Digital literacy skill development: Prescriptive learning analytics assessment model

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Abstract

There is a broad awareness of how information communications technology (ICT) digital literacy impacts everyday life. In schools, use of ICT tools has become mandatory. These tools include computers, tablets and mobile phones. These smart devices are used to send emails, browse the internet and make video calls. It is essential for teachers to identify student digital literacy levels through classroom activities and when to implement flexible ePedagogies for students who need help.

This presentation will provide easy-to-follow steps to manage learning analytics to determine digital literacy skill levels. Learning analytics can be used for a range of purposes: to compile assessment reports for individual learners to know how they rate compared with other learners; to highlight students who may need extra support; to assist teachers to plan supporting interventions for individuals and groups of learners; to support professional development teams when considering new courseware design and development; and to support institutional/corporate marketing and recruitment management strategies. However, some people may find it daunting to undertake learning analytics. This presentation will show why this perception is wrong by explaining a prescriptive learning analytics planning model. This session will give participants an understanding of the skills they need to carry out their own learning analytics through careful preparation of their testing instruments and an understanding of the importance of validating their measurement tools.

Introduction

Information communications technology (ICT) tools influence everyday life (Bradley, 2017). Digital connectivity is taken for granted as telecommunication services merge seamlessly with computer networks. In schools, using ICT tools – computers, laptops/netbooks – has become mandatory. Among other things, smart devices are used for email communication with classmates and teachers, for browsing the internet to find material for assignments and homework, and making video calls to participate in social networking. It is essential for teachers to identify students' digital literacy levels through classroom activities and know when to implement flexible ePedagogies for students needing help (Mat-Jizat, 2012).

Digital literacy is the possession of functional computer/screen-based reading and writing abilities (Spires, Paul, & Kerkhoff, 2017). When the school year starts, the digital literacy skills of students and teachers are usually unknown. However, many young people grow up surrounded by ICT, experiencing these tools as playthings (Bolstad, 2004), and because of this they are confident about seeking digital solutions in the classroom. In contrast, teachers who grew up in less ICT-saturated environments may be less comfortable using digital equipment (Dingli & Seychell, 2015).

It could be supposed that improvement in a teacher's digital skills will significantly boost their classroom confidence. To test this supposition, Mat-Jizat (2012) evaluated a task-based digital literacy tool for teacher training, capturing teachers' actual skill capability. The literacy tool was based on five categories of keyboard-based skills:

- preparing teaching and learning materials using word-processing, spreadsheet and database applications, internet searching, evaluating information found on the internet, browser bookmarking, emailing (including carbon copy and blind carbon copy features), taking a photograph, making a video, scanning a document
- using a spreadsheet to calculate students' total marks, ranking performance outcomes, and preparing graphs
- adding a new database record and making a simple database query
- social networking – correctly registering into discussion forums and posting appropriate feedback
- Word document formatting, including setting margins, adding headers and footers, adding page numbering and creating a table of contents.

Mat-Jizat's (2012) work shows that teachers digital skills could be significantly improved using a task-based digital literacy tool, and the use of one led to a substantial increase in their classroom confidence.

The purpose of this paper is to suggest that modelling digital literacy skills development requires a broader view than one concentrated on keyboard skills. According to Spires and Bartlett (2012), digital literacy extends beyond keyboarding to having the ability to make critical evaluations of digital resources. Well-designed ePedagogies adopt flexible instructional strategies for novice/experience skill development pathways (Victorian Government, 2018).

The paper is divided into two sections: a brief discussion of digital literacy skill development, followed by an introduction to a prescriptive learning analytics assessment model.

Digital literacy skill development

Ever since the advent of online (distance) education, well before the turn of the millennium, researchers have been recording how people interact with technology while they learn (Garrison, 2000). Educational researchers soon became concerned about whether the theoretical foundations of online pedagogy were strong enough to keep pace with emerging technological innovations, and stepped up their investigations of the impact of ICT tools on classroom activities (Anderson, 2008). They showed that the relationship between ICT and change in our social and psychological (psychosocial life) was strengthening. This phenomenon was first identified by Bradley with respect to converging multimodal media platforms (Bradley, 2017), and followed by others showing the relationship as a continually (digitally) connected lifestyle (see Figure 1), which has become omnipresent (De Wit, Koekemoer, & Nel, 2016).

