Pedagogical and Learning Strategies for Promoting Internet Information Literacy in Singapore Secondary School Students

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Abstract

Internet information literacy has the potential to open the whole world of knowledge to easy access and use. Computer literacy and Internet readiness alone do not empower the learner to capitalise on the use of the Internet to acquire useful knowledge. Without information literacy, the learner would be overwhelmed not only by the information overload but also by being confronted with the amount of unreliable information posted on the Internet. Therefore this paper looks at how the Internet age might influence the ways that students learn and how to capitalise on it to prepare those students for the digital world of today and how to be empowered for the future challenges of the increasing complexities of tomorrow.

The findings indicate that the integration of discipline-specific Internet information literacy into the curriculum is essential before we can enhance student learning using the Internet for resource-based learning. It is also to equip them with relevant information management skills and the ability to learn independently. These are fundamental skills required to become emerging lifelong learners in the midst of an information explosion so as to be able to meet the challenges of the 21st century and the knowledge economy.

Introduction: Learning and Teaching

Does learning primarily take place through memorisation of facts, procedures, routines and specific skills? If effective learning is to occur, based on a Piagetian perspective, concepts and schemata are constructed by the learners (according to the constructivist paradigm) to:

- assimilate the new information into their prior knowledge's cognitive structures
- accommodate by modifying the structures so as to be congruent with the new knowledge. (Shaver, 1992, p. 19)

Learning via memorisation and regurgitation could be obstructing students from becoming active, lifelong learners because what is supposedly learnt will not be meaningful learning so that the students may not be able to apply or make use of what they have learnt in another situation.

So is teaching "the passing on of biases, prejudices, and outdated content to uninterested students" (Shaver, 1992, p. 3)? For effective teaching to occur and to ensure students' ability to internalise the learning content, Silberman (cited in Shaver, 1992, p. 3) advised that the teachers think about the purpose and how that purpose would be affected by the teaching techniques, curricular content and classroom organisation.

To inculcate the lifelong learning mentality, we need to consider whether the learners are being taught the set of tools of subject specific learning strategies and techniques to empower them to explore the Internet. To learn effectively the discipline's knowledge domain, assimilation and internalisation must have occurred before the learners are able to use the knowledge meaningfully and to apply the concepts in contextualised situations. The use of the Internet 'forces' the students to internalise the concepts, to be able to synthesise and make use of the knowledge meaningfully.

Therefore, if the students are provided with access to the Internet for their exploration and self-directed learning, are they going to be able to 'sink or swim'? Providing the students with access to the 'bricks' (information via Internet access) would not necessarily ensure learning as a result (Lim, 2003). This is aligned to Diana Laurillard's remark that "It is as absurd to try and solve the problems of education by giving people access to information as it would to solve the housing problem by giving people access to bricks" (cited in Joint Information Systems Committee, 2002, p. 3).

In considering the pedagogical use of the Internet for teaching and learning, the following key issues might be required to be thought through:
1. What is the purpose of the curricular content that I want the students to learn using educational technology such as the Internet?
2. Is there an alternative and better teaching technique to achieve the instructional objectives, rather than using the Internet?
3. Are the students ready to explore the Internet on their own to construct meaning from what they read?
4. Are the students able to sieve out unreliable information?
5. What prior knowledge will be needed in order that they are able to internalise the learning content from the Internet?
6. What are the sets of tools of subject specific learning strategies and techniques required to be taught to the students for them to attain the instructional objectives and to be self-directed learners?

Background to the Research Study

In the research reported here, an investigation was conducted into the use of the Internet by learners to assimilate the new information and to present and explain their knowledge in a form comprehensible to readers. The 13 participants in the study were from three secondary schools in Singapore and they were 12 to 13 years of age.

The infrastructural framework set up in the majority of Singapore's secondary schools to promote the use of the Internet is highly developed and in some cases the schools are equipped with state-of-the-art computer technology. However, it has been noted that the school curriculum has changed very little compared with the curriculum in the late 1990s, despite the provision of sophisticated computer technology by the Ministry of Education to all the secondary schools since that time.

