# DEVELOPING AN ICT-LITERACY TASK-BASED ASSESSMENT INSTRUMENT: THE FINDINGS ON THE FINAL TESTING PHASE

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**ABSTRACT**

This paper reports the findings of a study which seeks to identify the information and communications technology (ICT) literacy levels of trainee teachers, by investigating their ICT proficiency using a task-bask assessment instrument. The Delphi technique was used as a primary validation method for the new assessment tool and the ICT literacy task-based assessment tool was developed to assess trainee teacher's levels of ICT-literacy. The findings showed that the ICT-literacy task-based assessment instrument were able to predict trainee teacher's ICT-literacy area of weaknesses.

**KEYWORDS**

ICT-literacy, task-based assessment, trainee teachers.

## 1. INTRODUCTION

The central concern of this study is to develop an ICT-literacy task-based assessment (TBA) instrument that may be used to evaluate trainee teacher's level of ICT-literacy. The current literature acknowledges the need for a measurement instrument that evaluates level of ICT-literacy levels (Wong 2002; Markauskaite 2005; Katz & Macklin 2007).

This type of measurement instrument is currently used as an entry level testing tool for university and job placements. However, existing ICT-literacy assessment instruments are either too expensive to be implemented, or too rigid with their expected answers. Moreover, they are not tailored to teacher's individual needs. The existing instruments either uses self-efficacy techniques or step-by-step task/instructions whereby they do not allow flexibility and creativity in completing the task (International ICT Literacy Panel 2002; Cox & Marshall 2007).

Following the inauguration of the International ICT-literacy Panel in 2000, the International Society for Technology in Education (ISTE) in 2008, proposed that in order to accurately assess level of ICT-literacy, such an assessment must include both technical and information literacy (International ICT Literacy Panel 2002; International Society for Technology in Education 2008). Two ICT standards which are the Information Literacy Competency Standards for Higher Education developed by the Association of College and Research Libraries (ACRL) and the Australian and New Zealand Information Literacy (ANZIIL) also echo the views of the 2000 International ICT-literacy Panel and 2008 ISTE (Association of College and Research Libraries 2000; ANZIIL 2008).

## 2. WHY TRAINEE TEACHERS?

Currently, ICT-literacy has been actively promoted in Malaysian schools by various agencies of the Malaysian Ministry of Education. The Ministry has also made it compulsory for all trainee teachers to be exposed to ICT tools, and by implication, the use of ICT-literacy in their pedagogical strategies (Chan 2002b).

The project team who was responsible for the ICT-implementation in Malaysian schools has listed three abilities expected of Malaysian students. This abilities include competencies to use ICT tools and ICT sources to: 1) collect, analyse, process, and present information; 2) support meaningful learning in various contexts; and 3) prepare students for employment (Smart School Project Team 1997). The competencies listed by the team coincide with the definition of technology literacy described by NAE and NRC; which called for an understanding of technology at a level that enable effective functioning in a modern technological society (NAE & NRC 2006). In focusing on improving school children's ICT-literacy, it is possible that current Malaysian trainee teachers may not be adequately prepared to teach under this new approach.

In spite of this, ICT tools must never be mistaken as the mechanism that we learn 'from', but rather as the tool that we learn 'with'. By having ICT tools such as computers, for example, they should be regarded as a learning aid rather than a learning point. Yet, in looking at the current Malaysian school scenario, Chan (2002a) identifies a serious gap between what is being understood by the teachers and what they actually practice. Most teachers prefer to use ICT to enhance rather than transform their current curriculum. Rather than changing their old teaching module to include ICT in their teaching activities, most teachers felt that it would be easier to use ICT to accommodate and enhance their existing/older teaching modules. For example: instead of using the overhead projector (OHP), the teachers would input their teaching notes into a digital presentation application (for example MS Powerpoint); or instead of manually creating a class timetable, the teachers are now using spreadsheets. It is proposed that these teachers may not have the initiative or time to explore other aspects of ICT that they could use to improve their teaching activities (BECTA June 2004).

In 2004, a group from the National Academy of Engineering (NAE) and the National Research Council (NRC) conducted a study to determine the most viable approach to assessing technological literacy in the US for K-12 students, K-12 teachers, and out-of-school adults. The report found that there was very little information available on the technological literacy of teachers (NAE & NRC 2006). Although many school children have sophisticated technological capabilities, they cannot be fully technologically literate unless their teachers are. There is an urgent need for an in-depth study on this topic and development of a suitable task-based (technological capability) assessment instrument.