With the rapid pace of technological change and our increased reliance upon ICT, it is no surprise that researchers are continually seeking new ways to characterise and study modern digital skills. Spires and Bartlett (2012) describe digital literacy not only in terms of 'traditional' phenomena that relate to singular computing (keyboarding) tasks, such as word processing, spreadsheets and databases, but in terms of gaining an accurate understanding of online resources through critical evaluation. Without such interrogatory digital skills, students may find themselves being led by the technology rather than overseeing their own learning adventures.

Digital literacy skills involve a complex mix of interrelating human–computer interactions (HCI) that represent the combination of ways people use ICT tools. They include: basic digital tasks (typing, searching, recording details, making calculations, printing); navigating digital content; gaining understanding from multiple digital resources; experimenting with new ways to create novel solutions; and conceptualising ways to communicate this new understanding with others. Development of these softer digital communication skills requires best practice ePedagogical strategies.

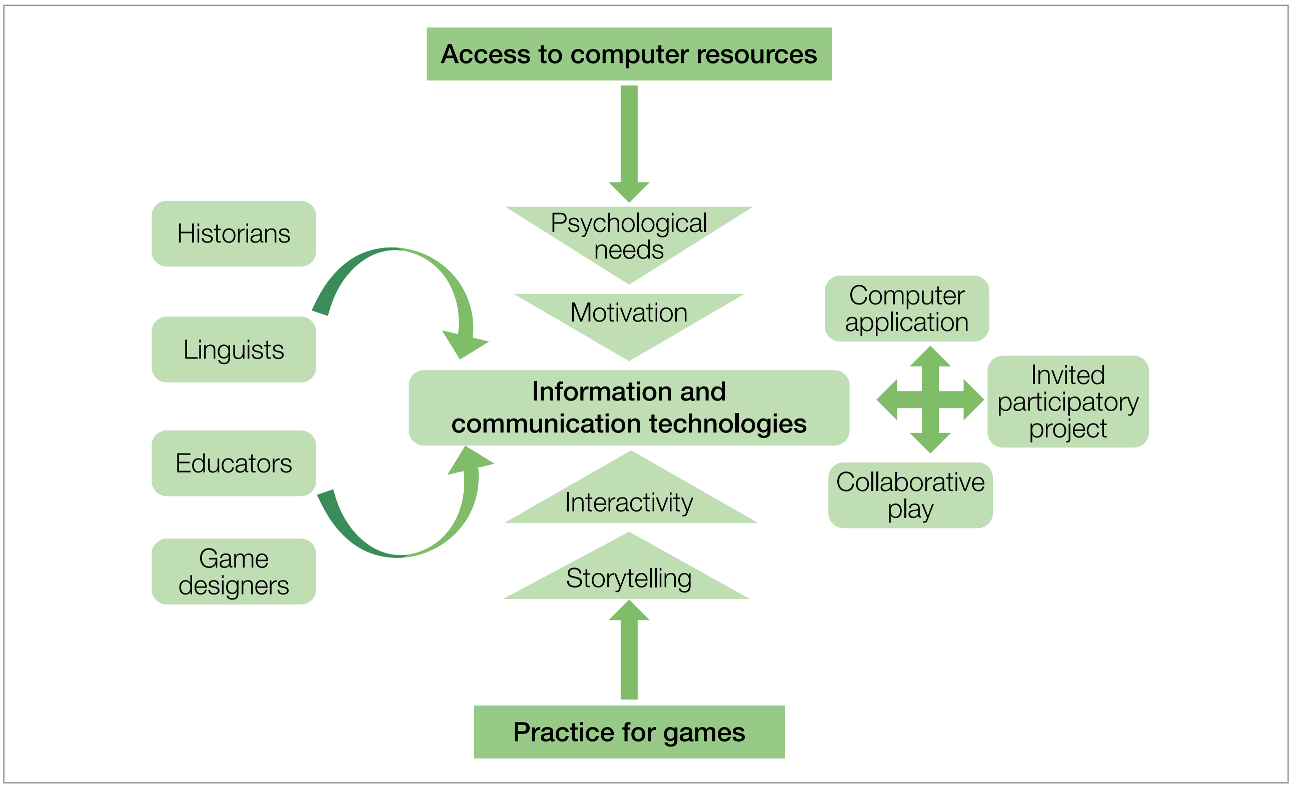

Figure 1 ICT tools signal multimodal media platform popularity (Adapted from Bradley, 2006)

