Engaging design & technology trainee teachers with the nature of technology – a case study

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Abstract

The paper describes a small case study in which pre-service design & technology teachers on a one year post graduate teacher training course in London, England were introduced to the idea of teaching pupils in schools about the nature of technology and the relationship between technology and society by means of a one day workshop. Observation of the workshop and the learning outcomes indicated that the trainee teachers were engaged and showed willingness to carry outn such teaching as part of a school design & technology curriculum. The discussion considers the trainees' responses, the significance of such activity in initial teacher education in the light of current revisions to the National Curriculum in England and how such considerations of the nature of technology in initial teacher education might be developed through collaboration amongst those interested.

Introduction

In 1999 the PATT proceedings carried a paper that used two small case studies describing the use of a framework for conceptualizing teacher professional knowledge (Banks & Barlex 1999). The authors argued from the case study data that the approach had considerable potential for enabling those about to enter the teaching profession to reflect on their professional knowledge. Others in the teacher education community then engaged with the conceptual framework and carried out similar case studies leading to a collaborative publication involving case studies from England, Finland and New Zealand (Banks et al 2004). This work became known as the DEPTH (Developing Professional Thinking for Technology Teachers) project. Four years later the International Journal of Technology and Design Education devoted an entire issue to studies involving the DEPTH project in five different countries (Banks 2008). This illustrates the potential for small case studies to provide a starting point for significant developments. The case study presented here builds on the previous work by the author (Barlex 2011) in which he explored teaching young people about the nature of technology. In considering ways forward the paper suggested that it would a useful exercise to discuss the nature of technology with those about to enter the profession so that they can develop their own understanding and consider ways in which pupils can be engaged in this. It is

hoped that this case study will provide a stimulus for others in initial teacher education interested in the area to undertake similar work in a collaborative vein in much the same way as happened in response to the initial DEPTH case studies.

The case study describes a one-day workshop session for 18 post graduate trainee design & technology teachers in the first term of their one year course at a university in the south west London. It will be presented in three main parts.

Part 1 will describe the introduction to the workshop and the tasks set to the trainees.

Part 2 will describe the trainees' responses to the tasks and their views on teaching about the nature of technology in secondary school

Part 3 will discuss the following:

The trainees' choice of technologies to explore

The need for trainee design & technology teachers in England to engage with the nature of technology

The possibility of developing an approach to engaging those about to become technology teachers with the nature of technology that can be used by educational researchers in different countries

Finally there is a short conclusion

The introduction to the workshop

At the beginning of the workshop the trainees were introduced to a rationale for including the nature of technology into the school design & technology curriculum. This rational was based on an analogy with recent developments in the school science curriculum in which pupils are taught about the nature of science sometimes referred to as 'how science works' (Millar, R. and Osborne, J. 1998 and Nuffield Foundation 2011). The trainees were then introduced to some of the ideas of the following writers concerning the nature of technology and its impacts on society.

Brian Arthur – viewing technology as the exploitation of scientific phenomena

Kevin Kelly – considering technology to be autonomous with pre-ordained development, influenced by its own history and mediated to some extent by society's collective free will

David Nye – rejecting technological determinism but supporting technological momentum

Brian Christian – asking what does it mean to be human in the light of developing artificial intelligence

Susan Greenfield – giving a a dystopian view in which virtual lives become more significant than real lives, there is access to unlimited information and stimulation, a breakdown of traditional family structure, and complete separation of sex from reproduction

Keri Facer – acknowledging some of Greenfield's fears but arguing that these can be countered if schools act as places where communities conceive and build their own future

The trainees were then introduced to two different classroom activities that could be used to engage pupils with the nature of technology, how it works and possible impacts. The first is derived from the Young Foresight project and requires pupils to consider a technological product from four perspectives: the technology itself, how it works; the society in which the product might be used and the extent to which it is acceptable, the people who might use the product and the extent to which the product meets needs or wants; and the market through which the product is made available (Barlex 2003). The second is a winners and losers identification tool developed by the Nuffield Design & Technology project which enables pupils to identify who might be directly and indirectly affected by a technological product and classify these as either winners (the technology is to their advantage) or losers (the technology is to their disadvantage) (Nuffield Design & Technology 2000).

To prefigure the task in which the trainees would be asked to consider a technology of their choice they were presented with four possible strategies for choosing:

- Take a 'use of technology' e.g. enable mobility, provide shelter, ensure safety and identify technologies used for this purpose
- Take a problem caused by technology e.g. climate change, resource depletion, information availability and reliability and identify technologies for possible solutions
- Consider new and emerging technologies and identify combinations that provoke interest e.g. a combination of nanotechnology and robots
- Choose an everyday activity e.g. making a cup of tea, and identify all the technologies and interconnections that enable the activity to be carried out.

