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A Typology for Identifying Teachers' Progress in ICT uptake

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Abstract: This paper describes the design of an instrument to help identify teachers' level of ICT uptake. The instrument takes the form of a typology matrix comprising four stages in ICT uptake across a continuum describing teachers' levels of dependence. Identification of teachers' positions in the typology matrix is determined by their affective, cognitive and demonstrated states of ICT application and use. The paper describes the process of determining the position of two elementary school teachers within the typology and discusses the reliability and validity of the instrument and the placement process.

Introduction

Schools and teachers are in midst of massive changes since the pressure to use information and communication technologies (ICT) began in the late 1980s. Addressing teachers' needs has become an important element for many school and educational systems around the Western world (Elmore, 1992). Unfortunately educational institutions under pressure to utilise ICT, have often found it easier to see the technology issues rather than the human ones (eg. Hodas, 1993; McClintock, 1988; Papert, 1998). The resulting outcomes have tended to be applications of ICT based on motives and directions that often fail to capitalise on the opportunities and affordances the new technologies can bring to teaching and learning.

The Need For a Scale of ICT Uptake

Much of the professional development for educators to aid in their ICT uptake has not had the expected effect, even though there have been many attempts at providing support for teachers during their ICT progression and many attempts at describing various ICT diffusion or uptake processes (Cheung, 1999; Christensen, 1997; Mahajan & Peterson, 1985; Marcinkiewicz, 1994; Russell, 1995; Sandholtz, Ringstaff, & Dwyer, 1992). Holloway (1996) suggests the processes may be too techno-centric and need to consider a more humanist perspective.

Writers concerned with change in education argue that most effective approaches to professional development consider both the whole system, and the people in it (eg. Fullan, 1999). Part of the challenge of orchestrating any significant and sustained change in educational systems is that these entities have significant natural inertia, and much of the change is illusory and confused with movement —the never-ending and sometimes chaotic movement that is characteristic of large organizations (Huberman, 1992). Teachers need to learn and adapt in such an environment. In fact Fullan (1999) argues "that learning occurs on the edge of chaos, where a delicate balance must be maintained between too much and too little structure" (p.ix). This makes the argument that improving the balance between individual teachers needs and their professional development is important, since the divergence of an individual's circumstances, pressures, resources and abilities could be vast.

One of the problems that often faces professional development for ICT uptake is that teachers come to the programs with vastly differing backgrounds and predispositions to learning. Their previous experiences and existing expertise plays a large part in influencing the form of professional development they need. Currently it is difficult to know how to differentiate among the teachers so that appropriate learning settings may be contrived (eg. Knowles, Holton, & Swanson, 1998). A number of researchers have discussed the training needs of teachers looking to use ICT as aids to their teaching and described strategies that can take teachers beyond their current zones of comfort (eg. Schrum, 1998). Within much of this discussion is an implicit understanding

of the need to be able to identify teachers' current development level with respect to ICT uptake along some typology. It was this need that provided impetus to the project described in this paper which sought to develop and validate such a typology.

The Research Setting and The Model

The principal aim of the research reported in this paper was to develop a framework by which teachers' pedagogies and capabilities with ICT could be mapped onto some multi-stepped scale as part of assessing their ICT uptake. The study was undertaken with interested teachers in two metropolitan elementary schools in Western Australia, over the second semester of their school year. This paper reports the four-stage typology of ICT uptake which was developed.

The typology was derived from a series of models of learning described by Brundage (1980) and Boud (1988) and with considerable input from studies of teachers and their teaching practices with ICT. In this sense it was grounded in the teachers' data as well as reliant on previous research. The model describes four stages: Dependence, Counter-Dependence, Independence and Interdependence (shown as Figure 1). These stages reflect typical phases through which all learners pass through as they achieve mastery on a new topic. ICT is simply another topic for learners to master, in this less techno-centric conception of ICT uptake as a learning issue.

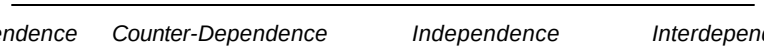

Figure 1: The four stages for learning new material (from Boud, 1988) and adapted to this model of ICT uptake

Within each stage of the model, the relevant literature provides descriptions that can help to identify how teachers feel and react. Through these descriptions it would seem possible to allocate any teacher to a location on the scale. To improve triangulation and to ensure consistency of reaction from teachers, descriptions for the typology were further developed to provide a more sensitive means to identify teachers' positions. Three domains were developed for each of the stages to enable different aspects of teachers' experiences and predispositions to inform their placement. These three domains are described as: feelings, understandings and behaviours. The domains were chosen to match the domains of human activity proposed by Bloom in the 1950s and still a useful distinction (Krathwohl, Anderson, & Bloom, 2001). The stages describe teachers' affective states, their cognitive states and the ways these are manifest in their actual teaching. If these stages were truly distinct and credible, then it was expected in developing the typology that teachers would be located at one stage, with their ratings for feelings, understandings and behaviours falling roughly into roughly the same stage.

