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Final Papers

Teacher ICT Skills: Evaluation of the Information and Communication Technology Knowledge and Skill Levels of Western Australian Government School Teachers.

An evaluation of knowledge and skill levels

In recognition of the need to integrate technologies with teaching and learning practices the Western Australian (WA) Department of Education and Training commenced a Learning Technologies Project for Government Schools in 1998. The increasing demand on teachers to apply Information and Communication Technology (ICT) in their teaching and learning has seen the Department implement a number of subsequent initiatives aimed at increasing government school access to ICT.

Underlying the aim of integrating and improving the use of ICT by students is an assumption that teachers themselves are competent and confident in the use of ICT in terms of teaching and learning. To implement appropriate support strategies there is a need for valid and reliable information about the existing ICT competence of teachers, and about the factors that enhance or hinder the development of teacher ICT competence and their application of it.

This evaluation was conducted to provide an assessment of the level and nature of ICT knowledge and skills among teachers in WA government schools and to establish to what extent teachers are integrating their ICT knowledge and skills in classrooms.

Conceptual Framework for Evaluation

A conceptual framework that represents factors of importance in understanding and measuring the ICT competence of teachers was developed following analysis of existing literature and current research work in the area. The knowledge and skills of teachers comprise a central component of the framework.

The evaluation methodology was designed to collect information on teacher's ICT knowledge and skills, the ways in which they use ICT and the extent to which they promote the use of ICT in student learning and to identify any factors that impact on each of these.

The conceptual framework, demonstrating each of the factors relevant to the evaluation is presented in Figure 1 below.

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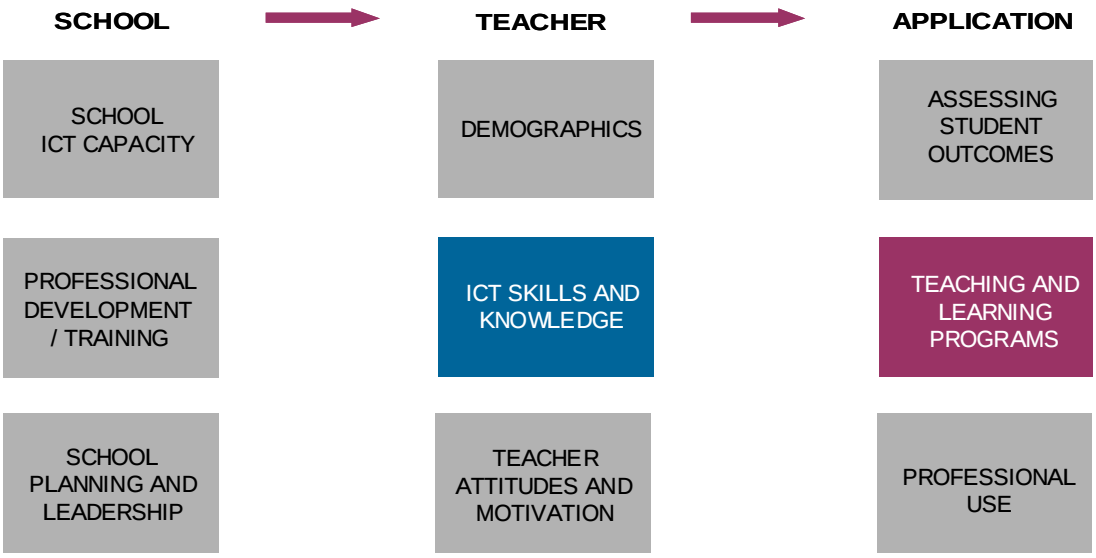
Figure 1: Conceptual Framework for Evaluation



Methodology

The evaluation methodology comprised:

ICT teacher survey: to enable teachers to self-report their levels of ICT knowledge and skill, the ways in which they use ICT and the extent to which they promote the use of ICT in student learning and to identify any factors that impact on each of these.

Objective online test of teacher ICT competence: to test the actual ICT knowledge and skills of teachers.

Statistical validation of the ICT Teacher Survey results against the outcomes of the objective online test of ICT skill.

ICT Teacher Survey

The ICT Teacher Survey collects information on the key demographics of respondents and asks teachers' views on a range of matters relating to ICT skill and usage, including:

- ✧ Their own ICT skills and knowledge;
- ✧ The extent to which they promote ICT usage in student learning and assessing student outcomes;
- ✧ The extent to which they use ICT for out of classroom professional tasks;
- ✧ Their school's ICT capacity;
- ✧ Their school's planning and leadership in ICT matters;
- ✧ Their attitudes and motivation towards ICT; and

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✧ Their experience of professional development and training courses provided by the school.

