Teachers talk about measuring ICT curriculum integration

ABSTRACT

Concomitant with the many initiatives concerned with ICT curriculum integration are requirements for measurement of the student outcomes of that integration, in keeping with recent education priorities that emphasize outcomes and accountability. However researching and measuring the impact of ICT initiatives has been found to be a significant challenge. In Queensland (Australia) an instrument to measure ICT curriculum integration quantitatively has been developed, trialled and evaluated. This paper provides an overview of the issues identified by teachers with respect to the affordances and constraints related to the use of the instrument as they experienced it during the trial. The talk is analysed quantitatively using Leximancer software, and qualitatively by thematic analysis. This analysis identifies a number of ramifications for the particular instrument being evaluated, as well as for all instruments with the general intention of measuring ICT curriculum integration.

INTRODUCTION

Concomitant with the many initiatives concerned with ICT curriculum integration (see for example Finger & Trinidad, 2002, for an Australian overview), are requirements for measurement of that integration, in keeping with recent education priorities that emphasize outcomes (Andrich, 2002; Solway, 1999) and accountability (Gordon, 2002; Mulvenon, Murry, & Ritter, 2001). However as Cuttance (2001) noted, "schools that developed ICT-based innovations found the discipline of researching and measuring the impact of their innovations to be a significant challenge" (p. 99). As a consequence of the "challenging" nature of this research, approaches that seek to quantify skills (Meredyth, Russell, Blackwood, Thomas, & Wise, 1999), or quantify available hardware (Withers & Coupal, 2002), or correlate available hardware with time of student use (Norris, Soloway, & Sullivan, 2002) have been employed. Large-scale investigations such as the Second Information Technology in Education Study (IEA, 2003) and enGauge (NCREL, 2003) have highlighted the need for the development of methodologies that effectively measure student outcomes as a result of ICT integration. In the United Kingdom, comprehensive research has been carried out by Becta (under commission from DfES) as part of their ICT in Schools Research and Evaluation Series (see for example Harrison et al., 2002; Hayward, Alty, Pearson, & Martin, 2003; Somekh et al., 2002). This research has included surveys of the attitudes and experiences of young people aged 5-18 and their parents, in relation to the use of ICT at home and at school (Hayward, Alty, Pearson, & Martin, 2003), studies of the impact of ICT on pupil learning and attainment (Harrison et al., 2002), and the use of innovative concept mapping methodology to "gain an insight into pupils' understandings of the role of computers in today's world" (Somekh et al., 2002, p. 34). In addition, two extensive reviews of the literature (Cox & Abbott, 2004; Cox & Web, 2004) have been undertaken to identify aspects of the way in which ICT is used and the actions of teachers that can help to ensure that ICT will have some chance of having an impact on attainment. Collectively, these studies reflect moves toward examining student use of ICTs rather than previous studies which tended to focus on the 'inputs' such as provision of ICT infrastructure and teachers' ICT training and professional development.

In Queensland (Australia), in order to measure ICT curriculum integration quantitatively an instrument was developed in 2003 that employed theoretical constructs from *Good Practice and Leadership in the Use of ICT in Schools* (DETYA, 2000) and *The Queensland School Reform Longitudinal Study* (Lingard et al., 2001). In the former of these documents four dimensions of ICT use in schools were identified that distinguish between ICT as a tool for use across and within curriculum, and a reform component for student learning and reorganization of schooling. In the latter document, a framework of four dimensions of classroom practice was described that involved intellectual quality, connectedness to the learner, classroom environment, and learner differences. The instrument developed from these constructs comprised two parts: the first sought background information on the teacher respondent, and the second explored learning, teaching and the curriculum. Background information included gender, school type, years of teaching experience, confidence with using ICT with their students, and frequency of their students' use of ICT. In the second part of the instrument, respondents were required to complete 45 items in which the sentence stem was: *In my class students use ICTs to ...*, for example: *In my class students use ICTs to communicate with others locally and globally.* Respondents were required to identify the current frequency of student use of ICT for each item as well as indicate preferred frequency of use on two 4-point

GLENICE WATSON
Centre for Applied Language, Literacy & Communication Studies
Griffith University

G.A.Watson@griffith.edu.au

ROMINA M. J. PROCTOR

Centre for Learning Research
Griffith University

R.Proctor@griffith.edu.au

GLENN FINGER

Centre for Learning Research
Griffith University

G.finger@griffith.edu.au

Likert scales (never, sometimes, often and very often). Each item was accompanied by a range of examples relevant to various year levels of students (P-3, 4-9, 10-12). The instrument also included an electronic collation tool. Aspects of the development and testing of this instrument have been reported in Proctor, Watson and Finger (2003), Finger, Proctor and Watson (2003), and Watson, Proctor and Finger (2004).

