Tell Me What You See: Pre-Service Teachers’ Recognition of Exemplary Digital Pedagogy

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Abstract

How do you identify "good" teaching practice in the complexity of a real classroom? How do you know that beginning teachers can recognise effective digital pedagogy when they see it? How can teacher educators see through their students’ eyes? The study in this paper has arisen from our interest in what pre-service teachers “see” when observing effective classroom practice and how this might reveal their own technological, pedagogical and content knowledge. We asked 104 pre-service teachers from Early Years, Primary and Secondary cohorts to watch and comment upon selected exemplary videos of teachers using ICT (information and communication technologies) in Science. The pre-service teachers recorded their observations using a simple PMI (plus, minus, interesting) matrix which were then coded using the SOLO Taxonomy to look for evidence of their familiarity with and judgements of digital pedagogies. From this, we determined that the majority of pre-service teachers we surveyed were using a descriptive rather than a reflective strategy, that is, not extending beyond what was demonstrated in the teaching exemplar or differentiating between action and purpose. We also determined that this method warrants wider trialling as a means of evaluating students’ understandings of the complexity of the digital classroom.

Introduction

Information and communication technology in education (ICTE) is of particular contemporary interest in teacher education as all Australian universities grapple with: (a) the progressive release of new learning area syllabuses coupled with the identification of ICT as a general capability in the Australian Curriculum; and (b) the launch of new National Professional Standards for Teachers (AITSL, 2011) which explicitly call for ICTE capability. There is also the unspoken need to prepare teachers at all levels of schooling for an unknown but distinctly digital future.

The research described in this paper was conducted in Semester 2, 2011 in parallel to the national Teaching Teachers to the Future Project [http://www.acde.edu.au/pages/page11.asp]. The study addressed a particular instance, that is, pre-service Science curriculum in the Faculty of Education at the Queensland University of Technology, Brisbane, Australia. Our research interest lay particularly in the capacity of pre-service teachers to identify effective digital pedagogy in Science and how, in turn, this might reveal their own technological, pedagogical and content knowledge (TPACK), a concept developed from Shulman’s situated theory of pedagogical content knowledge (Koehler & Mishra, 2008, 2009; Mishra & Koehler, 2006).

Contemporary research frequently draws from self-reporting surveys for example, individual understandings of TPACK (see Jamieson-Proctor, Finger, & Albion, 2010; Jordan, 2011). However, we lacked confidence in this method to show if graduate and beginning teachers could identify,
understand and hopefully adopt “good” practice. The approach we devised was in reaction to what we deemed, on the one hand, to be an over-reliance on self-reporting; and, on the other, the inherent problem in making explicit the intrinsically internalised technological, pedagogical and content knowledge held by our students.

Our approach began with an acceptance that professional competency of teachers is strongly connected to teachers’ capacity to understand and analyse classroom situations (Schrader & Hartz, cited in Zottmann, Goeze, Fischer & Schrader, 2010). From this, we opted to explore the potential of case-based learning (Fitzgerald et al., 2009; Merseth, 1996; Zottmann et al., 2010; Zottmann, Vogel, Goeze, Fischer, & Schrader, 2012). We were keen to appropriate the strengths of case-based learning into a research methodology, that is, the ability to:

- portray real-life pedagogical situations in a differentiated way;
- allow immersion in (and expression of) multiple perspectives; and,
- encourage the application of conceptual knowledge to case information to better understand the situation at hand a case.

We were also aware of and influenced by the ongoing work in simulated recall where practising teachers reflected on video recordings of their own classroom performance and, more recently, where recordings were analysed to guide the mentoring of pre-service teachers (see Reitano & Sim, 2010; Sim, 2006, 2011). In short, we were as interested in testing a new research design as we were in our students’ perceptions and understandings. This paper records our efforts in satisfying both interests.

**Background to the study**

The Ministerial Council for Education, Employment, Training and Youth Affairs (MCEETYA) premised its influential policy, Learning in an Online World, on the understanding that “21st century education integrates technologies, engaging students in ways not previously possible, creating new learning and teaching possibilities, enhancing achievement and extending interactions with local and global communities” (MCEETYA, 2006, p. 1). An attempt to enact this understanding was seen in the ambitious Digital Education Revolution launched by the Australian Government in 2008 (DEST, 2008) which promised – through the investment of AUD 1 billion over four years - to “turn every secondary school in the country into a ‘digital school’” (Browne, 2008, para. 2). More recently, DEEWR (the Department of Education, Employment and Workplace Relations) announced a $41.2 million investment in “new online materials for the first seven subject areas rolled out under the [national] curriculum, as well as cross-curriculum capabilities” (Garrett, 2011, para. 2). The intention in the latter initiative is to create a fully digital curriculum accessible online and linked to continuously expanded and updated materials as well as providing online professional development for teachers.