Survey Administration

Sampling procedure and response rate

ICT Teacher Survey forms were mailed to 2,332 teachers (approximately 12.5% of the total teacher population) working in government schools in W.A. Of these 1,500 were returned to the Department by the cut-off date, representing a response rate of 66%.

Subgroups of teachers from (a) metropolitan and country schools and (b) primary and secondary schools were identified using a stratified random sampling technique. The total number of teachers included in each subgroup was adjusted to reflect the actual proportions of the teacher population. The sub-group sample sizes were sufficient to ensure statistical confidence in the results for each sub-group of teachers from metropolitan primary schools; metropolitan secondary schools; country primary schools and teachers in country secondary schools.

The demographic characteristics of the sample are presented in the table below. Whilst no quotas were applied beyond school type and region, the random nature of teacher selection resulted in a good match between the demographics of the overall teacher population and those of the teachers who returned their survey forms.

Table 1: Sample characteristics

	Respondent Population	Teacher Population
Teacher Sample	1,500	18,225
	%	%
Region		
Metro	66	66 *
Rural	34	34 *
School code (population database):		
Primary Teacher	61	61 *
Secondary Teacher	39	39 *
School type (Survey response)		
Pre-primary	2	N/A
Primary	41	N/A
Middle	3	N/A
Secondary	35	N/A
District High	10	N/A
Other (incl. ed support & senior colleges)	8	N/A
Teaching role:		
Teacher & Admin	8	13
Teacher only	92	87
Teaching mode:		
Full-time	73	71
Part-time/Job-share	27	29
Gender		
Males	28	25
Females	72	75
Status		
Permanent	69	73
Permanent on Probation	6	26
Fixed term / Casual	24	

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Age		
<24 years	5	4
25-29 years	12	10
30-39 years	22	22
40-49 years	32	31
50+ years	29	33

** Note: A quota variable, therefore an exact match*

Online Objective Skills Test

To test that the teacher self reports collected by the ICT Teacher Survey was an accurate measure of the actual ICT competence of teachers, a subgroup of teachers who completed the ICT Teacher Survey also completed an objective test of ICT skills online. Electric Paper were contracted to provide an independent test of the ICT knowledge and skills assessed in the ICT Teacher Survey.

Sampling procedure and response rate

Of the 1500 teachers who completed and returned the ICT Teacher Survey, a total of 825 (55%) indicated a willingness to participate in the online skills test component of the evaluation.

The Department contacted 380 of the 825 volunteer teachers to complete the Online Objective Skills Test. Of the 380 teachers contacted, 230 undertook the Test, representing a response rate of 61%. The teachers selected to undertake the Test possessed a broad range of knowledge and skills and were representative of the full range of teacher ICT competence.

Statistical validation of the ICT Teacher Survey and Online Skills Test

Analysis of the results of the ICT Teacher Survey provides a very strong reliability coefficient (Cronbach Alpha of 0.98), suggesting that it is a statistically strong measure of ICT knowledge and skills.

Statistical analysis compared teacher responses to the ICT knowledge and skill items in the survey to teacher results on the Objective Online Skills Test to determine the validity of using teacher self-assessments as a measure of teacher ICT ability. Outcomes indicated that an individual's score on the ICT Teacher Survey is highly likely to be equal to their score on the Objective Skills Test, suggesting that teachers are not overestimating or underestimating their abilities in their self-reports.

Statistical comparison showed a correlation of 73% between the Objective Skills Test and the ICT Teacher Survey, suggesting a sufficient degree of content validity, when validated against the Objective Skills Test.

Analysis of the results of the Objective Skills Test provides a strong reliability coefficient (Cronbach Alpha of 0.89), suggesting that it is a statistically reliable measure of ICT knowledge and skills.

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ICT knowledge and skill levels of teachers

Teachers were asked about their use of eight commonly used ICT applications. For each software application a list of skills was provided, with teachers indicating which they had[1]. Teacher usage of the ICT applications varied widely, as shown in the table below.

Table 2: Teacher usage of ICT applications

	Usage Rate*
Base: All Respondents	n=1,500
	%
Word processing	98
Internet	97
Email	95
File navigation	93
Presentation packages	65
Spreadsheets	65
SIS Curriculum Manager	55
Databases	30

**Percentage of teachers who indicated that they could use the application.*

ICT Competence Index

In order to provide an easy to use statistic that summarises the teachers' responses to all ICT application survey items, an index was calculated. For each of the 1,500 teacher respondents, Rasch analysis was used to examine the results of the ICT skills listed on seven of the eight[2] applications addressed in the Teacher Survey and to develop a single index score for each individual teacher. This summary scale is called the ICT Competence Index.

