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Developing a Web-based Two-Tier Test for Internet Literacy

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Introduction

Assessment is an essential aspect of all instruction. Teachers need to know what prior knowledge students bring with them, as well as what and how well the students have learned in class. And likewise, students themselves should be aware of what they have learned, and what they have not yet to learn. Assessment using Web-based networks is definitely an essential part of e-learning (Chou, 2000; Chou, Chang & Jiang, 2000). The main focus of this study is how a Web-based two-tier test (WTTT) is being used for testing. This article first introduces the Web-based two-tier test, and then presents three test items for Internet Literacy learning. Conclusions and plans for future work are also provided.

Web-based Two-Tier Test

The two-tier test is a two-level question presented in a multiple-choice format. The first tier assesses students' knowledge about the particular questions, while the second tier explores students' reasons for their choices made in the first tier. The two-tier test was first introduced by Treagust (1988), mainly for diagnosing students' mis-conceptions or alternative conceptions in science (Tsai & Chou, 2002).

Treagust (1988) suggests that, in order to develop appropriate two-tier tests to diagnose students' alternative conceptions, researchers or test-makers should examine related literature to improve the quality of the tests and conduct unstructured student interviews

to gain a better, in-depth understanding of how students are reasoning. For instance, test-writers make sure students' possible existing (mis)conceptions are included among second-tier choices, and both tier answer combination represents different ways the students can reason about the question. By using the two-tier format, teachers or researchers should be better able to pinpoint students' mis-conceptions and try to correct them.

Traditional two-tier tests, done by paper and pencil, not only require a lot of paper work but also cannot give the students instant feedbacks. Computerized two-tier tests, on the other hand, seem to overcome these disadvantages: they reduce paper work, are easier to score, and give the students (and teachers) instant, helpful feedbacks. With recent advancements in network technology, Web-based two-tier testing (WTTT) has become more feasible and useful. It not only offers all the advantages of computerized two-tier testing, but also provides an easy, familiar interface for test-takers and lets researchers collect a larger amount of test results from students dispersed at distant sites.

Three sample WTTT items for Internet Literacy

As mentioned above, two-tier testing, in both paper-and-pencil and Web-based formats, has usually been for science educators to investigate students' mis-conceptions about scientific phenomena. It has seldom been used in technology or social science learning. However, we believe that two-tier tests can be used for computer/network studies, as well as the social sciences. In order to demonstrate our proposed ideas and to investigate students' (mis)conceptions about Internet literacy, three Web-based two-tier test items were designed and presented.

Internet literacy is a subset of computer literacy, which is generally defined as the basic knowledge, skills, and attitudes needed by all citizens to be able to deal with computer technology confidently in their daily life (e.g., McClure, 1994). As network technology advances, however, computer literacy is gradually becoming Internet literacy, that is, a net-literate person needs to possess the knowledge and skills to operate and use networks properly. In addition, they also need to know Internet's impacts and limitations on our lives and society.

When teaching Internet literacy, teachers usually found that secondary students (ages 15-to 18) possess some mis-conceptions about the Internet technology and usage. For example, some students misunderstood the relationship between the Internet and viruses. Other examples of misinformation include proper ways to download (e.g., MP3), copy or paste information from Web sites. Therefore, we designed three two-tier

test items to investigate students' misconceptions in these areas.

As shown in Figure 1, the first question item explores the relationship between the Internet and viruses by asking "Once computers are connected to the Internet, they will be attached by viruses." After students chose True or False, different second-tier statements were presented. For example, if students chose "True," two possible reasons are shown for student selection: (1) Because e-mails contain viruses; (2) Because the Internet transmits the viruses (figure 2). If students chose "False," another two possible reasons are generated by the system for student selection (figure 3): (1) Although e-mail may contain viruses, appropriate protection can prevent computers from virus attack; (2) Computers will be attacked as long as they do not have protection programs; it has nothing to do with the Internet connection. The WTTT system can also provide instant feedback for student response. For instance, for the students who answered "True" and then Answer 1, the following feedback would be shown (figure 4):

> You are partially correct. Standalone computers would be attacked by virus if the disk contains virus and your computers does not have proper protection. If your networked computers have proper protection, it might not be attached.

