ICT Competencies for School Students

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Abstract: This paper discusses results from a small-scale research study, together with some recently published research into student perceptions of ICT for learning in schools, to consider relevant skills that do not appear to currently being taught. The paper concludes by raising three issues relating to learning with and through ICT that need to be addressed in school curricula and classroom teaching.

Keywords: Learning with ICT, student perceptions, student experience

1   Introduction

> In my vision, *the child programs the computer* and, in doing so, both acquires a sense of mastery over a piece of the most modern and powerful technology and establishes an intimate contact with some of the deepest ideas from science, from mathematics, and from the art of intellectual model building. (Seymour Papert, 1980, p. 5)

When this author began introducing secondary school students to computer technology through using a computer program to perform calculations, the students quickly learned the consequences of illegible or unclear handwriting, and illogical or incomplete planning. The year was 1968 and the Year 10 mathematics students were being introduced to the FORTRAN programming language. Students did not see or physically interact with the computer as it was located at a nearby tertiary institution. Instead they wrote instructions on a coding sheet that the teacher delivered to data entry staff at the tertiary institution who converted the written lines of FORTRAN into code that could be processed by the computer. The data entry staff were not programmers, but instead were trained to use a keyboard to accurately copy the handwritten symbols, words, lines and spaces from a coding sheet and enter them into a machine that that turned each line of a coding sheet into a punched card, with a printed copy of

the entered instructions at the top of the card. These cards, together with appropriate first and final cards, were placed in line to be processed by the computer. Several days later the teacher would collect small bundles that consisted of cards wrapped in a printout for each individual student program.

For the first two or three coding sheets that each student created the teacher painstakingly proof-read and suggested corrections before submitting them to the data entry staff. One mathematics period each week was set aside for programming, and this always began with print-outs and punched cards being returned to the students. During the initial lessons the problems to be coded into the programming language were developed on the blackboard through class discussion and then copied onto the coding sheets. This approach resulted in most students successfully completing the set task. However as soon as students were asked to work individually to solve a problem by converting it into FORTRAN code and running it on the computer the number of errors increased exponentially. When students received a print-out indicating that the computer could not process a line of code, they were taught to identify the type of error – initially categorising errors as either theirs or data entry.

While it is not the intention in this paper to concentrate on the historical aspects related in the previous paragraphs, some of these aspects, together with the quotation from Seymour Papert, will be used to illustrate and suggest some key competencies and skills that students and many teachers do not appear to associate with educational use of ICT in 2014.

Many researchers have investigated the use, lack of use, and misuse of a variety of ICT in school classrooms. A large proportion of these studies have considered class-room use of ICT from the perspective of teachers, but fewer have considered educational use of ICT from the perspective of students. This paper reports on a small-scale study conducted towards the end of 2011 in a single school, and considers the actions and attitudes of approximately one hundred and seventy students in grade 4 or 6 at an Australian urban primary school.

2 The Study

In mid 2011 all the grade 4 and grade 6 students at a state government funded primary school in Melbourne, Australia, participated in a study that was intended to focus on a comparison of results from two mathematics tests – one presented and completed on paper and the other presented and completed online. The results and comparisons have been reported previously (author) and will not be detailed here. Over a period of two weeks following the completion of

both tests, students in each of the seven classes involved were interviewed. The interviews were conducted in a classroom by a researcher and with the class teacher present. Students were asked to think about the two mathematics tests and express their opinions and feelings about them individually and collectively. The interview sessions were video recorded.

While the school followed the curriculum set by the state education authority, teachers were given no explicit instructions about what or how to use ICT for teaching and learning. While the curriculum used in 2011 has been replaced, the approach to ICT in the new version is the same. The following quotation from the online introduction to ICT shows the general approach.

> ICT, an interdisciplinary domain, focuses on providing students with the tools to transform their learning and to enrich their learning environment … Learning in this domain enables students to focus on the task to be accomplished rather than on the technology they are using to do the work. (AusVELS, 2013)

This curriculum has three subdivisions: ICT for visualising thinking; ICT for creating; and ICT for communicating. The extended descriptions for each subdivision use generic terms such as 'graphic organisers' and 'ICT tools' and provide teachers with no substantial assistance or direction. If every classroom teacher was adequately trained and practiced in using ICT with students, such a lack of curriculum detail might not be critical. However the Journal of Australian Educational Computing (2012, 27(2)) published a special issue devoted to a major Australia wide research project into pre-service teachers and ICT. This showed that across Australia there are concerns about the deficiency in many ICT key competencies demonstrated by teachers and those preparing to become teachers.