The frequency of the ICT Competence Index follows a normal distribution. For the purposes of benchmarking and to help in the description of the wide range of skills and knowledge of teachers, the ICT Competence Index has been divided into three broad groups, as shown below.

Figure 2: Frequency Distribution of the ICT Competence Index – In 3 Stages

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[1] *The questions only asked the teacher to indicate which skills they had and did not ask how well or how often the teacher did the task.*

[2] *Very early in the analysis it was seen that the responses given to use of SIS Curriculum Manager were out of line with the responses given to the other questions. Further investigation led to the conclusion that usage of SIS Curriculum Manager is not in line with a teachers' general level of ICT competence because its usage is dependent on whether the school uses SIS Curriculum Manager. Because of this, SIS Curriculum Manager was omitted from subsequent analyses.*

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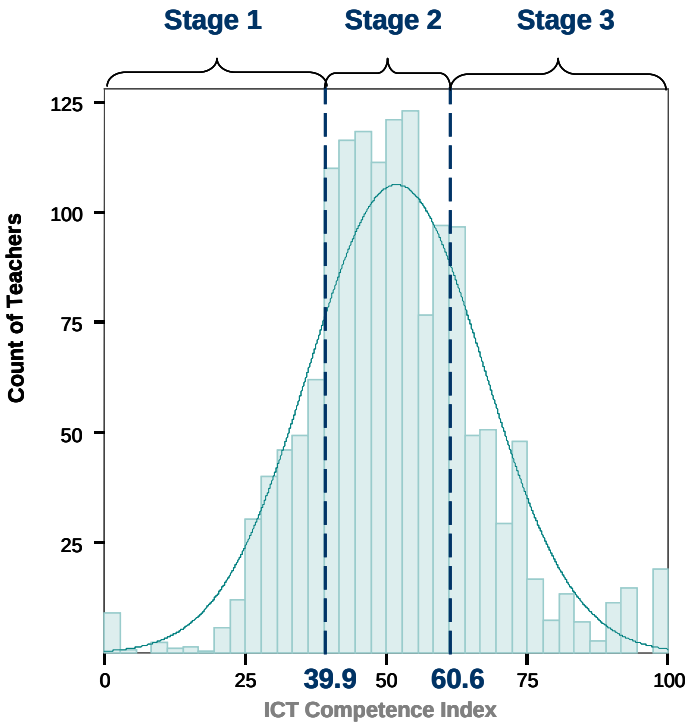

ICT Competence Item Map

Rasch Analysis was used to develop an item map through the calculation of teachers' relative use of each of the ICT skills. The map places items that are used by the most teachers across the top of the scale, whereas the items that are used by the fewest teachers are shown across the bottom of the scale.

The Item Map has been divided into the three stages of the ICT Competence Index, listing the skills that correspond to each of the stages. The cut-off points for each of the stages were determined by selecting tasks from each of the ICT applications that clustered together in a logical manner, as well as considering the proportion of teachers within each stage to ensure group numbers remained large enough to be meaningful. The items of ICT are shown in Table 3 overleaf, and include:

- **Stage 1** is comprised of 22% of teachers who typically have word processing skills and have used some aspects of Internet, email and file navigation. Generally, Stage 1 teachers have not used presentation software, spreadsheets or database applications (i.e. have an ICT competence scores between 0 and 39.9).
- **Stage 2** is comprised of 53% of teachers who in addition to possessing the ICT skills listed in Stage 1, have typically used Internet, email and file navigation to a greater extent. Stage 2 teachers also tend to have some presentation software and spreadsheet skills (i.e. have an ICT competence scores between 39.9 and 60.6).
- **Stage 3** is comprised of 25% of teachers who have typically undertaken most of the tasks in each of the listed ICT applications, including databases, extensively (i.e. have an ICT competence score over 60.6).

Analysis divided the individual ICT competence levels of teachers into three discrete stages for descriptive purposes only. The development of the ICT Competence Index

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in no way implies that Stage 3 is the most desirable level for WA government school teachers. While it may be appropriate for some teachers to be at Stage 3, it may be equally appropriate for other teachers (in differing circumstances) to be Stage 2 or Stage 1 users.