The critical understanding behind these initiatives and the goals of the study described in this paper is that there are significant differences between being an adept user of ICT and being a teacher who makes creative and effective use of the same technologies in teaching and learning. There are similarly differences in using ICT in peripheral ways in a classroom and the more integral purposes outlined in the Australian Curriculum where ICT is presented as one of the general capabilities to be embedded in all learning areas. This study focused on the Science Learning Area where students were expected to:

... ICT capability when they research science concepts and applications; investigate scientific phenomena, and communicate their scientific understandings. In particular, they employ their ICT capability to access information; collect, analyse and represent data; model and interpret concepts and relationships; and communicate science ideas, processes and information. (ACARA, n.d., para. 9)

ICT capability for teachers, or ICTE, is inherent in the requirement of the recently released National Professional Teacher Standards (AITSL, 2011) that “throughout their teaching practice, teachers ... [should be] able to use ... [ICT] to contextualise and expand their students’ ... learning” (p. 4).

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Several dimensions of the standards reinforce this definition. For example, Standard 2.6 demands, at Graduate level that teachers “implement teaching strategies for using ICT to expand curriculum learning opportunities for students,” while at the Proficient level, the standard calls for an “effective [use of] teaching strategies to integrate ICT into learning and teaching programs to make selected content relevant and meaningful.” It is self-evident that pre-service teachers need to have observed and have had experience of these strategies so that they may be confident in applying them in their own practice.

The challenge for teacher education is to help graduates achieve these goals. The rhetoric is easy: the reality is not. This study sought to move beyond what pre-service teachers may espouse in prepared essays or presentations or, as noted, reflect in self-reported measures. By asking them to “tell us what they saw” in a video ‘case’ rather than what they thought we might like to hear, we believe we have come closer to realistically gauging their technological, pedagogical and content knowledge in the teaching of Science.

Research Method

Marshall and Rossman (1999) suggested that the “initial curiosities [for qualitative research] ... come from real-world observations, emerging from the interplay of the researcher’s direct experience, tacit theories, political commitments, interests in practice, and growing scholarly interest” (p. 25). This study, while aligned to the Teaching Teachers for the Future project was predominantly (and methodologically) connected to the real world of teaching in the Faculty, particularly in the context of Science Curriculum and in the overarching goal of the University in preparing teachers for contemporary classrooms.

The research question asked if and to what extent our current pre-service teachers were able to recognise, that is, identify and evaluate ICT pedagogical practice in observed or proposed classrooms. We were keen for them, as the title of this paper reveals, to articulate their observations. To avoid simple self-reporting or purely descriptive observations, we asked for qualification into plus (indicating “good” practice), minus (indicating “ineffective” practice) and interesting (indicating something they thought worthy of note or had not expected to see). To code these responses so as to link them to the practical and theoretical experience of the pre-service teachers who were the participants in the study, we adopted and adapted the SOLO (Structure of Observed Learning Outcomes) Taxonomy (Biggs, 1999). We then followed this with a conversational analysis looking for particular keywords to convey a deeper understanding of observed pedagogy. Only findings from the SOLO coding are reported in this paper.

Research design

Participants

The participants for the study comprised of a volunteer group of pre-service teachers (early years, primary and secondary) within the Faculty of Education, QUT and representing six distinct groups (N=104). Table 1 summarises the characteristics of each group, namely, degree programs and sector specialisation. What the groups had in common was their enrolment in Science education studies during the period of the study and that all had received some specific presentations on ICT in Science relevant to their level of schooling specialisation. For purposes of this paper, the groups will be referred to as Groups A-F and where specific individuals are named they will be coded by Group name (a letter) followed by a randomly allocated identifying number, for example, A.15 or F.5.