Moreover, presently there is a dearth of research on the use of the Internet for resource-based learning by younger students and on the integration of the use of the Internet into the school's curriculum. Many of the studies on Internet information literacy have focused on tertiary level students.

Lifelong learning and capitalising on the Internet

The European Commission (cited in Scottish Parliament, 2001) defines 'lifelong learning' as an "all purposeful learning activity, undertaken on an ongoing basis with the aim of improving knowledge, skills and competence". It encompasses not only basic numeracy and literacy but also employment-related skills and formal and non-formal learning throughout life.

In fact, skills that are identified as being essential to participate fully in today's workforce are skills such as the ability to learn throughout one's lifetime and to keep oneself relevant and up-to-date with new challenges and with the advancement of science and technology. Learners are required to know what they need to know, how to get it and how to construct meaning out of it (California Media and Library Educators Association, 1994. p. v).

So what are the attributes of a lifelong learner? A lifelong learner is one who:
- knows how to seek information and knowledge through inquiry (Candy, 2000, p. 275)
- is able to apply the knowledge to solve problems (Candy, 2000, p. 275)
- is able to communicate and explain how to arrive at the solution (Candy, 2000, p. 275; Queensland School Curriculum Council, 1999)
- has depth of knowledge and is capable of complex thinking and insights (Queensland School Curriculum Council, 1999)
- is a reflective and self-directed learner (Queensland School Curriculum Council, 1999)
- is information literate, possessing the ability to locate, decode, evaluate and use information (Association of College and Research Libraries, 2000, pp. 2-3).

In Singapore and elsewhere, the pace at most schools was based on the industrial model with speed and efficiency, as well as the 'productive' utilisation of time and resources, being of utmost importance. Under the industrial model, teachers were regarded as the 'sage on the stage', a view that is counterproductive to the self-directed, engaged learning approach required when using the Internet in this information age (Lim, 2004). Therefore this project was undertaken to analyse how the Internet age might influence the ways that students learn and how to capitalise on

this in order to prepare the students for the digital world of today and tomorrow.

Purpose of the research study

The purpose of this study was to determine whether there is an interrelationship between information literacy and the effective use of the Internet to appropriate knowledge. The intent was to explore the connection among computer literacy, the Internet readiness of the participants, their academic performance and how these would affect the use of the Internet in their search for new knowledge and their academic schoolwork when they had attained that level of information literacy (Lim, 2004).

The Internet offers an immense digital repository of information, and knowledge cannot be gained and applied meaningfully unless students are guided purposefully in accordance with Rogoff's apprenticeships in thinking model (cited in Bruning, Schraw, Norby & Ronning, 2004, p. 199).

This study notes that, even if school students are Internet ready and also possess what is assumed to be an acceptable level of computer literacy, this will not be enough to empower them to make use of the Internet for educational ends and achievement. Internet information literacy is the missing link in the equation that affects the use of the Internet, enabling them to untangle the knots of knowledge to be applied meaningfully in contextualised situations (Lim, 2004).

The assumed level of computer literacy of the participants was gauged from their responses to the survey questionnaire about their use of the features in operating systems such as Windows and also of Microsoft software such as Microsoft Word. They were asked to rate themselves in terms of their comfort-level on a scale of one to five with the definition of the rating as outlined in Table 1:

Table 1: Scale for rating comfort level (Lim, 2004)

0	Have never used before	You have NOT used the item on your own to do a piece of schoolwork or other activities. Using it during the times when you attend the training or when your classmate who is in your group uses it does NOT indicate that you are using it so you have to mark this rating as your comfort level.
1	Not at all comfortable	You have used it on your own but with much difficulty; you prefer to use the usual method instead of making use of the computer.
2	Somewhat comfortable	You have used it on your own but with various people to help you, and you do NOT try to make use of other features that you are not familiar with.
3	Comfortable	You have used it on your own with minimal help from other people, and you have actually gone on to try new features on your own and have some successes and some failed attempts in which you needed to seek help to learn the new features.
4	Very comfortable	You have tried to learn new features on your own and feel very happy and excited with all the successes though there are a few failed attempts.