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Table 3: Item Map for ICT Competence (Skills & Knowledge)

		Word Processing	Internet	File Navigation	Email	Presentations	Spreadsheets	Databases
Stage 3	100							Use complex functions in queries
								Use more complex form design tools e.g. combo boxes
	95							Create and use parameter queries
	90							Use relational databases
								Use wizards to create forms, sub-forms or portals
								Create summary reports
	85							Use conditional formatting
								Use filtering
	80				Set up a discussion list			
							Use absolute and relative cell references	
							Import and export data	
	75							Use wizards to create reports and forms
						Add navigation buttons		Retrieve and enter data in an existing database
							Apply complex formulae	Use simple queries to retrieve data
	70						Refer to multiple worksheets	
						Create an original master		
						Insert hyperlinks		
	65	Use mail merge		Zip and unzip files				Create simple tables
			Alter browser preferences		Add a signature to emails			
				Do complex searches for files			Modify existing charts (graphs)	
	60		Conduct complex searches			Include sound	Create new charts (graphs)	
			Download and install software and plug-ins			Print handouts	Sort cells	
					Create a mailing list	Add animation and transitions		
Stage 2	55							
							Insert some calculations	
			Use advanced search tools			Can navigate back and forth during a presentation		
	50							
						Insert images	Insert and delete rows and columns	
		Set up styles		Navigate into a network		Edit an existing slide show	Create a new spreadsheet (enter data)	
	45			Recognise different file types		Change font and layout		
				Install software	Store messages in folders		Enter data into an existing spreadsheet	
			Organise Favourites or Bookmarks			Create a new slide show		
	40	Use columns and sections		Use appropriate Help files				
			Save images and text		Add attachments to emails			
Stage 1					Add to Address book entries			
	35	Add headers and / or footers			Access and use Address book entries			
			Create Favourites or Bookmarks					
		Insert page numbers			Locate Sent and Deleted messages			
	30	Change margins						
		Format a document		Navigate between existing folders				
		Change page set up						
	25	Insert images						
		Create tables		Create and name new folders				
	20	Insert text		Save files in a selected folder				
	15				Create and send emails			
			Navigate to known websites		Access emails			
			Do basic searches					
	10	Spell check						
		Change fonts						
	5	Open an existing document						
		Print						
		Create a new document						
	0							

Demographic factors that impact upon ICT competence

The following demographic factors have a statistically significant relationship with a teacher's ICT Competence Score.

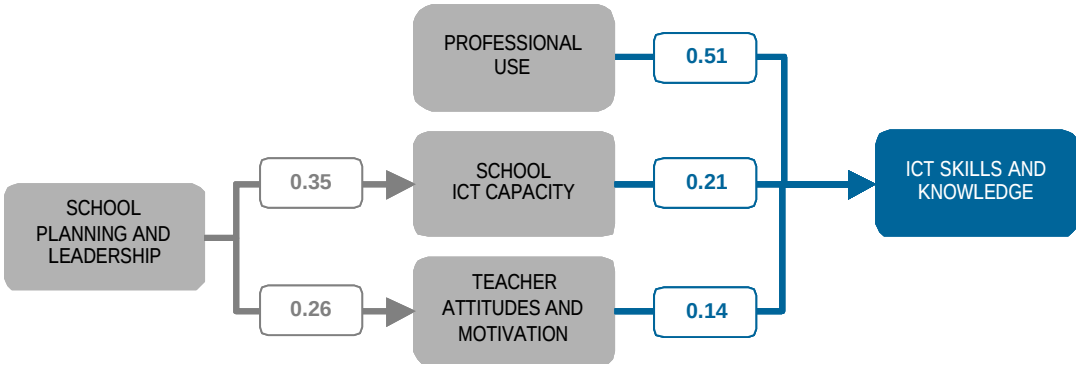
- **Gender**: Males are more likely to have higher ICT Competence scores than females.
- **Age**: ICT Competence scores decrease as a teacher's age increases.
- **Teaching experience**: ICT Competence scores decrease as the duration a teacher has taught in a WA government school increases; this may be attributed to the relationship between age and teaching experience.
- **School type**: Teachers at secondary schools are more likely to have higher ICT Competence scores than primary school teachers.

Other factors that impact upon ICT Competence

Structured Equation Modelling was used to analyse the relationships between ICT skills and knowledge and the other factors outlined in the Conceptual Framework. It was found that the factors with the strongest relationship with ICT skills and knowledge are Professional use of ICT; School ICT capacity; and Teacher attitudes and motivation.

These relationships are shown diagrammatically below. (Note, the arrows in the diagram can go both ways, however for this purpose are shown towards ICT skills and knowledge.)