The instrument was extensively trailed and evaluated in 2004. The evaluation comprised three major components: statistical analysis of the instrument trailed with 929 Queensland state school teachers; a peer review of the instrument involving a 15-member Peer Review Team; and interviews with 42 teachers from 6 Queensland schools who had used the instrument. This paper reports on the teacher interview component of the evaluation. The other evaluation components will be reported elsewhere. The paper provides an overview of the issues identified by teachers with respect to the affordances and constraints related to the use of the instrument across the curriculum as they experienced it during the trial. It describes the process, identifies outcomes as indicated by analysis with a software package for identifying dimensions of discourse (*Leximancer*), and by thematic analysis, and concludes with a range of commendations and recommendations relating to the particular instrument being evaluated, as well as quantitative instruments for measuring ICT curriculum integration generally.

The Process

Focus group interviews were conducted in six (6) state schools in Queensland. These schools were selected as a cross-sectional representation of urban, regional and rural; primary and secondary; and high, medium and low ICT integration demographics. In consultation with the researchers, an external independent consultant selected the schools based on her expert knowledge of the ICT capability of the schools. Table 1 provides an overview of the criteria on which the six schools were selected. To preserve the anonymity of the participants the schools have been given an alpha code.

The participants in the focus groups (N=42) were generally selected by the school's ICT coordinator as representative of the teachers in their school. All participation in the focus groups was voluntary. An analysis of the number of participants from each school, and their gender and years of teaching, is provided in Table 2.

Table 1: Schools Selected for the School Trials and Teacher Interviews

Selected Schools	Criteria for Selection
A	Secondary 8-12 school, 550 students (12%ATSI1) in a provincial town serving a rural community. Currently experiencing low-level integration of ICTs but in planning stage to facilitate greater ICT integration.
B	Secondary 8-12 school, 1100 students (5%ATSI) in outer urban community. Medium integration of ICTs through pursuing Action Learning projects using ICTs.
C	Primary and Secondary P-12 school, 450 students (34%ATSI) in provincial town and remote community. New Basics school.
D	Primary P-7 school experiencing rapid growth, 700 students (18%ATSI). Progressive ICT integration and hosts an ICTs and girls' group.
E	Primary P-7 school, 800 students (8%ATSI) in outer urban community.
F	Primary 1-7 school, 100 students (2%ATSI), rural location near provincial town. Progressive ICT integration in early stages with some innovator grants and new ICT community centre.

Table 2: Analysis of focus group participants by school

Selected Schools	Total Participants	Number females	Years teaching<5	Years teaching 5-20	Years teaching >20
A	7	5	2	1	4
B	5	5	2	2	1
C	8	6	6	2	0
D	7	5	3	2	2
E	9	9	3	4	2
F	6	5	2	3	1
Total	42	83%	43%	33%	24%

Participants were asked to complete the instrument and consider their responses to the interview protocol prior to the focus group interviews. The protocol provided an explanation of the research purpose and the process of the focus group interview, as well as identifying the four dimensions of ICT integration that comprised the theoretical frame for the instrument. The first part of the protocol questioned the participants' emotions and feelings when using the instrument; what they thought the instrument was measuring; whether the instrument helped to understand the expected standard of ICT integration; and what, if any, of the participants' ICT practices were not measured by the instrument. The second part of the protocol explored the assertions inherent in the instrument with respect to the dimensions of ICT integration, productive pedagogies, standards for ICT integration, and the acceptability of the instrument within professional practice. The third part of the protocol considered the value of the instrument for individuals, teaching teams, whole school direction and planning, and for the employing authority. The fourth part provided additional questions for the ICT coordinator and focussed on technical aspects of installation of the digital collation tool on their network, documentation, collation and aggregation of data, and the possibility of extrapolating from the results of the focus group participants to predict the value of the instrument on a larger scale.