The frequency of use of the computer and/or the Internet was surveyed in the same questionnaire. With information literacy and language power, students might then be able to utilise the information with a critical eye and internalise the information as knowledge that connects to their existing framework of knowledge. In the process, deeper understanding of the knowledge is attained (Lim, 2004). Thus Internet information literacy is the precursor to the use of knowledge for higher order thinking and knowledge management using the Internet. Information literacy is one strategy of teaching "how to come to know, and not what is known" (Lim, 2004).

Demographics

Out of the 13 Secondary One participants in the study, four also participated in the pilot. The three schools were selected based on the availability of infrastructure for Internet access by the students and on the school principals being believers in, or open to, innovative approaches to teaching and learning. The three schools catered for average and above average students who were from neither the top 5% nor the bottom 5% of the cohort (Ministry of Education, Singapore, 2004a, 2004b, 2004c) and who therefore represented the majority of students (Lim, 2004).

Terminology and intended outcomes

'Information skills' are defined by Wray (cited in Herring, 1996, p. 17) as consisting of all the necessary skills for students to cope well in the information environment which they get into, whether inside or outside school, and include "linking the use of libraries to the wider skills of reading, asking questions, taking notes and generally using the tools of self directed learning." (Herring, 1996, p. 17).

'Information literacy' and 'information skills' are used interchangeably (Herring, 1996).

'Computer literacy' is defined as "the degree to which individuals are familiar with computer operating systems and applications" (http://cyber.law.harvard.edu/readinessguide/glossary.html).

'Internet literacy' is a term used in this study to refer to the degree to which the individual is familiar with the mechanical or operational skills in the use of the Internet – that is, the level of Internet readiness.

The research study was conducted to:
1. Determine whether students with a higher level of computer, Internet and information literacy would be able to make more effective use of the Internet as a source of information and knowledge.
2. Investigate whether it is true that only students who are more highly computer, Internet and information literate are the ones who will be utilising the Internet more frequently for their schoolwork (Lim, 2004).

Thus the objectives of this study were to:
1. Determine the correlation between computer and Internet literacy and information literacy and the effective use of the Internet through the use of strategies and techniques in seeking information and knowledge.

2. Investigate whether the missing link in the equation of using the Internet by the students to seek knowledge independently to enhance their learning could be discipline specific information skills and the facilitation by the teachers.
3. Consolidate the findings of the reasons for using or not using the Internet (Lim, 2004).

In this paper, only the first and second objectives will be addressed.

Significance of the study

A "19th-century education system cannot adequately prepare students to live, learn and work in a global, digital age" (Lemke & Coughlin, 1998, p. 3). The use of technology in teaching and learning, if not integrated into the curriculum, will not ensure that student learning will be enhanced nor can we then claim that we have prepared them well for the digital, technology enhanced working world (Lim, 2004). Luke (1995) comments that the "rules of the game are somewhat different as we head into the next century.…A great deal of service and information-based work, consumption, and leisure depends on their [students'] capacities to construct, control, and manipulate texts and symbols" (pp. 3 and48).

It is increasingly essential for education to inculcate lifelong learning, to facilitate critical thinking, to develop the ability to learn and unlearn and to promote interdisciplinary teamwork in the curriculum. We need to educate students to become lifelong learners in the midst of an information explosion (Lim, 2004).

Using the Internet as an instructional tool to teach students is one of the strategies that educators can deploy to integrate technology with educational value adding into the dimensions of teaching and learning, in consideration of the need for the students to be able to construct, deconstruct, synthesise and manipulate texts, multimedia content and symbols from the Internet (Lim, 2004).