Data being reported came from a research project in which primary school students in grade 4 and grade 6 were interviewed in groups about two mathematics tests that had recently completed, one paper-based and the other online. Four of the 7 classes sat for the paper-based tests simultaneously, working in their usual classrooms. However the online tests were completed one class at a time in a computer room because the school did not have a sufficient number of computers to allow simultaneous testing. On the day that 4 classes attempted the paper-based test, the other 3 classes did the online test. A fortnight later the roles were reversed and each student attempted the alternative version of the test.

Whenever testing was underway a researcher moved between the rooms to observe and to respond to any questions that arose. Both the paper-based and online tests were supposed to be treated as parts of the formal assessment process by students and staff. However video recordings made while students sat the online test clearly indicate a difference in attitude among both students and teachers between the two types of test. While a full comparison of the results of the two tests is not relevant to this paper, the time taken by students to complete them is.

Table 1: Times for tests

Test	Allocated time	Average time spent on task
On paper	45 minutes	45 minutes
Online	45 minutes	14 minutes

One of the major reasons for not attempting to analyse and compare results between the two tests is provided in the following paragraph. Grades 4 and 6 were chosen for this study because they had completed the Australian national testing (NAPLAN) in the previous year, and it was hoped to compare the mathematics scores from this testing with results from this research. For most students there was a strong correlation between their NAPLAN mathematics score and the paper-based test score. However the online test results were significantly lower than the other test scores.

When researchers analysed the video recordings of students taking the online test it was noted that students spent much less time completing the test, and did not appear to go back and check answers before logging off. Almost all students took the full 45 minutes allocated for the paper-based test, but the same students averaged only 14 minutes for the online version. One complicating factor is this comparison of the time spent on task is the fact that there are fewer items in the online version, but not enough to account for such a dramatic time difference. The producer of both tests, the Australian Council for Educational Research, set the allocated time and stated that the tests were equivalent in that they assessed the same mathematical concepts at the same levels.

Following analysis of the video recorded class discussions and some focus group interviews with teachers and one researcher, it appears that both students and teachers had very different attitudes to the two types of test. Many of the students, together with several teachers, commented that they saw the online test as of having less importance and value than the paper-based test. Some

students indicated that they considered the online test as a type of computer game, and so they went through it as quickly as possible and did not bother to go back and check because that isn't done in games.

3   Discussion

This section commences with some brief thoughts about equitable access to the internet through various types of digital technology. It then relates findings from several research surveys to some aspects of the current Australian ICT curriculum, before considering issues that arose from the research study.

We are aware that access to digital information and technologies has become ubiquitous for many people because they have access anywhere and anytime. Mobile devices have altered the means and difficulties accessing the internet both in and out of school. This change in access raises different types of issues relating to equity of internet access for all students. One issue that will not be discussed relates to differences between the number and types of technologies students have available to be part of their learning. In the school which participants in the study reported here attended, almost all the students reported having access to digital technology at home. However some had to share a computer and internet connection with older siblings who had preference. Others had their own computer, but without internet access. What were of more interest for this paper were the attitudes, beliefs, and abilities of the students to differentiate between personal use of social media and educational uses of digital technology, including the internet.

A UK study of years 8 and 10 students (Becta, 2008) looked at internet use in the home and in the classroom. Among other things the authors reported that the majority of students used the internet to read, play games, and communicate within a personal social network, and that "relatively few learners are engaging in more sophisticated Web 2.0 activities such as producing and publishing their own content for wider consumption" (Becta, 2008, p. 4). It was also reported that it was possible that the participants did not have the necessary technical experience to create and publish online, and that they were not aware of possible creative uses of the digital tools they were using. It was also suggested "that experience with user-friendly social networking technologies may encourage them to see Web 2.0 applications as services that they consume, rather than as tools that they can use to advance their own aims" (Becta, 2008, p. 4).

In the US, the Speak Up research project, one part of Project Tomorrow, has been surveying teachers and students about education and digital technolo-

gy for more than a decade. In *From Chalkboards to Tablets*, their report based on data collected in 2012, notes that all forms of social media appear to be used away from the classroom. As has occurred in earlier surveys, this report notes that students comment on, and are dissatisfied with, the manner in which technology is used in classrooms. Specifically, it is claimed that 'dissatisfaction with using technology at their school is not about the quantity or quality of the equipment or resources; it is about the unsophisticated use of those tools by their teachers, which they believe is holding back their learning' (Project Tomorrow, 2013, p. 7). The report notes that this is very different to what was found in the early surveys. In the concluding section it is noted that