Instruments

Three differing videos were used as the stimulus cases. They were downloaded from [the now defunct] Teacher TV and selected for their relationship to the targeted courses and for their portrayal of
exemplary practice in real classrooms. Each was well produced and professionally edited. In each, a teacher worked through particular Science-related tasks using ICT. Each was deemed to be sufficiently complex for a variety of responses but simple enough to quickly convey the intent of the lesson or learning experience being portrayed. In this, the videos met the requirements for ICT as a general capability in Science as outlined by ACARA (n.d) and for case-based learning (Fitzgerald et al., 2009; Merseith, 1996; Zottmann et al., 2010; Zottmann et al., 2012). The videos are here referred to as:

V1: *Nursery* (including a range of ICT activities for kindergarten children) shown to the Early Years groups (A and B);

V2: *Thermal Insulation* (including a systematic fair test experiment in a Year 4 class based on how a cup of tea may be kept warm) shown to the Primary Group and one Secondary Group (C, D and E) (See Figure 2); and,

V3: *Measuring with a light gate* (including an experiment in a Year 9 class concerned with measuring acceleration of a vehicle down a slope) shown to a Secondary Group (E).

Table 1

**Characteristics of participating groups (N=6)**

<table>
<thead>
<tr>
<th>Group Name</th>
<th>Degree</th>
<th>Specialisation</th>
<th>Stimulus video</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Bachelor of Education</td>
<td>Early Years</td>
<td>Nursery (V1)</td>
</tr>
<tr>
<td>B</td>
<td>Graduate Diploma of Education</td>
<td>Early Years</td>
<td>Nursery (V1)</td>
</tr>
<tr>
<td>C</td>
<td>Bachelor of Education</td>
<td>Primary</td>
<td>Thermal insulation (V2)</td>
</tr>
<tr>
<td>D</td>
<td>Graduate Diploma of Education</td>
<td>Primary</td>
<td>Thermal insulation (V2)</td>
</tr>
<tr>
<td>E</td>
<td>Bachelor of Education/ Diploma of Education</td>
<td>Secondary</td>
<td>Thermal insulation (V2) Measuring with a light gate (V3)</td>
</tr>
<tr>
<td>F</td>
<td>Bachelor of Education/Double degrees</td>
<td>Primary and Secondary</td>
<td>Thermal insulation (V2)</td>
</tr>
</tbody>
</table>

*Note to table*

1. Number of surveys voluntarily submitted.
2. Group E observed two videos.

**Data collection**

We began with a short presentation to each group (N=6) during a scheduled tutorial session. These presentations had common elements referring to the growing importance of ICT in contemporary Australian classrooms, namely, the Melbourne Declaration and the general capabilities of the Australian Curriculum. We introduced or revised the TPACK model and its underlying understandings. We then showed the students a video of exemplary practice as a case relevant to their specialisation (see Table 1) and asked them to record their observations in a simple PMI (plus, minus, interesting) matrix. Before collecting the survey forms, we initiated a discussion around the case and offered the opportunity to add to recorded observations. The pre-service teachers were then given the choice whether or not to submit
their matrix to us for inclusion in our research. Submitting the anonymous form was deemed as consent to take part in the research.

Data analysis

We coded participant observations ($N=354$) from our 104 participants using the SOLO Taxonomy (Biggs, 1999) as our framework for analysis. SOLO, Structure of Observed Learning Outcomes, provides a hierarchical taxonomy for mapping understanding through five levels: Pre-Structural, Uni-Structural, Multi-Structural, Relational and Extended Abstract. A particular strength of the SOLO taxonomy is its adaptability to differing contexts. In this study, our definitions of the levels were:

**Pre-Structural.** No understanding demonstrated. Demonstrated by: Noting of irrelevant or simplistic details of classroom organisation or listing of technologies used in the classroom.

**Uni-Structural.** Concrete, minimalistic understanding. Demonstrated by: Attention to one activity, action or interaction in isolation.

**Multi-Structural.** Identification of several components with little connection between them. Disorganised collection of ideas or concepts. Demonstrated by: Identification of multiple activities, actions or interactions but without explicit reference to their interdependence or connection to broader learning outcome(s).

**Relational.** Understanding of the orchestration between facts and theory, action and purpose. Can apply the concept to familiar problems or work situations. Demonstrated by: Explicit identification of multiple activities, actions or interactions. Awareness of their interdependence and connection to specific learning outcomes.

**Extended Abstract.** Conceptualisation and transfer beyond what has been dealt with in the actual teaching. Demonstrated by: Explicit identification of multiple activities, actions or interactions and an indication of their interdependence and connection to specific learning outcomes.

Findings

For the purposes of this paper, we will treat the participants as a single cohort irrespective of specialisation or progress (year of study). Our initial tally of accumulated responses ($N=354$) is presented in Table 2.