Information literacy is highly desirable in this knowledge economy and should be taught in every discipline. It is imperative that students acquire the 21st century skills such as being learners who are able to seek relevant information from the ocean of information out there from reliable sources and to restructure, repackage and construct meaningful learning experiences (Lim, 2004).

This research affirmed that students' social capital and language proficiency play a significant part in integrating the use of the Internet into their schoolwork. The existence of community networks, the family's social circle and background and their peers, which and who constitute their social capital, can either support or obstruct them in the use of the Internet for their schoolwork. Lack of proficiency in the English language and lack of access to the relevant networks and resources will hinder them in the use of the Internet for school-work and affect their readiness.

Therefore student readiness to use computers and the Internet, planning for computer use and time management must be carefully thought through when blending the Internet for teaching and learning into the traditional curriculum (Stepien, Senn & Stepien, 2000, p. 5).

Methodology

The research paradigm used a case study approach. The choice of the case study method resulted in more accurate information about these particular cases and made it possible to acquire a more intimate understanding of the participants. The minimisation of the reactive effects of the participants could be addressed through intimate knowledge of the participants' behaviour as observed (Lim, 2004). This was used to corroborate the responses given to the questionnaire, to the open-ended questions that the participants completed to describe their feelings about the use of the Internet and to the exercises that they completed using the Internet whilst being observed by me (Lim, 2004).

 The measuring instruments consisted of the following instruments:
- A survey questionnaire to gauge the competency level of the participants' computer and Internet literacy and their Internet usage
- A dialogue session with the group of participants at the start to build up rapport and to make them feel comfortable with me and also to find out about their English language competency, their ability in academic performance and the ranking position of the schools (Ministry of Education, Singapore, 2004a, 2004b, 2004c)
- Two exercises for their completion using the Internet (as a task-based assessment of their information literacy competency levels) with the use of an observation matrix to record their Internet surfing techniques
- An interview or data collection checklist matrix (which was then administered as an open-ended questionnaire owing to time constraints and also because of the slowness of the Internet traffic) to find out more about the characteristics of the users or non-users of the Internet
- An information literacy scoring matrix to score the competency level of the participants' information skills based on the artifacts of the two exercises and with reference to the transcription of the audit trails of the participants' Internet surfing when completing the two exercises (Lim, 2004).

The exercises were of two types. The first exercise was to test the students' ability to search for the information and short, direct answers were required. It was an exercise about the first man to step on the moon. One of the questions read as follows: "In which State in the United States is he now residing? How do you know whether the information is accurate?" (Lim, 2004).

The second exercise required the students to synthesise the information from the Internet and to present the answer in about 30 to 50 words only:

> What are the functions, that is, the uses of the human skin? Why is there a need for the skin layering to exist? Choose any three of the functions of the skin and explain briefly, using words or otherwise, how each of the functions is being carried out by the skin. You need not write in complete sentences. The number of words required is about thirty to fifty words. (Lim, 2004)

The information literacy scoring matrix was designed to determine the students' competency levels based on the artefacts produced when the participants were attempting the two exercises. Four of the 11 skill targets that were being scored were:

1. Appropriate key words, concepts and names identified?
2. Search strategies used?
3. Appropriate sources consulted?
4. Information evaluated? (California Media and Library Educators Association, 1994, p. 1)

The detailed scoring rubrics matrix was drawn up with four scores for each skill target: accomplished; competent; ineffective; and not demonstrated. Percentages were used in the rubrics to demarcate the scoring of the four categories. The percentage was calculated by manually counting the occurrences and dividing by an estimated total in some cases. In other cases, it was done by comparing the 13 participants and by judging the artefacts produced to arrive at a quality criterion.

The quantitative survey questionnaire was used to elicit students' responses to three main aspects:

1. computer and Internet literacy (mechanical) and additional survey questions to determine the students' competency levels in the use of the features of the software for advanced use of computers and the Internet
1. using computer and Internet for schoolwork and assignments and
2. the competency levels of the students' information literacy skills (Lim, 2004).