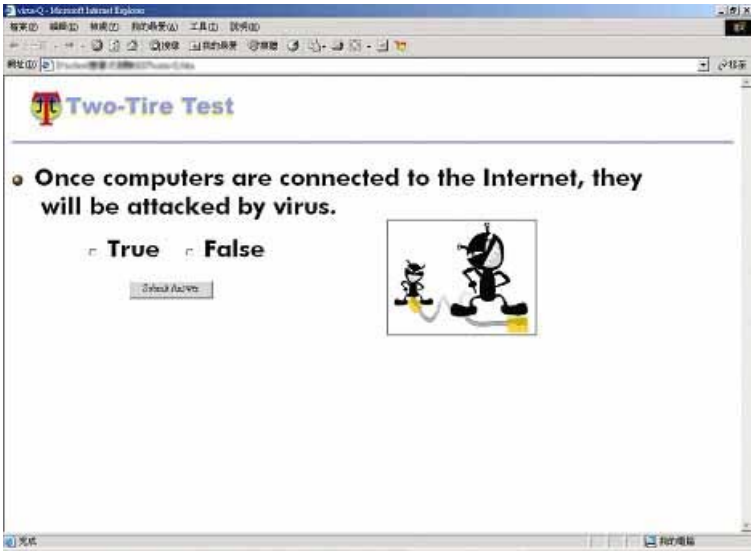

Figure 1: The first-tier statement of item one on computer viruses

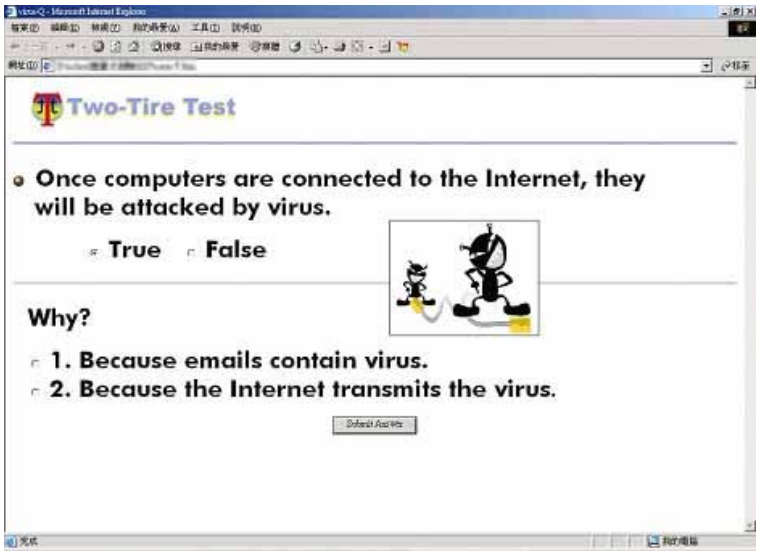

Figure 2: The second-tier statements for the first-tier answer True of item one

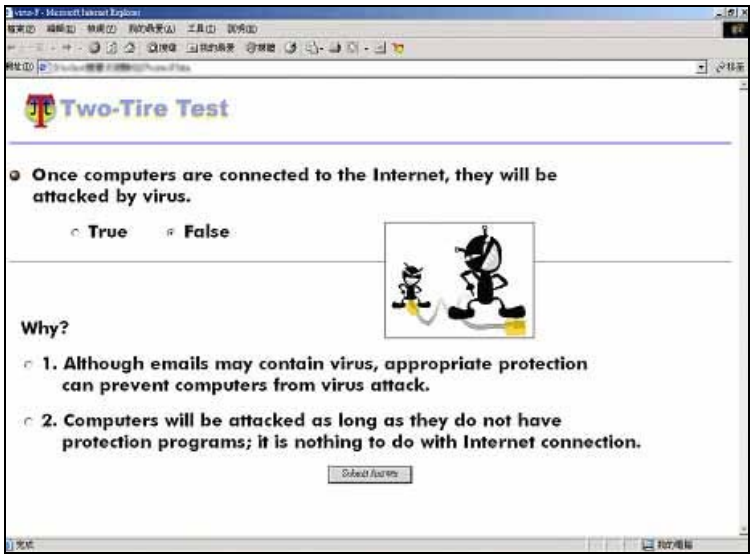

Figure 3: The second-tier statements for the first-tier answer False of item one

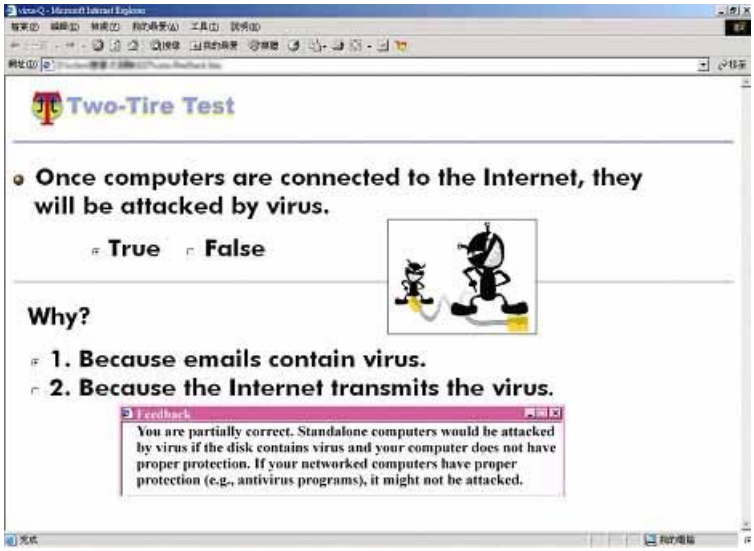

Figure 4: The feedback for students choosing True-1 answer combination

In addition, it is worth noting that the questions are presented with some multimedia, that is, with some graphics to attract students' attention. However, the graphics were kept small and simple so as not to delay transmission speed.

The second question focuses on the proper usage of Web information and was often asked by students as well as teachers: To demonstrate the learning achievements from computer class, students practice creating their own web pages and will show the work on the school website. When producing any web pages, may students copy and paste text and graphics directly from other people's web pages? If students chose "Yes", then two possible reasons in the second tier will be presented: (1) Producing web pages is for educational purposes, so it is fine, and (2) These web pages are only for teachers and classmates to see, so it is fine. If students chose "No", two second-tier reasons will be presented: (1) Based on copyright laws, one must get permission from the authors before using them, and (2) Other people's web pages are their intellectual properties, so students' conducts are considered as "stealing."

The third question was also an Internet-ethics problem teachers often encounter: students copy and paste articles from the Web and turn it in as their homework, without citing the source. This item will help teachers explore the students' ideas about plagiarism. The question states: David downloaded a 4-page article from a web site. He replaced the author's name with his own, reformatted the article, adding a cover, and turned it in as his social studies homework. Is David's conduct acceptable?

Second-tier reasons for the first-tier answer "Yes":

(1) He simply used this article for his homework, not for business or a money-making venture.
(2) David would never publish this homework, so as long as the original author(s) or the copyright owner(s) of the article do not know, it is fine. .

Second-tier question and answers for the first-tier answer “No”:
What kinds of problems might David’s conduct bring him?
(1) Infringement on the original author’s intellectual property right.
(2) Infringement on the copyright of the article’s owner(s).