Figure 3: Relative strength of relationship of factors on ICT competence of teachers



As the weights provide a quantitative measure of relative influence (or strength of the relationship) within the analysis, it can be deduced that professional use of ICT is the most influential factor on ICT skills and knowledge with a weight of 0.51, which has over twice the influence as the next factor, school's ICT capacity at 0.21. The third factor with influence is teacher attitudes and motivation with a weight of 0.14[3]. When

[3] *School planning and leadership* was found to have no additional influence over these three factors. However, it was found to have a mediating effect through *school ICT capacity* (0.35) and *teacher attitudes and motivation* (0.26).

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combined, the results for the three factors amount to 0.86 (the range is 0 to 1), which means that these factors account for 86% of the variance in ICT competence.

Professional use of ICT

The survey asked teachers to rate the frequency with which they use ICT to achieve seven specific aspects relating to professional use of ICT. Further analysis was conducted which examined the responses of all respondents to these questions and reduced the seven items onto a single scale. The single scale has been divided into three broad categories of use, those being low, medium and high. Results indicate that half (49%) of teachers are in the low category; a third (36%) of teachers in the medium category; and only 15% of teachers in the high category.

Demographic variations with professional use of ICT

- ✧ Teachers with a high frequency level of professional use of ICT are significantly more likely to have administrative duties than those with a low frequency level of professional use of ICT (16% vs. 4%).
- ✧ Teachers with a low frequency level of professional use of ICT are significantly more likely to be teaching at a primary school than are those with a medium or high frequency of professional use of ICT (49% low vs. 34% medium or high).
- ✧ Teachers with a medium/high frequency of using ICT for professional reasons are significantly more likely to be full-time teachers, (81% medium/high vs. 64% for low) whereas teachers with a low frequency of professional use of ICT are more likely to be part-time teachers (28% low vs. 16% medium/high).

School ICT Capacity

The strong relationship between a schools' ICT capacity and the ICT skills and knowledge of its teachers, indicates a need to investigate what comprises ICT capacity and how it can be improved. The survey asked teachers to rate the availability, use and ease of access of 14 different ICT resources at their school. Further analysis was undertaken which examined teacher demographics by the ICT resource capacity of their school.

The only demographic variation was found to be school type, with schools reported as having a high level of ICT capacity more likely to be secondary schools than primary schools and schools reported as having a low level of ICT capacity more likely to be primary schools than secondary schools.

Teachers' Attitudes & Motivation

Teachers were asked to indicate the extent they agreed with five attitudinal statements relating to their use of ICT. On the whole, teacher attitudes and motivation are extremely positive. Further analysis was undertaken which examined teacher attitudes by key demographics. It was found that the teachers who are most likely to express negative attitudes to these statements are more likely to be secondary school teachers; part-time teachers; and teachers aged over 50 years.

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The impact of training courses on ICT skills and knowledge

Teachers were asked to indicate whether they had undertaken professional development in any of seven areas of ICT, who had arranged the training and whether it was effective. From the information provided on the skills and knowledge of each teacher, competence scores were calculated. In order to determine the impact of training, the competence scores for each specific application were analysed by whether or not teachers had undertaken training. See results below. Teachers who had received training were then asked to rate whether they found their training course to be effective or ineffective. The results are as follows:

Table 5: ICT Competence Scores vs. Effectiveness of Training Received

	Effective Training	Ineffective training	Effectiveness not specified
Base: Respondents who received training			
SIS Curriculum Manager competence score	60	36	53
Spreadsheets competence score	41	27	52
Presentation software competence score	50	22	68
Databases competence score	24	5*	44

Teacher integration of ICT within the classroom

Teachers were asked to what extent they applied ICT within their teaching practice. Results are presented in the figure below.