This leads us to the quantitative analysis of this study.

Findings

Quantitative analysis

From the responses to the survey questionnaire, it was determined that the participants were quite aware of the usefulness of the Internet for their resource-based learning but because of their limited information skills they were not capitalising on the use of the Internet (Lim, 2004). Also they were found to be conversant with the ethical issue of plagiarism and it was observed that they would backtrack to write and restructure their answers when time constraint was not an issue. Most importantly, it was observed that the participants were not able to handle the information overload and were overwhelmed and felt 'lost' in the virtual information landscape of the Internet (Lim, 2004).

In Singapore, the infrastructure and the 'bricks' are there for secondary school students to access the Internet for school related purposes. It was determined from the survey that 11 out of the 13 (about 85 per cent compared to 42 per cent at a high school in Minnesota [O'Sullivan & Scott, 2000]) students relied on the Internet for school related purposes only when there were project related assignments that required them to look for resources. However, it was noted that the frequency of use of the Internet for school related purposes was quite erratic, peaking only when there were such project related assignments. For these students such assignments were quite infrequent (from none to three or four per year). Otherwise the use of the Internet was usually for non-school related purposes.

Similar to Bernstein's research (cited in Faust, 2000) on language acquisition, coding and the differential achievement of middle class and working class pupils, the acquisition of Internet information literacy and the use of Internet to advance their knowledge depend on the social environment that the participants come from. Motivation and self-efficacy in the use of the Internet inspire the students to further their understanding and to seek information and knowledge from the Internet.

Using Spearman's rho correlation test, the findings indicate the following correlations. Note that for ability category and English language proficiency "1" indicates "most competent" whereas for computer competency, Internet competency and information literacy "1" indicates "least competent". This accounts for the negative correlation in the data below:

- Computer competency and frequency of use of computer: 0.680 significance level
- Internet competency and frequency of use of Internet: 0.590
- Computer competency correlates with information literacy (0.675) and Internet competency (0.807)
- Internet competency correlates with information literacy (0.707) and ability category* (-0.673)
- Information literacy correlates with Internet competency (0.707), computer competency (0.675), English language proficiency (-0.570) and ability category (-0.705) and
- Ability category correlates with English language proficiency (0.788) in addition to information literacy (-0.705).

[*Note that the ability category starts with '1' as being 'most competent in their studies' and '9' being the least able among the 13 cases. They were categorised based on their first semester's results, the school's ranking position (Ministry of Education, Singapore, 2004a, 2004b, 2004c) and the streams (Lim, 2004).