(3) Revealing business or industrial secrets.
(4) Charged with forgery.

Evaluation of WTTT

To evaluate the usability of the WTTT system, an experienced computer programmer was invited to check the system’s programming and functions. In addition, an expert in computer ethics validated the appropriateness of the items and an experienced test developer checked the way the test items were presented on the computer screen. A small (12-student) user-based evaluation group also evaluated the use of the WTTT system and the wording of the test items. The system, interface, and test-item presentation were then debugged and revised according to the evaluation results.

From this WTTT experience, we found that the most difficult part was not the system development itself, but rather the construction of questions, in particular, the second-tier statements (or reasons) and the feedbacks for every answer combination. The construction of the two-tier test items in this study drew mainly from related research literature, computer teachers’ classroom experiences, and the present researchers’ interviews with fifteen interviews with secondary school students.

Conclusions and Future Plans

Clearly, Web-based two-tiered tests, being easily administered and time effective, can help educators investigate students’ misconceptions in various subject matters; in this case, Internet literacy. Obviously, the next step for our WTTT system is to collect more test items and conduct a large-scale field test so that the system will gather a large number of students’ responses on the items and then help us explore students’ alternative conceptions about Internet literacy. It is expected that more research will be conducted on interactive Web-based testing environments, two-tier test systems, and other such items to help teachers teach and students learn better.

References

Chou C (2000) Constructing a computer-assisted testing and evaluation system on the World Wide Web -- The CATES experience *IEEE Transactions on Education* **43**(3) 266-272.

Chou C, Chang Y F and Jiang Y Y (2000) The development of an on-line adaptive questionnaire for health education in Taiwan *Computers & Education* **35**(3) 209-222.

McClure C R (1994) Network literacy: A role for libraries? *Information Technology and Libraries* **13**(2) 115-125.

Treagust D F (1988) Development and use of diagnostic tests to evaluate students misconceptions in science *International Journal of Science Education* **10**(2) 159-169.

Tsai C C and Chou C (2002) Diagnosing students' alternative conceptions in science through a networked two-tier test system *Journal of Computer Assisted Learning* **18**(2) 157-162.