Table 2

| Coding of responses according to the SOLO Taxonomy (Biggs, 1999) |
|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                         | PLUS $\ (N=118)$             | MINUS $\ (N=118)$             | INTERESTING $\ (N=118)$            | TOTAL $\ (N=354)$            |
|                         | $n$ (%)                   | $n$ (%)                   | $n$ (%)                   | $n$ (%)                   |
| Pre-Structural          | 2 (1.69%)                 | 3 (2.54%)                 | 3 (2.54%)                 | 8 (2.26%)                 |
| Uni-Structural          | 5 (4.24%)                 | 36 (30.51%)               | 39 (33.05%)               | 80 (22.60%)               |
| Multi-Structural        | 62 (52.54%)               | 26 (22.03%)               | 33 (27.97%)               | 121 (34.18%)              |
| Relational              | 32 (27.12%)               | 19 (16.10%)               | 16 (13.56%)               | 67 (18.93%)               |
| Extended Abstract       | 12 (10.17%)               | 4 (3.39%)                 | 5 (4.24%)                 | 21 (5.93%)                |
| Blank/No response       | 5 (4.24%)                 | 30 (25.42%)               | 22 (18.64%)               | 57 (16.10%)               |
This data may be represented diagrammatically to show overall trends. Figure 1 clearly shows that the majority of accumulated responses were at the Multi-Structural level (n=121, 34.18%) with the least at the Pre-Structural level (n=8, 2.26%). It also shows a skewed but distinct ‘bell curve’ distribution with a fewer responses at the higher, that is the Extended Abstract level, than at the mid levels.

![Figure 1. Mapping of overall responses](image)

Biggs (1999) suggested that the SOLO levels of understanding fell within two distinct phases of learning: qualitative and quantitative. The qualitative (comprising of Extended Abstract and Relational levels) was marked by the integration of ideas into a structural pattern. The quantitative (comprising of the Pre-, Uni- and Multi-Structural levels) was typically marked by increased detail as respondents listed or described discrete facts or observations.

To discern the quantitative-qualitative distinction in this data set, it was first essential to remove the blank responses (n=57) leaving a total of 297 valid responses. From this subset, it was clear that the pre-service teachers in this study were predominantly at a quantitative level (n=209, 70.37%) with the majority – as with the overall trend (see Figure 1) - being at a multi-structural level in their responses (n=121, 57.89%). Eighty-eight (29.63%) were at a qualitative level with the majority of these being at the relational level (n=67, 76.14%).

The following tables (Tables 3 and 4) extend the quantitative-qualitative distinction by dividing responses into the Plus-Minus-Interesting categories and providing indicative examples of each drawn from observation of Video 2 which was concerned with testing differing thermal insulation on the pretext of keeping the teacher’s cup of tea warm (See Figure 2).
Figure 2. Scenes from the video (V2)

The intention of Tables 3 and 4 is to highlight the substantive difference between the quantitative and qualitative levels. The indicative statements provided are attributed to individuals as previously described and a code to the video referred to is also included (see Table 1 for details).

Table 3
Qualitative responses according to the SOLO Taxonomy (Biggs, 1999)

<table>
<thead>
<tr>
<th>SOLO Level</th>
<th>Observation</th>
<th>Indicative statement(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Structural</td>
<td>Plus</td>
<td>• n/a</td>
</tr>
<tr>
<td></td>
<td>Minus</td>
<td>• Only one group can work on laptop (D.1)</td>
</tr>
<tr>
<td></td>
<td>Interesting</td>
<td>• Use hot tea (D.1)</td>
</tr>
<tr>
<td>Uni-Structural</td>
<td>Plus</td>
<td>• Interactive, students enjoying it, teaches students how to use technology, made it very practical – actual task to help the teacher (F.1)</td>
</tr>
<tr>
<td></td>
<td>Minus</td>
<td>• Costly technology; dangerous use of hot liquid; expensive technology to be used by young children; use of liquids with electronic equipment (E.8)</td>
</tr>
<tr>
<td></td>
<td>Interesting</td>
<td>• How one mode of technology can be spread across the entire class. (D.2)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• Amount of technology available in the classroom; how basic the topic was (C.4)</td>
</tr>
</tbody>
</table>
Multi-Structural  
**Plus**  
- Everyone was engaged; the use of technical language almost indicated the class were quite well advanced; integration of maths; so many different types of ICT used; great that ALL of these are accessible. (C.9)

**Minus**  
- So much planning; kids who don’t have the laptop may feel left out. (C.5)  
- Lots of different technology, very expensive; different students allowed to use technology. (F.1)

**Interesting**  
- Relevant real world; ‘fish and chips’ thought at end; hot water in classroom; amount of technology in classroom; group work is well established. (C.8)

The focus at the ‘quantitative’ end of the SOLO Taxonomy was frequently on logistical matters, for example the cost of the equipment, class organisation and teacher planning. Increasing empathy with students was shown at the Multi-Structural level and interest in engaging and preparing students to participate. It should be noted that the majority of those in this study were at the Multi-Structural level.