Figure 1: Stacked bar chart of frequency of use, computer-Internet competency and information literacy
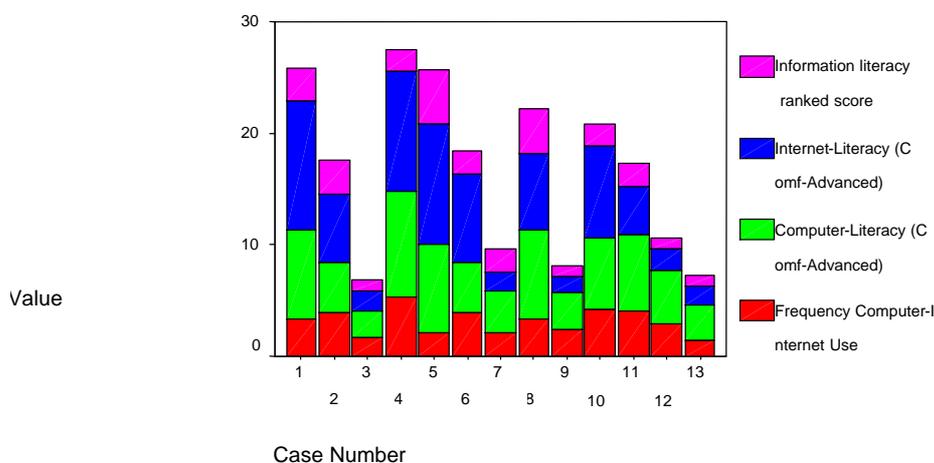
Figure 2: Stacked bar chart of competencies and frequency of use by ability
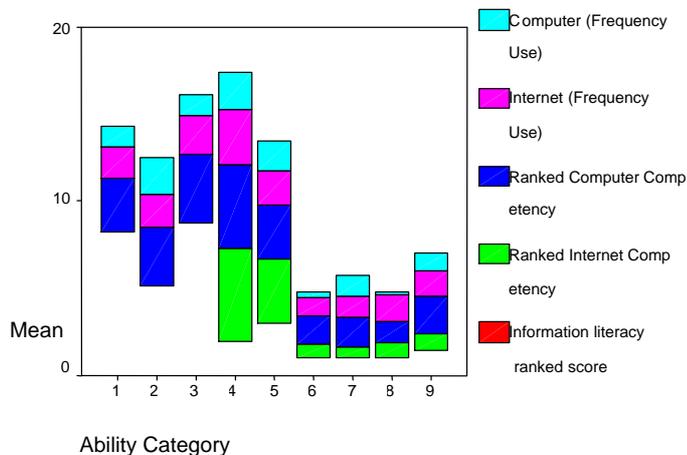
These results show that the statistics using Spearman's correlations verified that Internet information literacy correlated with Internet literacy (mechanical aspect) at a relatively high coefficient of 0.707 and with computer literacy at 0.675. However, it must be emphasised that an Internet savvy student with high computer literacy is not necessarily also competent in information literacy. This is because the results verify that information literacy is also dependent on the students' academic ability and proficiency in the English language.

Therefore the mechanical Internet competency level is not the only factor influencing the competency level of information literacy. However, it does indicate that students must possess a certain level of computer, Internet and information literacy in order to be able to make more effective use of the Internet (as evidenced by the score in information literacy; that is, the higher the score, the more effective the use of the Internet) as a source of information and knowledge. In addition to computer and Internet literacy, factors influencing Internet information literacy are the English language proficiency and the innate academic ability of the participants.

Furthermore, it was borne out by the figures and the statements above that there was correlation between the frequency of use of the Internet for schoolwork and the literacy level of the participants in computer, Internet and information literacy, and also their innate ability.

The findings substantiated the following claims:
- With a higher level of computer and Internet literacy, there is a higher possibility of higher information literacy, as demonstrated by the participants' more effective use of the Internet to seek information and knowledge.
- The more highly computer and Internet literate participants would utilise the Internet more frequently for their schoolwork, even though they might not be highly information literate.

Significance of Findings and Deductions and Inductions

Significance of findings

The significance of the findings is as follows:

- Generally it was observed and determined from the scoring rubrics that the students at Secondary One seemed to lack Internet information literacy skills.
- It was verified that high competency in computer literacy and mechanical aspect of Internet literacy do not imply that Internet information literacy will be learned, but it does indicate that Internet information literacy can be learned provided that the person possesses a certain level of competency in computer literacy and Internet literacy (mechanical aspect).
- Participants were observed to be overwhelmed by the mass of information from searching the Internet among to the lack of knowledge of searching strategies and techniques.
- They were aware of the usefulness and convenience of the Internet for their resource-based learning, as determined from the survey.
- It was determined from the questionnaire responses and dialogue sessions that those students who came from a home background or school conducive to fostering interest in the use of the Internet were found to be more Internet ready and this showed some correlation to the further development of information literacy skills.
- It has been determined that innate ability, proficiency in the English language (from the statistical correlations) and reading motivation (from the observations) were also influencing factors in the acquisition of Internet information literacy skills (Lim, 2004).