Instructional objectives: Making a pizza

		Declarative		Procedural			
		Band A	Band B	Band C	Band D	Band E	
		Verbal information skill	Intellectual skill	Intellectual skill	Cognitive strategy	Cognitive strategy	
		Concrete concept	Basic rule	Higher-order rule	Identify sub-tasks	Knows the 'how'	
		Knows basic terms	Discriminates	Problem-solves	Recognises unstated assumptions	Recalls simple prerequisite rules and concepts	
		Knows 'that'	Understands concepts and principles	Applies concepts and principles to new situations		Integrates learning from different areas into a plan for solving a problem	
Task no.	**Learning domain**						**Totals**
6	Make sauce					2 questions	2
5	Make dough				3 questions		3
4	Use oven			2 questions			2
3	Measure ingredients			2 questions			2
2	Read recipe	1 question	2 questions				3
1	Decode abbreviations	2 questions					2
	Totals	3 questions	2 questions	4 questions	3 questions	2 questions	14

Figure 2 Test instrument specification matrix (Adapted from Mat-Jizat, 2012; Mager, 1988)

Prescriptive learning analytics assessment model

Learning analytics can be used for a range of purposes: for compiling assessment reports for individual learners to know how they compare with other learners, to highlight students who may need extra support, to assist teachers in planning interventions for individuals and groups of learners, to support professional development teams when considering new courseware design and development, and to support institutional/corporate marketing and recruitment management strategies. However, for some people, undertaking learning analytics may seem daunting. Instead, by following a prescriptive learning analytics planning model, in which time and energies are spent on matching task objectives to required knowledge levels and careful preparation of their assessment instruments, people should be able to carry out their own learning analytics, as outlined in the following steps.

Step 1: Instrument preparation

Design a test specification (skill building) matrix that depicts two separate pedagogical functions to determine skill/knowledge achievement levels. Conduct a thorough task analysis and list the steps needed to achieve the learning objectives for each task (start with the easiest, end with the hardest) (see Figure 2, vertical axis). Determine the types of declarative and procedural knowledge development expected for each task (see Figure 2, horizontal axis). Write out test items according to where they plot on the matrix.

A well-designed skill level test will show test items as a gradual skill building progression. Start with the easy concepts or declarative knowledge (knowing that), moving through mid-range intellectual skills to procedural or cognitive strategies (knowing the how) (Theng, 2012).

Step 2: Set scoring regime

Choose your scoring method (e.g. dichotomous, multiple choice, or partial credit scoring techniques). Write out acceptable answers in preparation for the marking scheme. Allocate scoring for each test item.

Step 3: Validate testing instrument

Use an appropriate software application to check your test items are a fit for the Rasch model (Bond and Fox, 2015, list several such applications). Enter the scored test outcomes into the Rasch measurement application (usually by submitting a test scores input file, often as a spreadsheet or text file). Run the application, examine the result and remove test items considered bad questions from the input file. Rerun your item analysis until all test items are a Rasch model fit (see Figure 3).

Figure 3 represents Rasch estimate data shown here as a data map. The vertical dotted lines represent the fit thresholds; items to the right of the upper threshold (1.25) underfit the Rasch model and are considered bad items that must be removed from the test scores input file, while test items to the left of the lower threshold (.74) overfit the Rasch model, so are redundant items that can also be removed from the input file.