All focus group interviews were conducted by the external independent consultant who was known to many of the participants from work she had done previously with them in their school with respect to ICTs. Her independent status with respect to the development of the original instrument, and the high regard in which the participants hold her, enabled particularly frank communication. All interviews were digitally recorded and have been transcribed. In addition, the independent consultant kept written reflections on the focus group experiences in each of the schools and provided an overview summary of the key issues from her perception. The discussion that follows draws on data from the transcripts, and the consultant's written reflections and overview summary.

Transcripts were analysed quantitatively in the first instance using *Leximancer* software and then qualitatively using thematic analysis.

Outcome of *Leximancer* analysis of transcripts

Leximancer is a software package for identifying the salient dimensions of discourse by analysing the frequency of use of terms, and the spatial proximity between those terms. The *Leximancer* package uses a grounded theory approach (Glaser & Strauss, 1967; Strauss & Corbin, 1990) to data analysis. It computes the frequency with which each term is used, after discarding text items of no research relevance (such as 'a' or 'the'), but does not include every available word in the final plotted list. Constraints include the number of words selected per block of text as well as the relative frequency with which terms are used.

After computing a ranked list of terms, *Leximancer* computes the distance between each of the terms via computations equivalent to nonparametric factor analytic or cluster analytic procedures in quantitative data analysis. This analysis provided evidence of the range of issues identified through the focus groups. As with other

factor analytic procedures, there is no single solution, and the quality of particular solutions is best judged in terms of interpretability. The result of this computation is displayed in a two-dimensional spatial representation.

Figure 1 shows an indicative list of the first 27 ranked terms produced by a *Leximancer* analysis of the transcripts. Words that lack precise meaning (e.g., bit, lot, stuff) were then removed and the distance between the terms computed, giving the resultant two-dimensional spatial representation as shown in Figure 2. With *ICT* rotated to align with the vertical Axis (i.e. loading strongly on one of two factors), the terms *year, curriculum,* and *staff* also align with this axis indicating that these terms concern participant opinions about ICT in relation to *organisational* aspects of the school deployment of ICT. It is of particular interest that the term curriculum is central to the two axes, suggesting the importance of this term regardless of the immediate contexts of discussion.
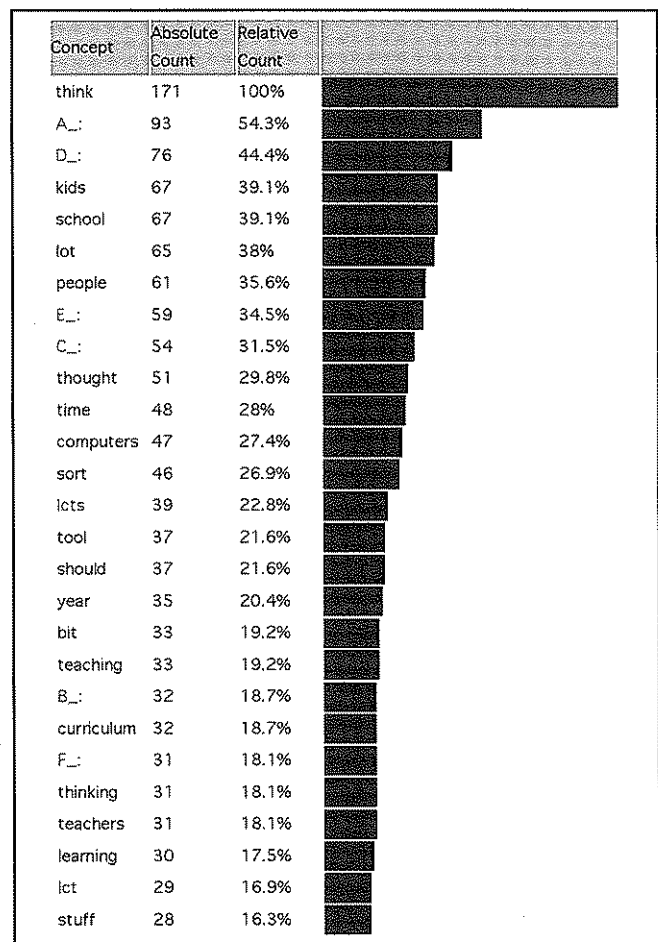
Concept	Absolute Count	Relative Count	
think	171	100%	
A_:	93	54.3%	
D_:	76	44.4%	
kids	67	39.1%	
school	67	39.1%	
lot	65	38%	
people	61	35.6%	
E_:	59	34.5%	
C_:	54	31.5%	
thought	51	29.8%	
time	48	28%	
computers	47	27.4%	
sort	46	26.9%	
Icts	39	22.8%	
tool	37	21.6%	
should	37	21.6%	
year	35	20.4%	
bit	33	19.2%	
teaching	33	19.2%	
B_:	32	18.7%	
curriculum	32	18.7%	
F_:	31	18.1%	
thinking	31	18.1%	
teachers	31	18.1%	
learning	30	17.5%	
Ict	29	16.9%	
stuff	28	16.3%	