> *"Today, while access is still not universal for all students, for the majority of the students across all grades, their attention is on how to use a wide range of digital tools and resources to enable a highly personalized learning experience. This self-initiated evolution from access to personalization provides an interesting model for thinking about the adoption and adaption of emerging technologies within our schools." (Project Tomorrow, 2013, p. 24)*

That this is not only occurring among students in US schools is indicated by a much smaller Australian study reviewed by DERN (Digital Education Research Network). Among other things, the student participants aged 12–18 were asked about their attitudes to ICT learning. As with the Project Tomorrow report, the students perceived teachers to lack competence in using ICT for learning. Interestingly there appear to be differences based on age about teachers using more ICT in the classroom. Among younger students up to 88 % wanted more use of technology by teachers, while only 42 % of the 16–18 year old students wanted this.

Curriculum documents such as AusVELS ICT are vague in terms of curriculum content at grade levels for a variety of reasons. One reason that applies in Australia is that schools are free to choose the type and brand technology they purchase, and the resultant variety of hardware and software make it extremely difficult for education systems and authorities to specify classroom activities for teaching learning with ICT. One consequence of this lack of curriculum specificity is that a range of key competencies that are considered critical in other developed countries, by both education authorities and industry, are not included in the Australian curriculum.

One example of industry concern is the DERN (2013) research review mentioned previously, which was commissioned not only to investigate stu-

dent perceptions of ICT in schools, but also their perceptions of ICT as a career path. In spite of almost every participant using social media for personal communications, and the general level of perceived personal competence with using ICT at school, only 31 % had considered ICT as a career and only 38 % of the 18 year olds thought studying IT would be interesting. It would appear that students sharply differentiate between out of school personal use of digital technology and educational applications of the same digital technology.

4   Conclusion

The purpose of this paper has been to argue that research appears to indicate that we are moving away from Papert's belief at the beginning of the paper. It is likely that for student users to control the technology for learning they require both instruction and practice. This implies a level of ICT knowledge and skills that many current teachers, and those preparing to become classroom teachers, do not possess. The small research project reported here, combined with the research reports discussed, give rise to several issues the teaching and learning of ICT in schools.

Over the past few years schools across the developed world have introduced tablets and iPads into the classroom. The author's experience with these devices is restricted to their application in primary schools with children aged 5 to 11 years. While a general observation has to be that students appear to enjoy using tablets, closer inspection suggests that often what students are doing on these devices is mindless, repetitive, and difficult to connect to stated curriculum learning goals, other than that technology is being used.

For both school-provided and BYOD (bring your own device) technology the programs (apps) that are used are determined by the school or education system. For many students this means that what they use and do on devices at home does not correspond with what they use and do in their classes. This is first and most important issue arising from this discussion: students lack meaningful experiences in using ICT for learning.

Records show that over time the number of students in a class has varied greatly. Aristotle appears to have interacted with one student at a time, something that still occasionally occurs in special circumstances. Teachers are trained to work with groups of students – a whole class or sub-group of a class. The smaller these groups become, especially when each group or individual is doing something different, the less capable and confident teachers become. For example, from the perspective of a teacher there are enormous differences between pairs of students in a laboratory conducting the same science experiment,

and students working at a computer in pairs or on their own while they solve a problem or create an artefact of their own choosing. This is a second issue: the majority of classroom teaching occurs in classes or groups, but when a student is expected to learn using ICT it often needs to be an individual activity. It appears that currently neither students nor teachers are successfully managing this transformation between modes of learning.

A third issue is one that is beyond the control of both students and teachers. The digital technology available for learning, both hardware and software, changes constantly. Students and teachers begin using a particular piece of ICT and almost inevitably it changes – either through the release of an updated version or through a new product that is different even though it might offer the same options. It can be disconcerting to be learning theorems of Euclidean geometry that have been known for thousands of years, or to be studying a play by Shakespeare that is centuries old, through making use of digital technology that is constantly changing.

In summary, it has been argued that in schools there are key competencies of ICT that have been, and are still being, lost because of the lack of specificity in all curriculum areas that invoke teaching and learning with and through ICT.

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Biography

Anthony Jones is Senior Fellow of the Graduate School of Education at the University of Melbourne and Deputy Director of the International Centre for Classroom Research. He has taught in primary and secondary schools, and has been involved in initial teacher education and teacher development for more than three decades. After commencing computer use with a Year 10 Mathematics class in 1968, he has continued exploring learning and teaching with and about ICT.

Prior to becoming a teacher educator he taught in primary and secondary schools. Since the late 1960s he has focussed on both teaching and learning with and through ICT, with a particular interest in mathematics.