**Table 4**  
Qualitative responses according to the SOLO Taxonomy (Biggs, 1999)

<table>
<thead>
<tr>
<th>SOLO Level</th>
<th>Observation</th>
<th>Indicative statement(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Relational</strong></td>
<td><strong>Plus</strong></td>
<td>• To show comparisons between students' predictions - as a display, good use for class co-construction, accuracy of (D.4)</td>
</tr>
<tr>
<td></td>
<td><strong>Minus</strong></td>
<td>• Not cater for ESL/NESB; unpack terminology (may have been done in prior lessons); teacher direction may inhibit self-directed learning. (C.12)</td>
</tr>
<tr>
<td></td>
<td><strong>Interesting</strong></td>
<td>• The language the kids use is very impressive; effective use of the whiteboard; integration of Maths into Science. (C.6)</td>
</tr>
<tr>
<td><strong>Extended</strong></td>
<td><strong>Plus</strong></td>
<td>• Good context; open questioning and open enquiry; great development of question to test; designing fair test themselves; the students are really engaged; made predictions. (E.4)</td>
</tr>
<tr>
<td><strong>Abstract</strong></td>
<td><strong>Minus</strong></td>
<td>• Not all classes have whiteboards and cameras; data logger does the graphing for them and they may not understand as well. (D.16)</td>
</tr>
<tr>
<td></td>
<td><strong>Interesting</strong></td>
<td>• Still using usual teaching strategies but using ICT to facilitate them; students learning to use new/different technology; basic student understanding of variables; teacher didn’t know the outcome before the lesson. (F.3)</td>
</tr>
</tbody>
</table>

The indicative statements from the qualitative levels of the SOLO Taxonomy (Table 4) show a substantively different set of observations. It is of particular interest in the Extended Abstract statements, that the technology is almost transparent as the pre-service teachers start to look more closely at the pedagogy and interactions in the classroom, for example, references to questioning, student language, and understanding of content and processes.

As noted, invalid responses ($n=57, 16.10\%$) were left blank and it cannot be known the reason for this omission. Only four participants (3.39\%) left all three categories blank but curiously opted to submit their response form. Interestingly, overall, there were markedly fewer invalid responses in the Plus category ($n=5, 4.24\%$) than in either the Minus ($n=30, 25.42\%$) or Interesting ($n=22, 18.64\%$) categories. It might be conjectured that it is simpler to identify a positive characteristic than
something that is negative, unusual, counter-intuitive or perplexing. It might further be said that heightened experience or empathy is needed to note what is missing or to take in the full complexity of what is happening in a busy classroom.

When scanning the data, we noticed that it was rare to see the one SOLO level across the three categories (plus, minus, interesting). Only 11 (9.32%) of all respondents were consistent across the levels. Of these, there were no instances of consistency at the Extended Abstract or Pre-Structural levels. Two (1.69%) were consistently at the Uni-Structural level, six (5.08%) were at the Multi-Structural level while three (2.54%) were at the Relational level. This is telling in that it indicates a naivety in the participants’ capacity to identify and evaluate teaching practice. Similarly, no group – irrespective of course or prior knowledge – showed consistent trends.

Discussion and conclusion

The study described in this paper was small-scale but has given us considerable confidence in the re-use of its method. Of particular interest was the richness of the data collected, that is, the wide variance in responses and the rarity of individuals at the same ‘level’ across the Plus, Minus and Interesting categories. We were also interested to note the relative difficulty in identifying the ‘minus’ and ‘interesting’ aspects of classroom practice and intend to use these findings to inform targeted learning experiences and discussion with our students.

The findings have shown that the participating pre-service teachers were typically at a Multi-Structural level, that is, they used a descriptive rather than a reflective strategy rarely extending beyond what was demonstrated in the teaching exemplar. They did not appear to be confident in differentiating between action and purpose and they did not make specific reference to the Science content/context being shown. While not unexpected given their limited experience of the pre-service teachers who took part in the study, the findings provide a clear indication that more targeted instruction and extended use of video cases is needed in our Science curriculum units.

References


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