## 3. THE NEED FOR A DIFFERENT INSTRUMENT TO ASSESS TRAINEE TEACHERS' ICT-LITERACY

Several studies have been conducted on students (Katz 2007; Russell & Finger 2007), trainee teachers, and in-service teachers (Luke 2001; Knezek & Christensen 2002; Jamieson-Proctor, Burnett, Finger & Watson 2006). Most of them involve participants' perceptions and attitudes on their preparedness to integrate ICT as tools or teaching ICT as the class subject.

The quality of the research design in ICT-literacy studies is also an issue because too many research studies applied the self-assessment methodologies (see Jamieson-Proctor, Burnett, Finger & Watson 2006; Markauskaite 2007; Ball & Levy 2008). Computer self-efficacy involves a belief of one's capability to use a computer. Markauskaite's (2007) study for example, utilised the self-efficacy theory in her questionnaire design. Each test-item in her questionnaire started with the phrase "I believe I have the capability…" and was measured using a six-point Likert scale.

Other studies applied a combination of both self-efficacy methodology and a more hands-on evaluation of the participants ICT-literacy. One such example was in Wong (2002) study. In her study, she developed an IT preparedness assessment instrument, which measured teachers' preparedness in using ICT using three different measures: a self-efficacy instrument to evaluate their attitude towards using ICT; a hands-on instrument to assess their ICT skills; and ICT-knowledge exam-based questions that consists of 25 multiple choice questions which tested the teachers knowledge on ICT and computers. Nonetheless, the hands-on instrument lacks flexibility and does not encourage critical and analytical thinking, as it gives the teachers step-by-step instructions of what was to be performed, and the exam-based questions may not represent the teachers' actual ICT knowledge as the multiple choice questions may allow guessing.

To cope with today's technological demands, people need to acquire more than just the basic ICT skills and knowledge. They need to know how to use their acquired knowledge and skills by: thinking critically; applying knowledge to new situations; analysing information; generating new ideas; communicating;

collaborating; solving problems; and making decisions. These skills can provide both flexibility and security. People who can learn new information, are able to use software programs and conceive new ways of doing things, have much better prospects than those who cannot (Partnership for the 21st Century Skills 2002).

The lack of ability to think critically and analytically, and also to make decisions is apparent in Malaysian school students. Earlier studies have shown that students' critical and analytical thinking abilities in Malaysia were between below satisfactory and fair (Zaharah 1995; Azlan 1997; Razali 1999).

It is further noted that Malaysian teachers may also lack the ability to teach these skills or are less prepared to teach by incorporating these skills in teaching and learning activities (Rajendran 2001; Rosnani 2002). Teachers may understand the importance of teaching critical thinking to students, yet some appear to not have the necessary instructional strategies to teach it (Rosnani 2002). These issues corroborate this study's need for an enhanced ICT-literacy TBA instrument that is flexible; not based on self-assessment; and includes test-items that test cognitive skills. The tasks for the ICT-literacy TBA instrument should focus on familiar/normal, computer-based activities for a classroom environment that teachers usually find in their schools.

A task-based assessment method, allows the participants the freedom to complete the task in any way they wish, as long as the task requirement is fulfilled. It means that, if the task asks for an appropriate learning aid to be created which includes an image and a video, the participant is free to use whatever computer applications that they feel comfortable to use, to edit the pictures, create videos and other digital learning aids. As long as the task requirement is fulfilled, the task is considered complete. Task-based tests allow the participant to demonstrate acquired knowledge capacity and an ability to correlate tasks with the theories or concepts learned previously. Instead of judging knowledge acquisition through a series of multiple choice selections or self-evaluation, task-based assessment forces participants to place knowledge into a context that can be understood and explained (Teachnology Inc 2011). Task-based assessment also allows the participants to show what they know, instead of just telling what they think they know. It is considered as the best method for this new ICT-literacy assessment instrument as it shows the participant's actual ICT ability.

# 4. THE METHODOLOGY

This study was conducted in three phases: Phase-1 preliminary review; Phase-2 expert judgement on ICT-literacy indicators; and Phase-3 instrument validation and testing. In Phase-1, review of the literature was conducted, where it involves drawing on the existing literature on ICT-literacy; ICT-literacy standards; existing ICT-literacy assessment instruments; and the Malaysian Smart School (*MSS*) requirements. Eleven ICT-literacy indicators were identified in this first research phase. In Phase-2, the identified ICT-literacy indicators were evaluated by a specially chosen panel of experts (PoE). Two Delphi interactions were then conducted where the first was to evaluate the ICT indicators, and the second was to validate the *draft ICT-literacy TBA instrument.* In Phase-3, the *draft ICT-literacy TBA instrument* was validated and tested through two pilot tests, and finally the instrument was tested on a larger number of participants for its final instrument trial.

