ensure users needs are met. In particular, attention must be given to how the search process is initiated. Then, an understanding of what user processes are involved is necessary. Finally, why such an interpretation is derived by the user must also be examined. All in all, this means that linguist and other behavioral scientists are just as important as the

technical specialist in the development of global Web-based knowledge enterprise portals that can actually deliver the type of information that is germane to the needs of a specific end-user.

ACKNOWLEDGEMENTS

The authors want to record our appreciation for the collaborative work with Ken Eustace and Geoff Fellows, both of the Internet Special Project Group, for the early work on Web and LamdaMoo in Australia. We wish to thank all the 2005-2008 tutors and students in the OUHK class of CT212 Network Programming and Design. Gratitude also extends to Dr Rex Sharman, Educational Technology and Publishing Unit (ETPU) and Dr Thomas Tang, OUHK, for offering many constructive review comments. We also like to thank the three anonymous reviewers for the many critical and constructive comments. Many of the comments have been addressed in the revised paper. Any remaining shortcomings are ours.

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