Figure 1. Indicative list of ranked terms produced by Leximancer analysis of transcripts

"The first thing that annoyed me was that I really didn't know what very often meant..."

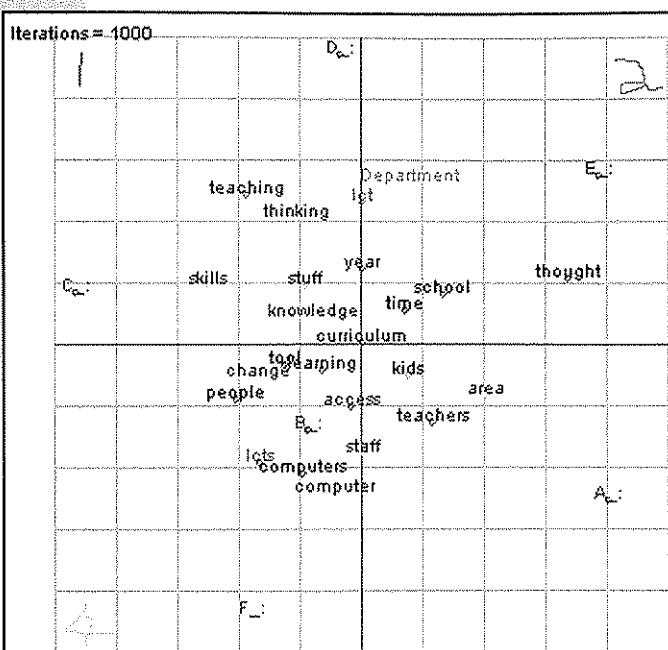Teachers talk about measuring ICT Curriculum Integration

Figure 2: Two-dimensional spatial representation of terms produced by Leximancer analysis of transcripts

Generally, participants appeared to discuss the organisational aspects of ICT in terms of teaching preparation (*teaching, thinking, knowledge, skills: Quadrant 1*), generic organisational aspects (*time, school, thought, Department: Quadrant 2*), the social actors (*kids, teachers, area: Quadrant 3*), or resource allocation (*tool, learning, change, people, access, computer, computers: Quadrant 4*).

It is of some interest that school A's interactions focused more especially on the social actors (Quadrant 3), schools B and F focused on resource allocation (Quadrant 4), school C focused on teaching preparation (Quadrant 1), and school E focused on generic organisational aspects (Quadrant 2). This level of analysis would be of interest to the individual schools and could provide important directions for the provision of resources and professional development at the school level.

Outcome of thematic analysis of interview transcripts

This section will analyse the transcript data thematically (Miles & Huberman, 1994; Patton, 2002) to provide an overview of the participants' views with respect to various aspects of the instrument. While the participants took advantage of the focus group opportunity to discuss a wide range of topics (as indicated by the *Leximancer* analysis above), only those themes that related directly to the instrument are included in the following discussion. These themes are: the definition of ICT integration; a tool for reflection and planning; the items; the scales; the

examples; the electronic format and collation tool; and the context.

It should be noted that, generally speaking, the reaction to the instrument was positive and it was seen as valuable in terms of advancing ICT integration. There was considerable disparity between the generally positive attitudes with respect to the instrument expressed by participants from the primary school sector, compared with the more negative attitudes from the secondary school sector participants. A similar disparity was evident in the very positive attitudes to technology and learning expressed by participants from the primary sector and the generally negative attitudes from participants from the secondary sector. Thus it is important to note that the views expressed by the participants about the instrument were inextricably linked to their views about the wider issues of ICTs and learning more generally.