The Delphi technique and the Rasch IRT model were applied for the qualitative and quantitative parts of this study, respectively. The Delphi technique was chosen as the most suitable philosophical/research approach for conducting the *expert judgement phase* (Phase-2) of this study.

For the quantitative part of this study, the Rasch IRT model was employed. The Rasch IRT model is assumed to be invariant across different groups within a research population and across populations (Hambleton & Murphy 1991; Swaminathan 1999). It requires that both the test-items and participants conform to the Rasch IRT model before claims regarding the presence of skill or ability can be considered valid. Therefore, under this Rasch IRT model, mis-fitting responses require a reason for the misfit, and may be excluded from the data set if they fail to address the expected skill or ability. The Rasch IRT model also provides a way of measuring the quality of the test-items by confirming their suitability for participants and how well they measured participants' abilities (Wu & Adams 2007).

The Rasch IRT model generally utilises the response pattern. It assumes that participants with a low attribute have little chance of guessing the correct answer and participants who achieve a high attribute will almost certainly choose the correct answer (Nunnally & Bernstein 1994). Central to idea of the Rasch IRT

model is the *probability principle*. A person's response to a particular test-item is never certain. It is always influenced by human error. Thus, a probabilistic approach must be employed. In the Rasch IRT model, probabilities are introduced through consideration of the odds that a person would give a correct response to a test-item. This is known as *logit.* The *logit* is a mathematical model that converts both difficulty and ability into the same units. The *logit* is a $\log_e$ of the odds of a correct response given. The Rasch dichotomous model equation used in the Quest analysis describes the probability of observing a specific score $x_{ni}$ as (Adams & Khoo 1996):

$$P(X_{ni} = x_{ni}) = \frac{\exp(x_{ni}w_{i1}(\beta_n - \delta_{i1}))}{1 + \exp(x_{ni}w_{i1}(\beta_n - \delta_{i1}))}$$

Where $x_{ni}$ is person *n*'s response to item *i*, $\beta_n$ is the ability of person *n*, $w_{i1}$ is the score assigned to one step in item *i,* and $\delta_{i1}$ is the difficulty of the one step in item *i*.

The validation and testing process showed that the *ICT-literacy TBA instrument* is valid and reliable when tested on its intended participants, and the instrument is ready. The instrument provides information with regard to each participant's area of weakness in ICT.

## 5. THE PARTICIPANTS

There were two categories of participants for this study: 1) the qualitative study participants (the PoE members); and 2) the quantitative study participants (the Malaysian trainee teachers).

### 5.1 Qualitative Study Participants – PoE Members

There were seven PoE participants for the qualitative study and they were selected based on their educational and occupational backgrounds. The PoE members were three academics in the field of educational technology, and one officer from the Malaysian Ministry of Education, and three teachers from the *MSS.*

### 5.2 Quantitative Study Participants – Malaysian Trainee Teachers

One of Malaysia's public universities, the *Sultan Idris Education University* (UPSI), was chosen for the location to conduct the research. This is the only teachers' university in Malaysia with the sole purpose of training pre-service teachers. For this study, the participants were undergraduate students who were currently enrolled in a Bachelor of Education degree at UPSI. The university has eight faculties offering both undergraduate and postgraduate degrees. The students are generally between 20 to 30 years old, and of mixed ethnicity (Malay, Chinese, Indian, Indigenous and others). Participants from the same semester across eight different faculties were invited to take part.

Different participants were used for each of the three activities (pilot test-1, pilot test-2 and final instrument testing) in this third phase of the ICT-literacy TBA instrument development. During the pilot testing-1 session, 16 trainee teachers were randomly chosen and were willing to participate. Twenty (out of the 50 invited) trainee teachers from the Faculty of Business and Economics participated in pilot testing-2. For the final instrument testing process, 148 (out of the 382 invited) trainee teachers from the semester-four batch, representing all faculties in the university, agreed to participate.

## 6. THE FINDINGS

There were three parts of findings which was based on the different phases of the study. As previously explained, Phase-1 involved identifying suitable ICT-literacy indicators to be used to evaluate trainee teachers level of ICT-literacy. The findings from Phase-2 and Phase-3 are discussed below.