Following this line of reasoning, the typology seemed to promise a means by which, in theory, ICT uptake could be measured by progress along the four stages and within the three domains simultaneously. The typology was presented as a 4x3 matrix (Figure 2) with cells defining the basic layout. It was named the ADL uptake model in an attempt to capture the role of Autonomy, Dependence and Learning in the ICT uptake process.

Stage / Domain	Dependence	Counter-Dependence	Independence	Interdependence
Feelings				
Understandings				
Behaviours				

Figure 2: Four stages of ICT uptake proposed as the ADL model

To enable the typology to be applied within general settings, distinct and unique descriptions for each of the cells were developed. These descriptions needed to provide ways to describe teachers across the 4 stages within the 3 domains. Fig. 3 demonstrates Descriptors taken from the *Understandings* row across the 4 stages.

Understandings	Survival issues with ICT dominate; Concerned more with own mastery and learning	Limited/local thinking about ICT; Teaching oriented	Directed, focussed ICT thinking; Teaching and learning oriented	ICT thinking, usage now second nature; Learning oriented, student focussed

Figure 3: Example of Descriptors for the four stage model, in this case over the domain 'Understandings'

Each cell of the 4x3 table was further elaborated with Pointers that are representative of that stage and domain. For example at *Dependence*, the teachers' *Understanding* might typically include some but probably not all of

these: W*ary of ICT's flexibility, instability; questions own role; cannot yet comprehend ways to use ICT broadly; believes ICT is an object to be examined, learned, taught about; seeks explicit even unequivocal standards, regards explicit step-by-step guidance as critical; prefers single solutions.*
These Descriptors and Pointers are not indicative of fixed immutable steps that every learner passes through but general and overall predictable patterns to their feelings, thoughts and behaviours, which are representative of each stage. Some will pass through them more quickly than others for example, but the distinctions are, in Brundage & MacKeracher's terms, "an aid to analysis and … not meant to reflect universal, absolute differences" (1980, p. 11)

Mapping the Data—Two Teachers' Records

To test the utility and efficacy of the typology, a number of elementary teachers were interviewed and observed whilst teaching as a means to discover their understandings, feeling and behaviours in relation to their use of ICT in the classroom. The teachers were then mapped into the various cells of the typology and their positions investigated.
Using the data obtained for each of the teachers in the study, the ADL matrix was completed and teachers' positions noted. It was a relatively simple process to fit the teachers into the four-stage ICT uptake scale and thus to give them some form of quantitative index that could be compared at a later date to ascertain if progress in terms of advancing their positions could be determined.
The findings indicated that credible roles like novice through to sustained ICT user were categories that could be identified for teachers fitted to this typology, although it was decided to avoid using role names as the interest was on classifying their current location or stage, and allowing them to move stages as they needed and as they progressed.
It was found that the quickest way to rate the teachers was to review their data record from interviews, notes etc and decide which cells represented them best. For validation purposes in the study, the teachers were mailed a copy of the completed table and each was asked to circle positions on the table which they felt were relevant and descriptive of themselves. Positions where the teachers marked multiple pointers provided sufficient evidence to suggest that they perceived themselves to be 'in' that cell. Remarkable commonality between the researchers' predicted and teachers' own ADL matrices was found.
Teachers' positions within the typology were indicated on summary charts in which the cells that represented their status were shaded grey. For example a novice might have a chart (called their *ADL location chart*) with all the left column shaded, and nothing else (see Fig. 4).

	Dependence	Counter-Dependence	Independence	Interdependence
Feelings				
U'standings				
Behaviours				

Figure 4: Sample ADL location chart of ICT uptake for a Novice ICT-using teacher

Using The Typology

The following sections describe several teachers who were investigated and whose ICT uptake was judged and located on the ICT uptake location chart.