These Rasch measurement applications provide a unidimensional scale. Figure 4 shows equal intervals along each axis that measure people's performance (each X on the left-hand side represents one participant) and test items together (numbered on the right-hand side). ACER software for Rasch measurement is available from https://www.acer.edu.au/conquest (Adams, Wu, & Wilson, 2015; Wu & Adams, 2007).

Step 4: Modify test items

Check the compatibility of the model and the data through the item fit statistics in the Rasch measurement application. Delete and/or modify non-fitting test items as they shift along the scale throughout this process. This iterative process has very powerful benefits, such as revealing what can happen without careful attention to non-fitting test items. Figure 5 depicts a poorly designed instrument that was too easy for the students/trainees.

Step 5: Implement test

Give properly validated test items to participants (students/trainees) in a pre-and-post-test assessment instrument. For instance, when investigating the effectiveness of an instructional strategy/learning program, a pre-test will determine the level of skills/knowledge before people undertake it, while the post-test will measure any change/knowledge acquisition after the instructional intervention.

Step 6: Analyse results

Expressing the magnitude of change in a student's/trainee's proficiency following an instructional program, as the magnitude or size of effect, as defined by Cohen's statistical power analysis (Cohen, 1977), has become popular with researchers (Bakkar, 2016). Some Rasch model applications provide a Quest item analysis output table (Figure 6). This table gives the best of both measurement practices of classical test theory and item response theory in establishing the Rasch model's discrimination value.

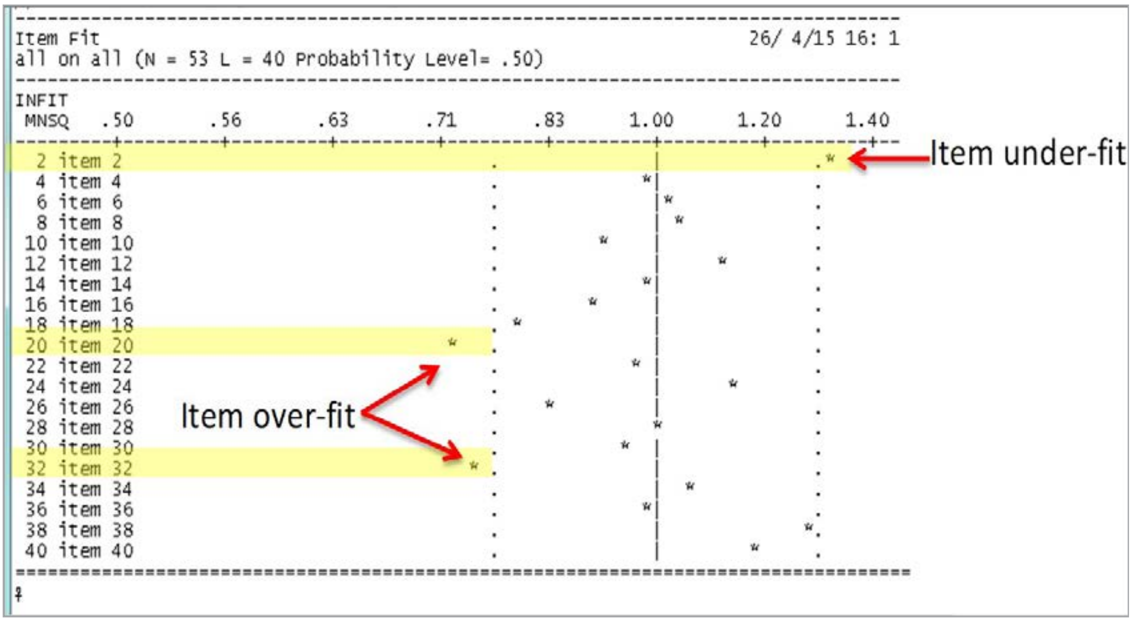

Figure 3 Rasch model – item fit (Adapted from Bakkar, 2016)

