

## Colloquium

### Developing a web-based two-tier test for internet literacy

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#### Introduction

Assessment is an essential aspect of all instructions. Teachers need to know what prior knowledge students bring with them as well as what and how well the students have learned in class. Likewise, students themselves should be aware of what they have learned and of what they have 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 on how a web-based two-tier test (WTTT) is being used for testing. This paper first introduces the WTTT and then presents three test items for internet literacy learning. Conclusions and plans for future work are also provided.

#### WTTT

The two-tier test is a two-level question presented in a multiple-choice format. The first tier assesses the students' knowledge about particular questions, while the second tier explores the students' reasons for the choices they made in the first tier. The two-tier test was first introduced by Treagust (1988), mainly for diagnosing students' misconceptions 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 that students' possible existing (mis)conceptions are included among the second-tier choices and that both tier answer combinations represent different ways that the students can reason about the question. By using the two-tier format, teachers or researchers should be better able to pinpoint students' misconceptions and try to correct them.

Traditional two-tier tests done by paper and pencil not only require a lot of paper work, they also cannot give instant feedback to students. Computerised 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 feedback. With recent advancements in network technology, WTTT has become more feasible and useful. It not only offers all the advantages of computerised two-tier testing but also provides an easy and 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 previously mentioned, two-tier testing in both paper-and-pencil and web-based formats has usually been for science educators to investigate students' misconceptions 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 or network studies as well as for the social sciences. In order to demonstrate our proposed ideas and 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 confidently with computer technology in their daily life (eg, 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 the Internet's impacts and limitations on our lives and on the society.

When teaching internet literacy, teachers usually find that secondary students (ages 15–18) possess some misconceptions about the internet technology and its usage. For example, some students misunderstand the relationship between the Internet and viruses. Other examples of misinformation include the proper ways to download (eg, MP3), copy or paste information from websites. Therefore, we designed three two-tier test items to investigate students' misconceptions in these areas.

The first question item explores the relationship between the Internet and viruses by asking 'Once computers are connected to the Internet, will they be attacked by viruses?' After the students choose 'true' or 'false', different second-tier statements are presented. For example, if students choose true, two possible reasons will be shown for student selection: (1) because emails contain viruses and (2) because the Internet transmits viruses. If students choose false, two other possible reasons will be generated by the system for student selection: (1) although emails may contain viruses, appropriate protection can prevent computers from virus attack and (2) computers will be attacked by viruses as long as they do not have protection programmes; 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 answer true and then Answer 1, the following feedback will be shown:

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

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 are kept small and simple so as not to delay the transmission speed.

The second question focuses on the proper usage of web information and is often asked by students as well as teachers: to demonstrate the learning achievements from a computer class, students practise creating their own web pages and 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 choose '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 choose '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 the students' conducts are considered 'stealing'.

The third item is an internet-ethics problem that 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 four-page article from a website. 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 a 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 does (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 that 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 feedback 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 15 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 to learn better.

### **Acknowledgement**

This work was supported by the National Science Council in Taiwan under Projects NSC NSC91-2511-S-009-007 and NSC92-2520-S-009-006. Previous versions of this article were presented at the International Conference on Advanced Learning Technologies (ICALT-2003), Athens, Greece, and the World Conference on Educational Multimedia and Hypermedia. (ED-Media 2005), Montreal, Canada.

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