Figure 3: Frequency of professional use of ICT

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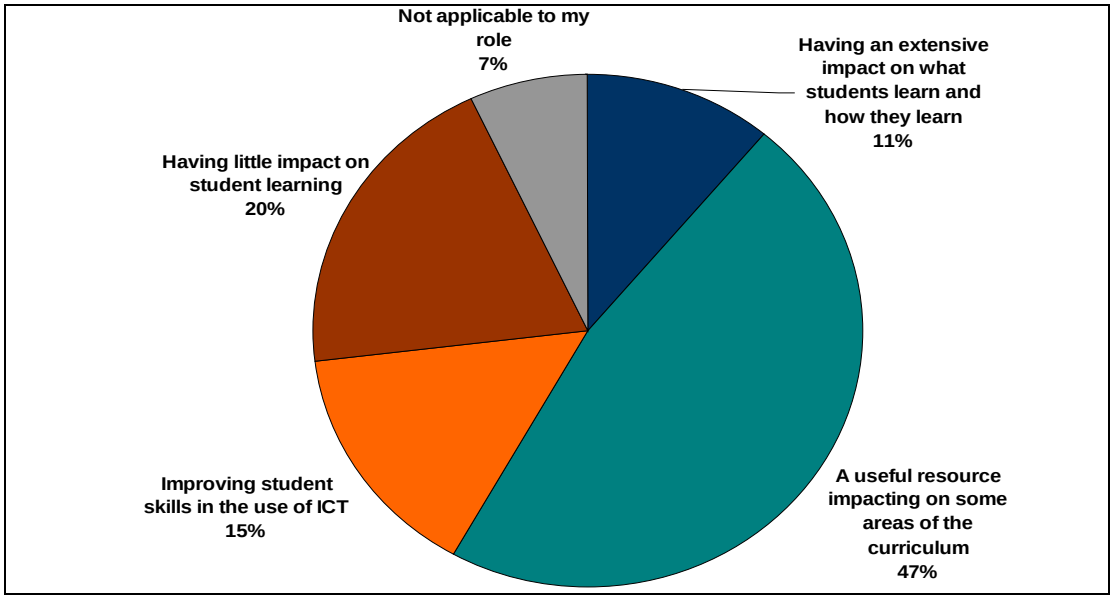

Analysis was undertaken of the extent to which teachers' reported that they incorporated ICT into learning to achieve nine learning outcomes. The results are presented in Figure 4 below:

Figure 4: ICT Integration within learning

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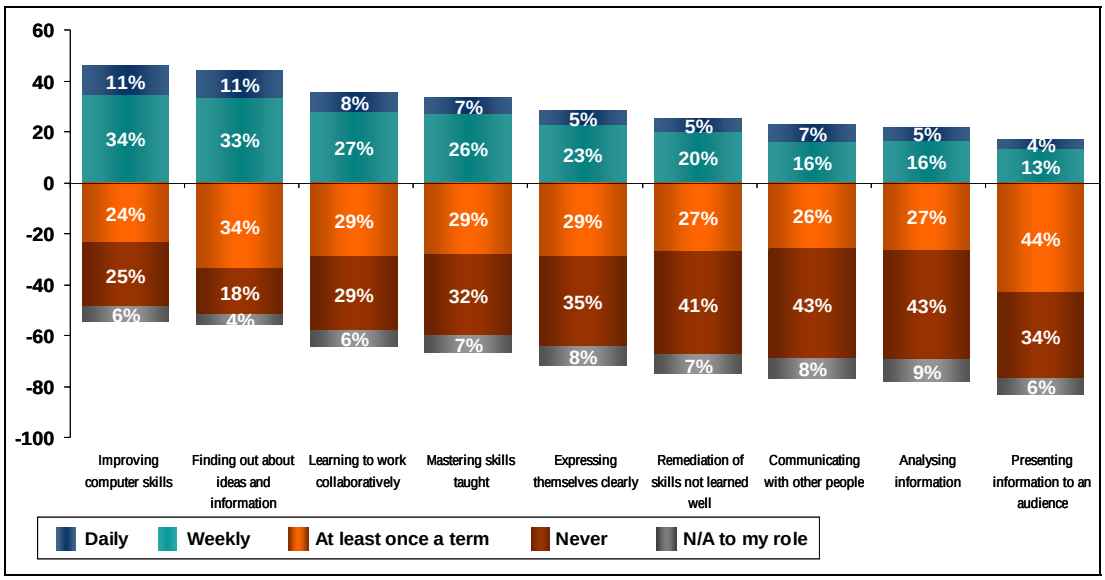

ICT Integration Index

Rasch Analysis was used to summarise teacher responses to the above set of questions onto a single scale**,** the ICT Integration Index. As can be seen in the figure below, the frequency follows a skewed distribution, with a high proportion of teachers with low ICT Integration Indices (i.e. Less than 50%).