## 6.1 The Findings from Phase-2

The seven PoE participants reached consensus after two Delphi-rounds have been conducted. They agreed that there were twelve ICT-literacy indicators that should be used to evaluate trainee teachers' level of ICT-literacy. The twelve indicators were:

Table 1. List of finalised ICT-literacy indicators

| **Identified ICT-literacy indicators : Finalised** | |
|---|---|
| 1. Navigation and search; | 7. Manage; |
| 2. Production and analysis; | 8. Create; |
| 3. Plan / define; | 9. Communicate /collaborate; |
| 4. Access; | 10. Reflect; |
| 5. Integrate; | 11. Understanding and handling ICT tools. |
| 6. Evaluate; | 12. Assess |

The PoE participants also validated the *draft ICT-literacy TBA instrument* where the ICT-literacy indicators was transformed into ICT-based tasks which were common for teachers. For evaluation purpose, each of these tasks was divided into a few test-items.

## 6.2 The Findings from Phase-3

The *draft ICT-literacy TBA instrument* underwent a continual validation and testing process in a series of pilot studies, before it was tested on a larger population of trainee teachers in the *final instrument testing* process. The Rasch IRT model and the Quest *interactive test item analysis system* (Adams & Khoo 1996) was implemented as the data analysis tool for these performance data validation and testing.

For the *final instrument testing,* all 148 participants completed all six tasks in the *ICT-literacy TBA instrument*. The responses for the *ICT-literacy TBA instrument* were coded by the researcher into an electronic data file using Microsoft Excel. A text file was then prepared for the Quest analysis (Adams & Khoo 1996).

The Quest analysis produces a *Kidmap* of an individual participant's performance in terms of depicting their correct and incorrect response patterns, according to the Rasch IRT model's expectations. The Kidmap locates each test-item on a vertical scale according to its difficulty from easiest to hardest and then separates the test-items horizontally (left or right), according to whether the participant answered them correctly or not. Importantly the map locates the participant's ability on the same vertical scale.

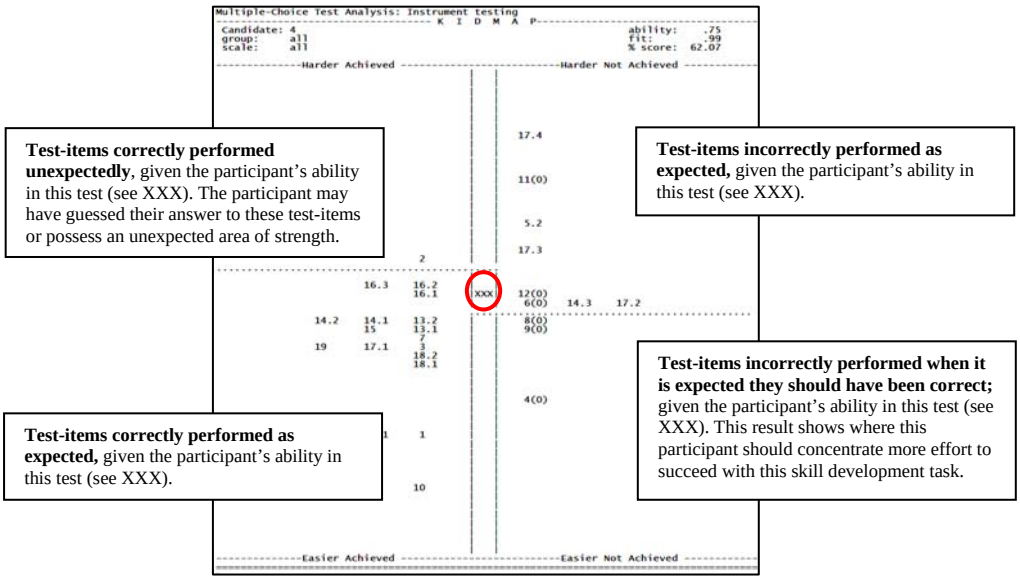


Figure 1. Kidmap – showing an individual's performance

Based on the Kidmap findings, a graph of achievement summary of all the candidates was produced using the data. Figure 2 showed the level of the participants ICT literacy ability based on their achievement for each test-item. For each test-item, the achievement were grouped into four level of competency: 1) Easier Achieved (EA), 2) Harder Achieved (HA), 3) Easier Not Achieved (ENA), and 4) Harder Not Achieved (HNA).