The trainees were then presented with a set of 'crunch' questions to underpin their thinking throughout the rest of the workshop

- Is technology autonomous and beyond our control or is technology under human control?
- Does technology control us or do we control technology?
- Is technology value neutral or does it have implicit values?
- Does the availability of technology change human behaviour?
- Who decides which technologies are developed?
- Who decides which technologies are adopted?

They were then asked to work in groups to tackle the following tasks

- Identify a technology (ies) that you think young people might find intriguing and/or need to understand
- Explain how it works and what it is used for
- If appropriate indicate something of its history
- Use the classroom activities to critique the technology (ies)
- Develop a presentation (no more than 5 minutes in length) that presents your findings and considers the costs and benefits to society of using the technology (ies)

To give some indication of the standard of presentation expected the trainees were shown the TED talk by Sunni Brown about doodling (Brown, S. 2011). Sunni Brown is an expert in the use of visual thinking to support organizational and group success (Brown, Gray & Macanufo 2010).

Trainees' presentations and views on teaching

The Trainees divided themselves into five groups. The first group considered the place of avatars in virtual lives. The presentation began by indicating the extent to which most people's lives already involve a substantial amount of digital information stored in a variety of databases and that for an increasing number this information is deliberately made available to be seen by 'invited' others. The presentation noted that a smaller but significant amount of people are involved in taking part in additional lives by means of avatars operating in virtual worlds – through on line gaming and so called second life They then posed the question that if a person had an avatar how might it be used to help them in their 'real' as opposed to a virtual world – in the workplace, in education, in parenting? They then considered the consequences of competition between the physical and virtual worlds; something described by Susan Greenfield. They used the Young Foresight device to consider the pros and cons of such a situation. They noted that whilst it might enable the breakdown of stereotypes and support equal opportunities the virtual identity might become so strong that people preferred to live the virtual life and neglected their physical life. This they argued could lead to a decline in physical activity and poor health and the breakdown of social endeavours and communities.

The second group considered Nintendo games and asked the question 'Does the Nintendo 3DS offer a positive contribution to the advancement of technological and human evolution?' The presentation began with a time line of the development of Nintendo games starting at 1989 with the first gameboy and finishing with Nintendo3DS. They used the Young Foresight device to identify important aspects of the Nintendo 3DS as follows:

Technology - hand held interactive gaming device with 3D capability and augmented reality
People - any gender, ethnicity, culture and age
Society - start of gaming revolution, change in communication, interaction and play
Market - equal market share across North America , Japan and rest of world

They used the winners and losers tool and indicated that there appeared to be many more winner groups than loser groups but a significant loser group was the family.

The third group considered food manufacture using Pringles as a main example. The presentation gave information about the rationale for producing Pringles – stackable, fresh, crisp, unbroken from the tubular container and linked the developers, Proctor and Gamble, to McDonalds which processes un-served French fries so that the resulting material can be used as Pringles feedstock. In using the Young Foresight device to comment on Pringles they noted the effectiveness of the manufacturing process (showing a YouTube video); the appeal of the product to a wide range of consumers; the marketing via a 'once you pop you can't stop' slogan and the acceptance by society of the product – wide availability in supermarkets. In their winners and losers analysis they noted the consequences of automated manufacture, the destination of the packaging in landfill and the problems caused by overindulgence of such highly processes foods. To some extent these features would have been better included in the Young Foresight analysis, as they don't explicitly identify particular winners and losers.

The fourth group considered MP3 players and 'portable' music. The presentation gave a history of music playing devices - wax cylinder, shellac discs, vinyl discs, walkman cassettes, personal CD players, MP3 players including ipods and iphones. They noted that the latest developments had resulted from a convergence of the following technological improvements: better, smaller batteries; increased memory capacity and data compression. They saw the MP3 player as a great leap forward for portable music – small, light, easy to carry, can be used anywhere, instant access and highly reliable, with social benefits – cheaper access to music, democratization of music and reduced environmental impact through digital manufacture and distribution. They saw the winners as the consumer, the distributor, independent labels and the environment. They identified the drawbacks as isolation from surroundings and people, ear damage, piracy, short life span, data loss, poor quality control and the impossibility of personal repair. They saw losers as the consumer (health risk and poor quality sound), the distributor (piracy and loss of control) and large labels (piracy again). They speculated about the future of portable music noting that MP3 players will cease to exist as storage devices as entire libraries will be accessible wirelessly from the cloud. This they saw as a disruptive technology leading musicians being able to operate in niche markets yet still reach a wide audiences on line. They wondered whether this increased availability of on line music with its inherent limitations might give rise to resurgence in live music.