The definition of ICT integration

In the process of data collection, describing what the four dimensions of ICT (DETYA, 2000) integration mean and seeing the dimensions as an explanation or rationale for ICTs in schools caused considerable impact. The interviewer noted that the participants listened to the explanations as if it was "new news" and that the interview process itself was a learning experience for the participants in this regard. Four of the six ICT coordinators commented on how powerful the dimensions were and how they "made sense".

It was generally considered that the most powerful attribute of the instrument was in the definition of the integration of ICTs that the instrument describes through each of the items. The productive pedagogy framework inherent in the items was seen as valuable and sending the best message possible about what ICT integration means. When describing what applicability the instrument had for individual reflection, group planning and school planning, the comments related mostly to the definition portrayed through the items. Some ICT coordinator participants did not realize such a definition existed and once they saw it, liked what it said. Generally speaking, the ICT coordinator in each school had a much more sophisticated view of what ICT integration meant, what might impact on the level of integration, and usually had a much bigger and more sophisticated picture of curriculum and pedagogy generally than the classroom teachers. While this is to be expected, the scale of the difference in understanding was considered by the interviewer to be "stark" and could be seen as the ICT coordinators illustrating leadership or middle management level thinking. The interviewer noted that it cannot be emphasized enough "how powerful and useful the definition organized into dimensions is for setting a tone, communicating a definition, and stimulating professional discussion and reflection on the school's progress".

A tool for reflection and planning

The value of this instrument as a tool for reflection was the most prevalent and powerfully delivered message in every

interview. As one participant noted, it was "a great way to look at yourself in a non-threatening way, because you do it alone or just with one person to reflect on your own teaching". Another described this as a "light bulb" experience:

Some of the questions I answered "never" to, I just start thinking, well, you know, I answered "never" so obviously I need to start including that in the curriculum. So it's like a light bulb in different ways.

In addition, this process of reflection was seen as providing incentive to try new forms of ICT integration even if the initial reflection was a bit "scary":

I think if you're wanting to self-reflect on your ICTs integration then it's a place to start and to review. If you were really not confident it could be, yeah, very scary. But maybe it might have the reverse effect. You look at it and you think well, I've got "never", but maybe I really could do that. The other thing is that you also see the greater scope of where and how it can be used and have a look at a bigger picture. I never thought about using such and such or never thought that doing this was a part of ICT skills.

From the perspective of the ICT coordinators, the instrument was seen as having value as a planning tool:

I think from my perspective I would use it to measure across the board whether year levels that were using it and integrating it in a variety of KLAs [Key Learning Areas]. Are there some year levels that are only using particular KLAs? And what is the number of teachers that are using it? And how many are still eager to expand that use? How many are there that really would like professional development to further their own journeys, and further integrate it into the classroom.

The items

While the transcripts show that the interviewer emphasized the extensive number of items (45 in total) repeatedly in the interviews, the participants failed to engage with this idea and in fact there was some agreement that it did not actually take very long to do. This could be understood in terms of how the participants perceived the value of the instrument to them, that is, as a reflective tool on their ICT integration practices and a stimulus for new ideas. As explained below, they were not particularly engaged with the notion of the instrument as measurement, except for some mild curiosity about personal outcomes (and how they could tweak their responses to get a better final score). It should be remembered that these participants were volunteers and willing contributors to the research. A similar attitude to the number of items might not be shared by those required to complete it as part of employment obligation.

Only rarely did the participants engage with particular items, suggesting that the items were generally well understood, although there was some discussion about the appropriateness of the items for particular groups such as special education children. In the following excerpt, a special education teacher expressed confusion about whether she should interpret the items according to the functional or chronological ages of her students:

Well for me, you know how we clicked special education and then you had to click your year level, I sat there for about 2 minutes looking at it and thinking well what exactly do I write? Do I write the year level they're functioning at or do I write their chronological year level? Will that influence the way these statements are going to come out at the end?

When asked about whether or not the instrument provided sufficient opportunity to indicate what they did in their classroom with respect to ICT integration, that is, were there items the instrument lacked, there was little response, suggesting this was not seen as a problem. However, there was some desire expressed to include open-ended questions in the instrument that would allow participants to provide some explanation for their responses, as evidenced in the following excerpt:

It would be nice to have at the end just a couple of, are there any factors at your school that may have impacted on your answer, for example access policies, economic factors, some schools don't, the kids don't have money always for internet, my sister teaches out west, the phone lines don't work half the time, so that really impacts on her, and she has got kids doing distance education on line, so it's really tough

Another call for open-ended questions related to providing opportunity for participants to describe their particular application of the ICT integration, for example "facilitate creativity, it doesn't allow you to say how we did it, what we used …".