It was found that only two of the 13 participants (15%) would be categorised above category one, where category zero denotes "*'Not yet identified'* and 'Expected to find in non IT [information technology] students'" (Edwards & Bruce, 2002, p. 9) and category one denotes: "'*Information searching is looking for a needle in a haystack'* and 'Focus is on the topic'" (Edwards & Bruce, 2002, p. 9) when the learner believes that *"Once I understand the topic I am looking for then I can find it"* (Edwards & Bruce, 2002, p. 9).

Although these teenage students were non-IT students, only three of the 13 participants (23%) were not IT savvy and could be classified under category zero. The remaining eight (62%) were in varying degrees of being IT savvy and could be categorised under category one as they were trying hard to understand by asking me questions and then performing the search as if "looking for a needle in a haystack" (Edwards & Bruce, 2002, p. 9).

Deductions and inductions

The analysis of results confirmed the following deductions and inductions:

1. Computer literacy and Internet literacy are essential for learners to learn Internet information skills.
2. A high competency level of computer and Internet literacy does not imply high competency in Internet information literacy.

3. Other factors essential explicitly for the uptake of Internet information literacy are reading motivation, ability in academic performance and proficiency in the English language.

4. Discipline specific reading strategies for comprehension, learning strategies and self-regulating strategies are also factors influencing the learners' uptake of Internet information literacy. This is because the use of the Internet to learn independently requires learners to know how to interact with the different genres of text form and multimedia content. Also the qualitative analysis of this study (Lim, 2004) justifies the need for reading strategies to be taught to the learners, as the comprehension level of the participants is quite low and this affects the scoring of the information literacy, thereby resulting in being skewed towards the low end of the Internet information literacy score.

5. The lack of knowledge into conceptual areas and related concepts to the question hindered the participants' ability to identify relevant key words to refine the search. However, even when after some exploration the abler participants (abler as in academically) were able to make use of new terms to refine their search, but the less able participants still stuck to the same manner of searching (Lim, 2004).

Limitations and Recommendations

Limitations affecting validity

To make this study feasible within the timeframe, the social capital of the participants was discerned based on the scant information obtained from dialogue sessions of at most 15 minutes in duration and on the writing of responses to the open-ended questions (Lim, 2004). There was a possibility of the participants over-estimating their information skills as they were aware that this could be what I would be looking for (Lim, 2004). Furthermore, the number of participants was only 13 and so the results might not generalise to a larger sample size and to schools of different settings and prevailing climates (Lim, 2004).

Recommendations for future research

This small research project points to the need for quite a wide range of possible research areas into Internet information literacy before we can integrate the use of the Internet into the curriculum. Possible areas for future research include reading strategies and comprehension using the Internet; the relation between social capital and habitus and the use of the Internet; network infrastructure and the use of the Internet in the classroom; the safe use of the Internet; alternative assessment using the Internet; and the provision of resources for disadvantaged students and differentiated instruction using the Internet (Lim, 2004).

To educate and prepare the younger generation to work in the 21st century and to be able to face the challenges of the future, we need to undertake research into the designing of classroom activities making use of Internet information skills to learn discipline specific knowledge. This issue and self-directed, engaged learning using the Internet will be the focus for research in differentiated instruction and Internet information literacy (Lim, 2004).

Conclusion

Internet information literacy skills empower students to capitalise on the use of the Internet for cognitive aspects of the information used. It must be emphasised that it is not just the mechanical skills in finding the information. By equipping the students with effective learning skills through the acquisition of discipline specific information skills and in the use of the Internet, we are empowering them to become self-directed, independent and active learners (Lim, 2004).

We are preparing the learners to become lifelong learners to be able to adapt and 'swim' with the 'tidal waves' in the vast ocean of outpouring information and new developments and changes, adjusting their sails to the winds of the new developments and environmental and landscape changes of the 21st century (Lim, 2004).

Moreover, just as the library provided equitable access to printed resources in the past (when the Internet was unheard of) to poor and rich learners alike, we may want to look into how we are going to capitalise on the Internet to provide resources for all learners, irrespective of the social capital and habitus that the learners bring along with them (Lim, 2004).

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