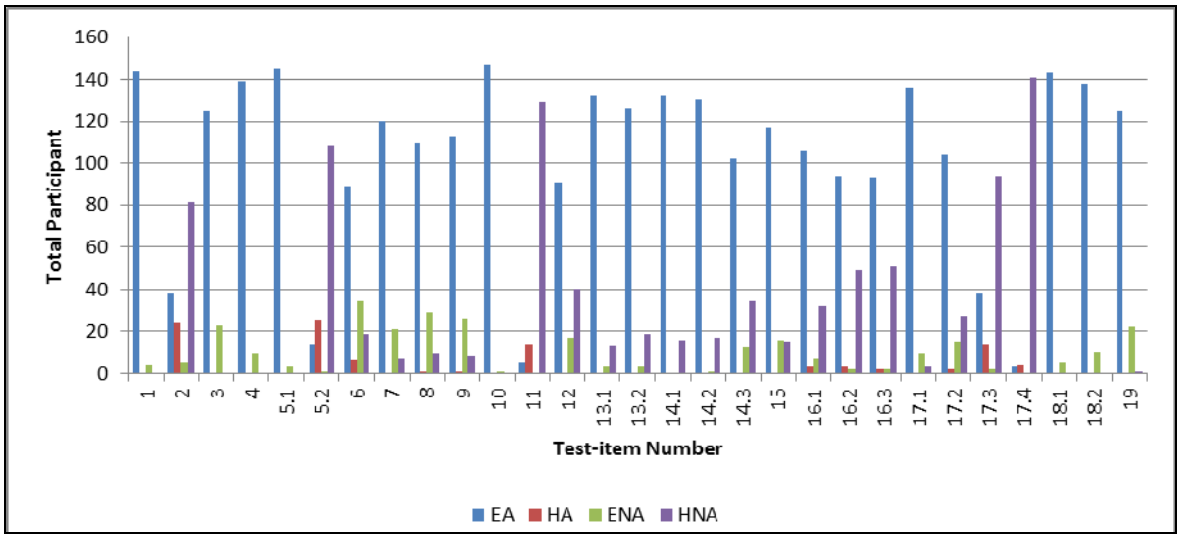


Figure 2. Achievement summary graph

This group of participants proposed that test-item 5.2 (using basic spreadsheet formula to assess student grade), test-item 11 (reflect/judge credible website) and test-item 17.4 (knowing how to evaluate credible webs) were the hardest test-item with EA value less than 10% of total participants. This finding demonstrates that this group of participants lack the skills involving the use of a spreadsheet application and also the skills and knowledge needed that would enable them to identify and judge credible websites. These skill and knowledge is exceedingly important for trainee teachers who are going to be teaching in a Smart School environment. Definitely we do not want the teachers to be teaching the school children with resources which are unreliable or hearsay.

Aside from that, the findings also indicated that the learning domain tested below were easy for this group of participants, where none of the participants scored these items as HA or HNA (Table 2).

Table 2. Learning domains with no Harder Achieved or Harder Not Achieved score

| Item no | Learning domain tested |
|---|---|
| 1 | manage |
| 3 | basic ICT capabilities |
| 4 | basic ICT capabilities |
| 5.1 | assess |
| 10 | Internet navigation & search |
| 18.1 | perform analysis & producing appropriate document |
| 18.2 | perform analysis & producing appropriate document |
| 19 | basic ICT capabilities |

Figure 2 also showed more than 10% of the participants scored ENA on five test-items. The learning domains were:

Table 3. Learning domains with Easier Not Achieve score

| Item no | Learning domain tested |
|---|---|
| 3 | basic ICT capabilities |
| 6 | perform analysis & producing appropriate document |
| 7 | plan & define |
| 8 | access |
| 9 | manage |

Rasch model suggested that these learning domains (Table 3) should be easy to the participants. However, more than 10% of them were unable to correctly complete the tasks. The reason might be because of carelessness, or might even be because of their over confident attitude they misread the task requirement and wrongly executed the tasks. It might also be because the already had the knowledge but they had forgotten how to execute them, due to uncommon use of the task in the participants' daily work. Whatever the reasons, the participants needed to revisit this group of tasks immediately and resolve the problem.

## 7. CONCLUSION

Based on this findings, the ICT-literacy TBA instrument identified that this group of participants suggested that the *assessing* information; *integrating* information from multiple sources; and *evaluating* the information that they have, as the hardest ICT-literacy skills. These skills however, were among the most important ICT-based skills that a teacher must have.

The ability to pin-point to the exact ICT-literacy ability that the trainee teachers lack might help them and their institution of higher learning in providing necessary intervention or additional skills to these trainee teachers. Their training can target their specific area of weakness, and redundancy in training information can be avoided. This in turn can save a lot of trainer's time and cost.

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