The scales

The relative nature of the scales (very often … never) against the items caused some problems for the participants as exemplified in the following transcript excerpt:

How often is often and very often in a classroom because once, I was just talking to [another teacher], and she said oh, I do it often because I do it every day. I said well often to me would be sort of, very often would be sort of all day just about. So are we writing the same sort of thing?

The participants suggested one measurement made little sense because use is variable in a year, or with a cohort of students, or dependent on school circumstances, that is, use is not homogenous. This caused particular problems for participants from the secondary sector as their ICT integration may be markedly different between their subject areas and they were unsure about which area they were reporting. An example of this type of concern is contained in the following excerpt that was elicited as a first response to the interviewer's question about feelings when using the instrument:

The first thing that annoyed me was that I really didn't know what very often meant. Because very often varies with year level, with your subject, with your availability and access [to computers]. So the "very often", I felt that I was not using the word in the same way from year level to year level.

The scales were also seen as providing a subtext of expectation, that is the participants interpreted the scales as reflecting the employing authority's expectation that they should be ticking "very often" for most of the items and noted a feeling of guilt about their "never" responses. At times the reaction to this expectation was close to indignation or was at least defensive and seen as impacting on their professional decision making, as in the following excerpt:

You almost think at the end of every stage you should be ticking very often on everything when in fact I'm not sure that that's the case. You know you make some professional decisions about that stuff.

The examples

The examples provided with the instrument were seen as valuable in helping to interpret the items as follows:

I was happy to see, although I didn't necessarily agree with all the examples, I found that a very useful tool for me for interpreting what the statement [item] meant.

However, the main value of the examples was from the perspective of providing ideas for future ICT integration. For example, in the following excerpt, the participant explains that she found the examples so valuable that she looked up all of them, not just the ones she needed to help her understand a particular item:

I mean those examples, when you're looking at, you know, what it means, those examples gave me loads of good ideas. I thought they were good so I went back and read them all then not just the ones that I needed explanation for.

While the examples were well received there was a feeling that more examples could be provided particularly to meet unusual or particular teaching situations. For example, the special education teacher quoted above expressed an expectation that the examples provided would be tailored to her situation:

That wasn't the case. But I thought well where's this going to end up for me. And then when I went in and I was looking at the questions and I was thinking I don't know how this even relates to what I'm doing and I sort of sat there and thought about it, well maybe I could throw that in there, or maybe I could throw something else in and that could sort of mean that for me. But maybe if there was sort of a different off-shoot.

The electronic format and Collation Tool

Overall, the electronic format of the instrument did not create excitement with the participants and many completed the instrument in paper format. None of the ICT coordinators indicated they would use the instrument electronically with staff. However those who had completed the instrument electronically found it easy to use, as articulated in the following excerpt:

It worked well and it told you how many more things you had to do. Like I hate it when these things break down and don't work like you want them to work. If you made some mistakes it told you the mistake, it said you haven't filled in all the boxes, and you hit the thing and it went down a bit further.

Not using the instrument in its electronic format negates the possibility of using the Collation Tool but of those who did use this tool, many were surprised at how poorly they rated on the results graphs and most did not know what they meant or what to do with the results. Some queried how the scores were calculated. The most powerful suggestion was that collating the results across each of the dimensions individually would be more useful. However some expressed interest in seeing their personal outcomes and how to improve on that outcome, as exemplified in this excerpt:

I think there was also to me that bit of curiosity of where will I be plotted after answering all the questions. You know, like knowing that there are those four dimensions and saying well, yes I have actually done it twice and now I know where you can add to it to get yourself plotted in a certain position.

It may be possible that some of the unwillingness to engage with the electronic version of the instrument could relate to suspicion about the purpose to which the collated data may be applied at the school or system level. For example, one participant questioned if the results could obligate her to do extra work:

I think it depends what's going to happen [to the data] and what happens after that. Ok, this is where I got plotted. Does that mean I have to do extra work in that area? Is that how it's going to be used? As a little reminder ok, you're not doing that in the classroom, this is what you need to do to fix that.