Teacher A: Paula.
At the end of the research period Paula was very much in control of her learning environment. She had realised a few years earlier that she was becoming irrelevant, and decided that she wasn't prepared to continue unchanged in her teaching. When asked if the advent of the computer lab in her school had put extra pressure on her, she replied:

> PAULA:I can only speak for me but it should have put pressure on everybody. It did to an extent, but on myself…because of my age... I wanted to last the distance, and I saw a lot of people {here at school} that I didn't want to be like. I didn't want to have their attitude, and I knew that I haven't perfected the craft of teaching because it is always changing... according to the demands of society. A lot of them haven't noticed that! {Int1:line56}

This became the impetus for her to rethink her whole approach to teaching. She started telling her students that school was their job, not hers. She began to attend professional development courses that were going to help her change the way she thought and taught, and it had a kick-back effect on her usage of ICT:

*INT: So you agreed to a plan that put a block of computers into a lab first, and class machines later? And you thought that was a good idea, but then...?
PAULA: It still is, but it is frustrating having to wait. With the way I think, and maybe a few others think, as subjects become more integrated and we go that way, and we bring aboard thinking skills, allow the kids to learn how to think, to set their goals and so on. Whatever. It means that they have to work more independently, they need to be more self-motivated, and given the opportunity to set their own goals. This is as opposed to someone playing entertainer, and pulling surprises out of a hat for the students each day. As kids set their own goals they learn to start saying I want to search on the Internet for something, I want to scan this picture in for this project, takes some digital photos and so on. Now, over three years we have gone from *a* lesson in the computer lab -- and it was really my lesson I was the one on the learning journey -- and now it's them telling me what they are doing and planning. {Int1:line86}

By the time Paula assembled her ICT uptake location chart, she was not only making use of ICT as a learning tool in her class, but she was also encouraging her students to do the same. In fact some of her Year 4 students were the school experts on various pieces of ICT:

PAULA: In my class there was a handful who were experts at taking photos, printing and down-loading. Another little kid decided he was interested in scanning. Now I haven't got a clue how to do those... I know they're not hard... but why should I bother? So I handed over to them. It's more of, me standing back, getting time to understand and observe {while they do the work}. The kids know that I can't down-load pictures. It might take me just five minutes to learn, but it's not as important to me as it is to them. When I get my own digital camera then it will be. So the kids don't come along [to school] to watch me work, instead I stand back and watch them. They are more in control of what they do. {Int1:line 212}

Although she could be described as highly student-centric in her approach, she had become a competent user of ICT; and it was harder still to fault her use of it in her teaching. She was willing to share ideas with others, was a mentor to Nora, the adjacent Year 3 teacher, and they left the room divider open permanently, so that they could share students, ideas and support.. Her ICT planning and usage had become second nature to her, and she was focussed on her students' performance not her own. Her use of the Internet and e-mail as tools were indications that she had become not only Independent but also Interdependent in her ICT usage. Her ICT uptake location chart was very predictable (see Figure 5).

	Dependence	Counter-Dependence	Independence	Interdependence
Feelings				
U'standings				
Behaviours				

Figure 5: Final ICT uptake location chart for Paula

Very few of the teachers chose pointers in more than two columns, and very few did not choose all the cells in a column either. These facts provided support for the principle that there was some underlying pattern to the categorisations.
Nevertheless, this did not explain all the charts. Some teachers' charts did clearly cover two columns—perhaps Paula's chart, Figure 5, was an example of this—and it was felt that there could be an explanation for this. Teachers who straddled multiple categories along the scale, it was decided, might be in the process of transition between categories. Support for this notion was strengthened by the observation that teachers rarely straddled more than two stages when they completed their chart. In Paula's case she may be showing evidence that she was covering two categories, or stages, but the fact that she was performing at the upper of the two stages (in other words, she had circled sufficient pointers in her *Interdependence behaviours* cell, the one at the bottom right of her chart) was good reason to allow her this categorisation. David was a better example of someone in transition.

Teacher B: David
Although he was negative about ICT, David bought a computer during the research period and began to make use of it at home. His interest levels were higher than his performance levels, as he found them initially confusing and was unwilling to try any but the most mundane activities with his students. He believed that the school and the Department of Education (his employer) expected him to teach students about ICT, and that they had never provided enough support to help him even start the process. He admitted that his usage was unsystematic, and felt that he was exp ected to show high levels of skill with computers all the time:

DAVID: Oh, I'm quite sure that I'm required to have every kid completely computer literate, and doing very complex computer type things, I'm sure that's happening here. {Int1:line 46}

Not only does he have unrealistic expectations of his own use, he puts pressure on himself as well. When one parent offered to help on Fridays, he was pleased and pressured in equal measures:

DAVID: .... I had the head of the P & C in my classroom, an absolutely wonderful person called Jaccques, very very computer literate, and he's actually been in the classroom on Friday mornings, taking loads of kids doing word processing...
*INT: I saw your thanks to him in the newsletter.
DAVID: yes, but, I can see in his eyes, that he knows I don't know what the hell I'm doing. He's done extra things like buying a set of headphones, brought in a few CDs; and every Friday morning I wonder what the hell am I going to get Jacques to do on computers. So I feel pressurised there, I feel anxious and worried… (Int1:line70}

It is apparent that David feels that he must provide all the direction when it comes to computer use. It is a focus of his attention and not a tool or a conduit to a learning purpose. These are the characteristics of a Dependent person on the ICT uptake typology. At the same time he admits that computers definitely have a place in schools, and that he would like to improve. He doesn't know how he will become an adopter of computers in his class, but he has some ideas which seem to simultaneously guide and stress him:

*INT: So how will you become this person moving from considering to adopting?
DAVID: … I don't know. I don't have a clear idea in my head, or goal, of how the computer can be used in the classroom. To me it's always been a token gesture. Where you're rostering a child on a computer, and we were seen to be doing some something, but I can't see how it's integrated into the learning environment. I do actually like the idea very much of using it for remedial purposes, like teaching phonics, that sort of stuff. And I like the idea of using the Internet in the classroom…. ahhh, open-ended research type stuff; and I like the idea of being able to network with other teachers through the Internet. {inr1:line91}

David, with no clear idea of how computers can be used, and who regards their usage as part of a 'token gesture', is relatively low on the typology of ICT uptake.
In summary he perceives it as a novelty or even a threat, is defensive about his lack of progress and seems unlikely to make any progress without specific and localised support. His understanding is limited, but as well as views about ICT as a teaching tool, he also envisages some more flexible and open-ended uses of ICT which suggests that his thinking at least is a little more towards Counter-Dependence than either his Feelings or his Behaviours. Hence his chart has a peak as shown in Figure 6.

	Dependence	Counter-Dependence	Independence	Interdependence
Feelings				
U'standings				
Behaviours				

Figure 6: David's Initial ICT uptake location chart

Discussion

The placement of the teachers on the chart provided a number of interesting findings which merit some discussion. In the first instance, the typology was found to provide quite consistent descriptions for the participating teachers. The teachers' positions in the table tended to be within the discrete stages across the 3 domains being used. There was a high degree of consistency in this suggesting that the typology was able to reliably place teachers in a stable position.
Furthermore there was a high degree of consistency between the positions which the researchers placed the teachers and where they placed themselves. This consistency provided some sense of triangulation of the data and provided some assurance that the typology could accurately place teachers.
In a number of instances teachers were found to sit in one stage but to have some connection with a cell in an adjacent stage. These instances tended to suggest teachers whose position on the typology was not stable and was indicative of a teacher who was perhaps moving along the typology to an advanced level of ICT uptake. This finding was confirmed on several occasions when such teachers were found to have moved positions along the typology to stages indicative of greater levels of ICT use and uptake.

Summary

This paper has described the design of an instrument to help identify teachers' level of ICT uptake. It was less techno-centric than many previous versions, and was shown to have some utility. Two aspects of describing a teacher's location were evident. Some fitted easily to the three domains of a category suggesting that they were characterised by that stage and some stability; others tended to straddle two (but rarely more) stages, suggesting that they were in the process of change.

All the possibilities for placement on the scale were expected to describe people with very different needs about ICT and expectations about ICT training. In fact it was evident that these teachers with their diverse views and different ratings ion the ICT uptake typology, had quite different support needs and diverse professional development needs, even though they may have been in the same schools and similar circumstances.

It was supposed that teachers other than those in the two case schools would be undergoing similar stresses and also need a variety of support and professional development services. Thus the typology could be applied more widely. A useful next step could be the development of an instrument or questionnaire to investigate an alternative way to finetune the placement of people onto the grid, as the current one might provide too many cues to users who had seen it before.

The typology appears to provide a reliable and valid way to determine teachers' positions as users of ICT in their teaching and learning. Further study will be carried out to ensure the typology can be used effectively in mainstream settings. If and when this is possible, the typology would appear to provide considerable assistance as a means to helping to ensure that professional development programs can be targeted in meaningful ways to the recipients based on their needs and their current capabilities as users of ICT in their teaching.

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