Figure 5: Frequency Distribution of the ICT Integration Index – In 3 Levels

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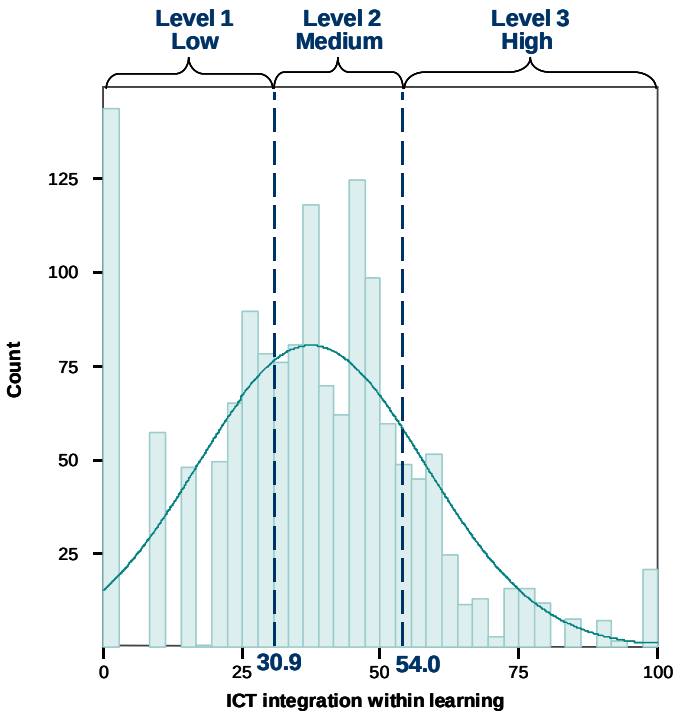

ICT Integration Item Map

Rasch Analysis produced an ICT Integration Item Map, which indicates the relative use of ICT to achieve each of the nine learning outcomes. See Table 6 below.

Table 6: Item Map for ICT Integration within learning

	Frequency			
	Never	Up to 1+ times a term (infrequent)	Once or more a term up to Weekly (often)	Weekly up to Daily (regularly)
Low	Re-teach skills not learned well Communicate with other people Analyse information	Find out about ideas & information Improve computer skills Learn to work collaboratively Master skills taught Express themselves clearly Present info to an audience		
Medium		Present info to an audience Re-teach skills not learned well Communicate with other people Analyse information	Find out about ideas & information Improve computer skills Learn to work collaboratively Master skills taught Express themselves clearly	
High			Present info to an audience	Find out about ideas & information Improve computer skills Learn to work

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				collaboratively Master skills taught Express themselves clearly Re-teach skills not learned well Communicate with other people Analyse information

The Item Map has been divided into the three levels of the ICT Integration Index, and shows the skills that correspond to each of the levels. By reading across each level the table indicates the frequency at which each of the learning outcomes is achieved. Thirty six percent of teachers have a low ICT Integration score, 46% of teachers have a medium ICT integration score and 18% of teachers have a high ICT integration score**.**

Demographic factors impacting on teacher ICT integration

There is only one demographic factor that displays a statistically significant relationship with the extent to which a teacher integrates ICT within learning in their classroom, which is their mode of employment. Full-time teachers are statistically significantly more likely to integrate ICT within learning than are part-time/job share teachers (39% and 33%).

Other factors impacting on teacher ICT integration

Structured Equation Modelling was used to analyse the relationships between teacher ICT integration within learning and the other factors outlined in the Conceptual Framework. The following factors, in order of the strength of their relationship with ICT integration are presented below.

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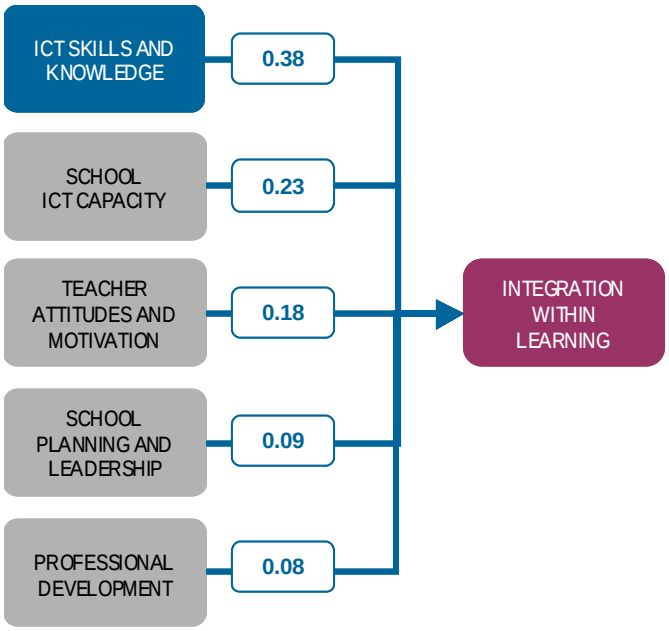
Figure 6: Relative Influence of ICT competence and ICT integration.



The figure clearly shows the very strong relationship (0.38) between the extent to which ICT is integrated in the classroom to achieve learning outcomes and the ICT skills and knowledge of the teacher. This can be interpreted to mean that teachers with higher levels of ICT skills and knowledge are more likely to integrate ICT within learning than teachers with lower levels of skills.