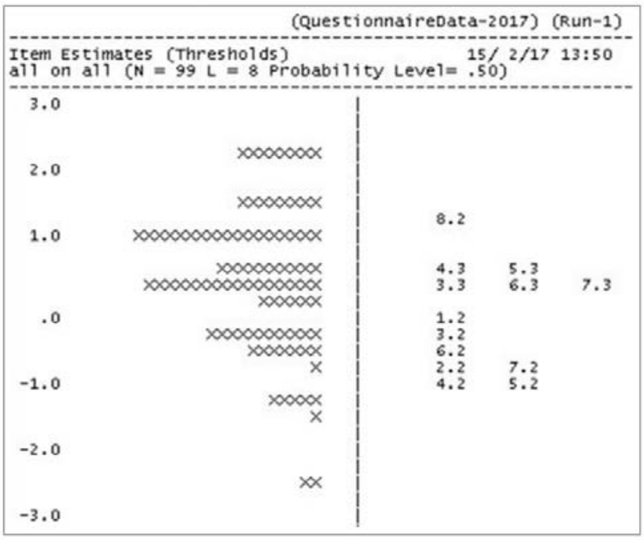

Figure 4 Rasch model – example variable map

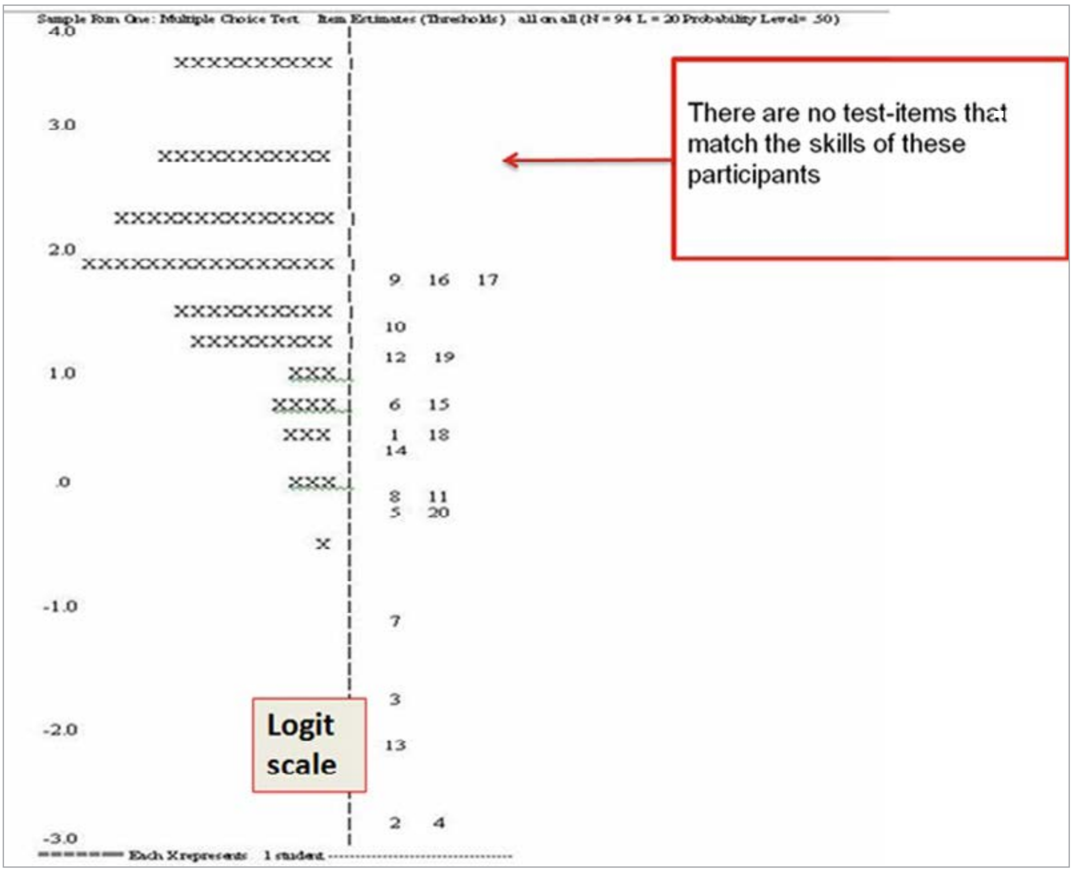

Figure 5 Poorly designed instrument

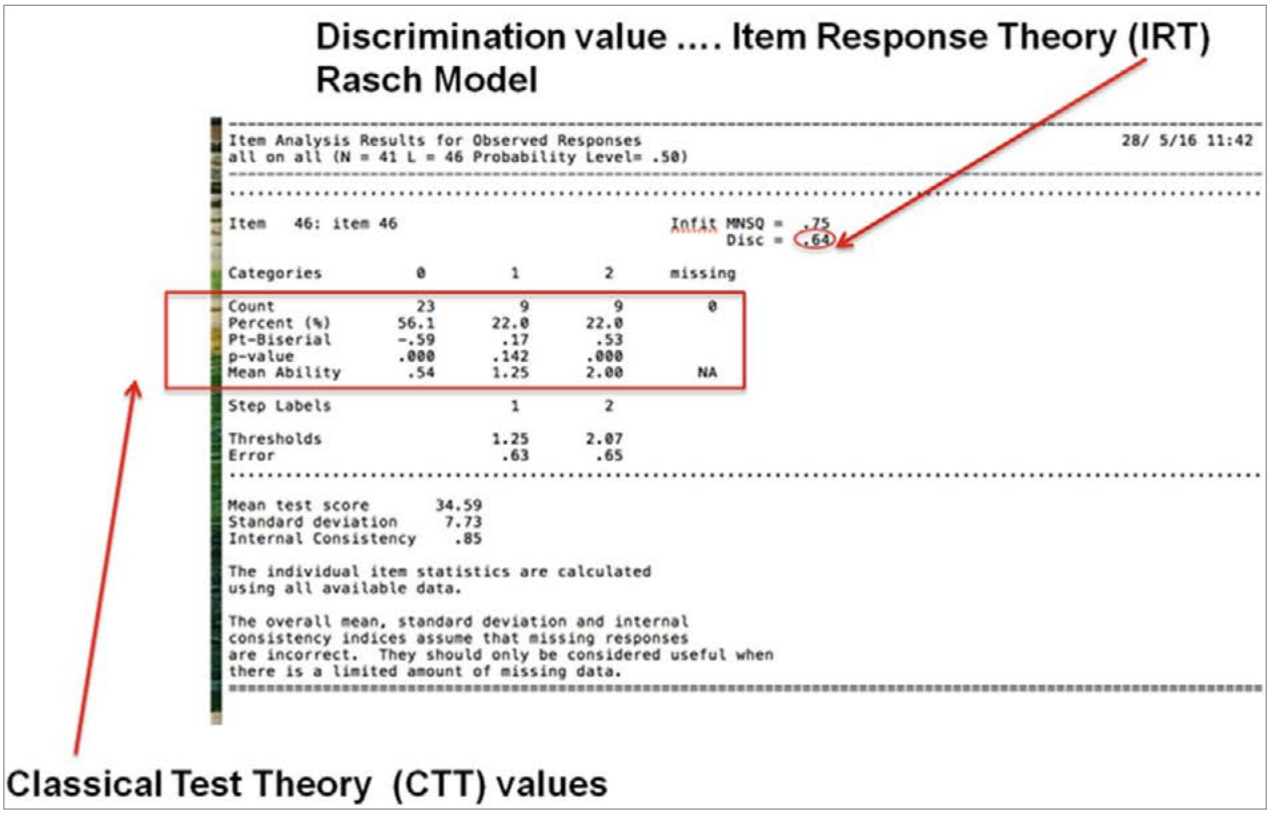

Figure 6 Test item analysis table

Summary

This paper opened with the impact of ICT and digital literacy on our everyday lives and then discussed testing learning performance through a prescriptive learning analytics model. School students are required to navigate their digital learning materials through critical evaluation of various multimodal media platforms. Without carefully crafted ePedagogies, learners will miss opportunities to expand their horizons using 21st-century digital communication skills. Adopting a prescriptive learning analytics assessment model will ensure that teachers/classroom facilitators keep track of digital literacy skill levels by implementing a summative assessment regime that checks accumulated knowledge/skills as classroom activities progress.

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