The context

The context of the school culture seemed to have a considerable impact on the participants' willingness to use ICTs and on the level of professional conversation about learning, pedagogy and curriculum interpretation. With respect to various items on the instrument, participants from the secondary sector said things like "We don't have any pedagogy here"; "Numeracy skills are not applicable in my area (SOSE teacher)"; "The problem I have with it is ....". The volume of negative comments, the extent of agreement with the sentiment, and the general sense of disempowerment expressed by participants from the

secondary sector suggest that acceptance of the instrument in this sector could be problematic unless underlying factors causing teacher dissatisfaction with ICT use in secondary schools are addressed.

The context also impacted on the completion of the instrument in its electronic format. No participant from the secondary sector completed the instrument in this format while in the primary school, using the instrument in electronic format did not present a problem. Even in the P-12 school, the secondary teachers did not use the electronic format while the primary teachers did. These data are too limited to extrapolate to a wider context concerning the culture of working electronically in secondary schools compared with primary schools, but in this data set the difference is marked.

CONCLUSIONS

This analysis of the talk by teachers, when evaluating an instrument intended to measure ICT curriculum integration, has a number of ramifications for the particular instrument being evaluated, as well as for all instruments with the general intention of measuring ICT curriculum integration.

The participants' talk indicated that the instrument provided a valuable tool for defining ICT integration; for reflection on ICT integration practices in classrooms; for planning to enhance ICT integration practices in schools; and as a source of examples that provided valuable ideas for ICT integration. The talk also indicated that teachers needed to be provided with professional development to assist in understanding the value of the instrument for individual teachers, schools, districts and the system at large; that examples needed to be enhanced to include as wide a sample as possible to cater for all teaching contexts; that questions seeking demographic data needed clarification for secondary teachers and special education teachers so that they are directed to focus on a particular class, year level, subject or chronological age group; and that the scale (Never to Very Often) needed clarification.

With respect to the general idea of using a quantitative instrument to measure ICT integration there was very little concern, indicating that this form of methodology and the basic concept of accountability were, if not acceptable, then seen as inevitable to the participants. However, this level of acceptability may relate to the voluntary nature of the participation and might not be reflected in the wider teaching profession. It also should be noted that, even for these participants, there was already talk about how to make the result come out better, rather than how to improve practice, the desired outcome of the instrument. Further, the instrument should be seen as a snapshot in time and will need regular updating if it is to continue to measure anything meaningful with respect to ICT curriculum integration. Finally, while this paper has been concerned with evaluating a quantitative ICT curriculum integration instrument, it underscores the value of qualitative data to illuminate aspects of the quantitative methodology. Ideally, any measurement of ICT curriculum integration needs to include a range of methodologies.

Dr Glenice Watson is Head of the School of Curriculum, Teaching and Learning in the Faculty of Education at Griffith University. Dr Watson lectures and researches in the area of Information and Communication Technologies (ICTs) in school and tertiary environments. She has a particular interest in teacher ICT professional development that leads to multiliterate student outcomes.

Dr Romina Jamieson-Proctor is a Senior Lecturer in Mathematics and ICTS for Learning in the Faculty of Education, Griffith University. She has had first-hand involvement with the use of Information and Communication Technologies (ICTs) in classrooms since 1980, as a teacher and Principal with Education Queensland. She has had extensive involvement in teacher preparation and professional development to promote the integration of ICTs across the P-10 curriculum, working as a computer network coordinator in schools and currently as a Senior Lecturer in Mathematics and ICTs for Learning at Griffith University. Her research interests include the use of ICTs as cognitive tools and intellectual partners, ICT curriculum integration and transformation, the development of reliable measurement instruments, and the evaluation of educational programs and initiatives.

Dr Glenn Finger is Deputy Director of the Centre for Learning Research and Senior Lecturer in the School of Education and Professional Studies in the Faculty of Education at Griffith University, Gold Coast campus, Queensland, Australia. Dr Finger lectures and researches in the areas of Information and Communication Technologies (ICTs) and Technology Education. As Deputy Director of the Centre for Learning Research, Dr Finger has specific research interests in examining the question – what new kinds of learning are needed to prepare people for successful engagement with a changing world?

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