The fifth group considered the use of zebra fish biology to cure heart disease. They started with the recent campaign concerning research into the zebra fish which can repair damaged heart tissue. Their winners and losers analysis of research that leads to medical treatments for heart disease noted the development of commercial brands to deal with anti-ageing and raised some of the social and economic problems associated with a society in which there is a larger proportion of older people. They noted that the research involving zebra fish was more humane than other possible approaches. Investigation on embryos could be carried out on eggs outside the female zebra fish unlike investigations on mouse embryos which develop inside the female and have to be removed from the female mouse resulting in the death of the female mouse. Finally they asked

where cell regeneration technology would be applied identifying the following possibilities: cloning, growing organs for transplants, anti ageing products and cosmetic surgery.

Feedback from the trainees on the extent to which they would wish to teach pupils in secondary school about the nature of technology was positive in all cases. They had mixed views on exactly when such teaching should take place. Some advocated starting in primary schools with pupils aged 10 years, others thought it should be part of the curriculum for pupils aged 11 – 14 years whilst others though it best to delay such work until pupils were at least 14 years old.

Discussion

The trainees were asked to identify a technology that they thought young people might find intriguing and/or need to understand. The technologies they chose would in all cases meet these criteria. They were provided with four different approaches to choosing their examples. Only one group appeared to make use of any of these strategies. The group considering MP3 players considered developments in the new and emerging technologies of battery design, increasing memory capacity and data compression. It is perhaps not surprising that a member of this group was a trainee with a degree in electronic engineering The group which considered the use of zebra fish biology to cure heart disease chose this topic as a member of the group had a relative who had recently survived a heart attack and had become involved in supporting a charity that raised funds for research into ways to combat heart disease. The group that considered food manufacture had two members whose specialist area was food technology. Some of the group which chose Nintendo games were mature students whose own children played these games. The group who chose avatars and their place in virtual lives were the only group to explicitly relate their chosen technology to the ideas of writers presented in the introduction. The reasons for choosing a particular technology vary from group to groups but personal experience and area of subject expertise seem to play a major part. Three of the groups explicitly used the Young Foresight approach to considering their chosen technology whereas all groups used the winners and losers approach indicating to some extent that both these techniques might be useful in developing approaches to critique.

In England the National Curriculum is undergoing revision. The Minister for Education, Michael Gove, has commissioned an Expert Panel to make recommendations. At the time of writing the Panel has recommended that design & technology become a basic subject (DfE 2011). This means that both primary and secondary schools will be required to teach the subject offering courses for older children that will lead to qualifications in public examinations but that there will be no statutory programme of study or attainment targets. Schools will decide on content according to local conditions and public examination specifications. The Panel's main reason for this is given on page 24 and footnote 57 of the response and indicates that the Panel views design & technology as having weaker epistemological roots than those subjects granted National Curriculum core or foundation subject status. Of course this is incorrect. Technology which is the subject underpinning design & technology has epistemological roots going back much further than, for example, science and a well established canon with regard to both the philosophy of technology (Dusek 2006), which has a strong and interesting relationship to the philosophy of science, and a role in putting science education under a scrutiny which widens pupils' perceptions of the usefulness of science (Layton 1995). The minister has still to pronounce on these recommendations and the Design & Technology Association is campaigning for design & technology to be reclassified as a subject that has a statutory programme of study. A situation in which design & technology has no statutory programme of study will leave many schools lacking guidance and it will be essential that teachers have some understanding of the nature of technology and the way it interacts with society if this is to be part of a design & technology curriculum. Even if the subject is given a statutory programme of study and attainment targets it can be argued that it is still highly desirable for trainee teachers of design & technology to consider the nature of technology. At the moment there is no requirement in initial teacher education for this to be addressed.

It is important to ask whether the approach used in this case study provides a transferrable

means of engaging trainee teachers from other institutions in England and other countries with the nature of technology. Is an introduction which considers a range of ideas from contemporary writers in the field appropriate? Are the writers and the ideas in this study the most suitable? Are the classroom tools for engaging with critique the most apt? Are the ways of choosing a technology to consider useful or necessary? Are the 'crunch questions' the most suitable for stimulating discussion? Does the presentation task lead to the most appropriate learning outcomes? The author would welcome discussions with colleagues who are interested in the place of the nature of technology in initial teacher education for technology teachers so that an acceptable general approach may be developed and studies of its use and effectiveness be carried out in different countries.

Conclusion

Clearly caution must be exercised in drawing firm conclusions from such a small study but the findings may be taken as indicative of the wider picture and help with regard to considering how those training to be technology teachers may be introduced to the nature of technology and the relationship between technology and society. There is no doubt that the trainees were engaged by the workshop and responded positively to the idea that they might teach pupils in schools about the nature of technology and the interaction between technology and society. As the only input into their initial training such a workshop would be inadequate to equip them to tackle a significant amount of such teaching but it does serve to whet their appetites. It is hoped that this small study could provide a starting point for developments that lead to collaboration in considering the nature of technology in initial teacher education for technology teachers.

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