The next most influential factor is school ICT capacity at 0.23, followed by teacher attitudes and motivation (0.18). Of lesser, but still significant influence are school planning and leadership (0.09) and professional development (0.08)[4].

School Planning and Leadership

As outlined earlier, school planning and leadership has a statistically significant relationship with ICT integration within learning. The survey asked teachers to indicate the extent to which they agreed with six statements about their school's planning and leadership in relation to the use of ICT at their school. Further analysis examined the responses of all respondents and looked at the key differences between low, medium and high levels of planning and leadership. Nearly half (43%) of teachers are in the low category, a third of teachers (36%) are in the medium category and in the high category are 22% of teachers.

Demographic variations with school planning and leadership

[4] *When the weights of these five factors are combined, the aggregated weight comes to 0.96 (the range is 0 to 1), which indicates that 96% of the variance in the responses* for **ICT integration within learning** *are explained by these factors. This is a very high proportion, and indicates that through understanding these factors we can understand almost all that influences ICT integration within learning.*

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Teachers who are at schools with high scores for planning and leadership (rather than medium or low scores), are more likely to be older teachers, i.e. over 40 years old and to have had over 20 years teaching experience.

Impact of Professional Development on ICT integration within learning

Structured Equation Modelling found that professional development[5] significantly impacts on the degree to which teachers integrate ICT within the classroom. Further analysis shows that teachers who have received training on how to integrate ICT within the classroom are significantly more likely to be integrating ICT within their classroom (44%) than those who had not undertaken such training (34%).

Barriers to ICT integration

Teachers were asked in the survey how often factors outside their control restrict their use of ICT and at the end of the survey, teachers were asked the following open-ended question: *Please describe any factors that would increase your use of ICT in the classroom?* Seventy eight percent of teachers surveyed described factors that would increase their use of ICT in the classroom in response to this question. This high response rate for this style of question indicates the high level of involvement teachers have with the issue.

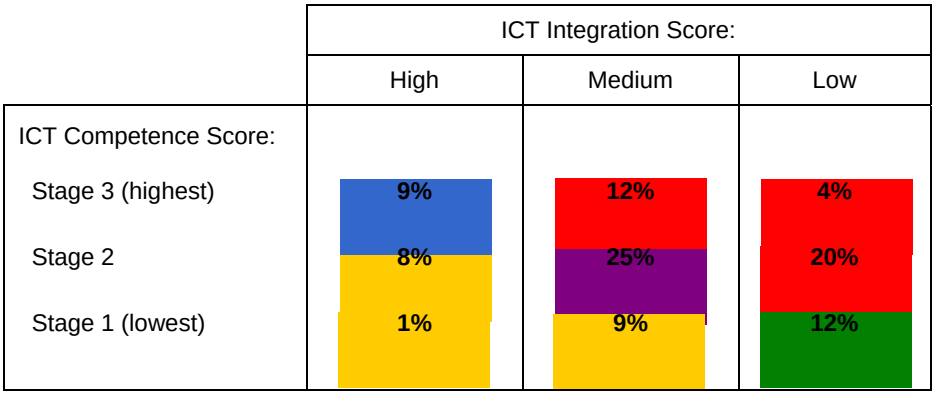
Summary of evaluation outcomes and implications

Figure 8 below presents the proportion of WA government school teachers who are classified within the matrix based on their ICT competence and ICT integration scores in this evaluation.

ICT Competence: by summing across the rows, it can be seen that 25% of teachers have a Stage 3 score, 53% have a Stage 2 score and 22% have a Stage 1 score.

ICT Integration: by summing down the columns, it can be seen that 18% of teachers have a High score, 46% have a Medium score and 36% have a Low score.

Figure 8: ICT Competence and Integration Matrix



[5] *That is professional development as measured in the questionnaire.*

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Different sections of the grid have been colour coded thus:

- ✧ Green: Teachers who have a low ICT competence score and a low ICT integration score (12%).
- ✧ Yellow: Teachers who have a higher ICT integration score than their ICT competence score (18%).
- ✧ Purple: Teachers who have moderate ICT competence and ICT integration scores (25%).
- ✧ Red: Teachers who have a higher ICT competence score than their ICT integration score (36%).
- ✧ Blue: Teachers who have high ICT competence and high ICT integration scores (9%).

The characteristics of each of the groups of teachers, along with the ICT development and support strategies identified in the evaluation as being most appropriate to each group provides the department with a guide for strategic action, following determination of the desirable minimum levels or standards of competence and integration.

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