Cultural constructs of technology: a different paradigm for technological literacy

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Abstract
Current frameworks for describing the processes of technology tend to be from the viewpoint of a 'technologist'. Within these frameworks, the philosophy that underpins the analysis of technology derives from the sciences and engineering. Technological criteria are used to question and judge the role of technology in human affairs. Views today on what it means to be 'technologically literate' rest on such technical frameworks. A major drawback is the emphasis placed on the distinctions between society and technology; representations do not necessarily show what influences the 'effect' of technology on the society in which it is situated.

We need to look behind the 'processes' which drive technological innovation, accumulation, diffusion and adjustment in a society. This paper outlines an ethnographic study currently looking at how culture and personality affect cognition and values in the way certain social groups construct their interpretation of technology. The implications of these findings for educating for technological literacy will be discussed.

Culture is the

> ...conventional patterns of thought, activity and artefact that are passed on from generation to generation in a manner generally assumed to involve learning...[1]

Introduction

This paper describes the background research and fieldwork methodology for uncovering the cultural constraints on technological understanding and how the findings might be used to produce realistic achievements in the goal towards technological literacy.

Current means of studying technology can be seen largely as an examination of effective technical training rather than a perspective on human contributions to technology. The frameworks for technical training are devised from the viewpoints of technologists, with the philosophy underpinning technology deriving from the sciences and from engineering. The implication of this is that the language used to convey concepts relating to technology is of a distinct rhetorical form based on rational scientific thinking. This has the effect of creating a split between non-technologists and practising technologists in the way technology can be interpreted. The former is more reliant on narrative thinking, using analogy and story-telling to conjure an inner picture of the outside world, the latter accustomed to particular forms of conceptual thinking conveyed through particular use of language.

This paper arises from initial research by the author and is based on the premise that technology is a fundamental human activity. It is embedded in the process of creating and sustaining a culture that contains and defines groups and individuals, each of whom can, at least unconsciously, respond to the human input that shaped the prevalent technology. In this paper, the author will attempt to show that a balanced interpretation of technology ought to build on individual understanding of technology in the real world through contextualising specific issues. What this will reveal is the way individuals employ their own repertoire of language and how they use it to build an understanding of the way the world works.

What is technological literacy?

> A person who is literate can read and write. A person who is literate in technology understands technology. Technologically literate people know that technology is not

> magic. Rather, it is created by people to solve problems and meet human needs. We study technology so that we can make more technologically informed decisions.[2]

Technology, as taught in schools, has been established as a practical/technical subject. Its main concern is with the design and manufacture of products and systems drawing knowledge from a wide range of subject areas, often including science and maths. A result of this approach is that frameworks for studying technology are based on technical frameworks and from the viewpoint of technologists that assume technology has objective effects which can be measured and predicted; these effects are unaffected by humans.[3] This technical outlook is the result of an infusion of scientific and engineering views about the way the world works. From this foundation spring interpretations about what it means to qualify for being technologically literate.

Scientific and engineering methodological approaches work well for explaining the operations of observable phenomenon resulting from unobservable mechanisms. They do not work well for explaining human actions that provide the contributions to technology, such as creativity, decision-making, and the basis of choices and judgements. After all, if one agrees that technology is the result of social behaviour and the structured product of interactions between knowledgeable agents, then it must be to further some end or another. How the end is realised is the result of mental and social as well as practical activities. If there is to be a thorough deconstruction of what it means to be technologically literate, it must not depend on knowing the objective nature of artefacts, nor on acquiring know-how, nor studying linear process models of what designers, engineers, and technologists do. Rather, it should emphasise that technology is a socially motivated phenomenon within a defined cultural setting, and should encompass meanings and structures within human associations that lead to value judgements and responsible actions. All of these arise from the discriminatory conversation between individuals who possess a common understanding of technological issues.

Making "technologically informed decisions" can mean not just having an understanding of basic rules of technical causality, but also an understanding of the way technology has effects on the human environment and why these take place. In addition, it is important to understand the way humans can affect technological outcomes, either through the manifestations of technology or its deployment. Cultural interpretations of technology, based on social circumstances, are made by people on a daily basis. These interpretations are more likely than not to be non-technological in orientation and context-based within interpersonal conversation. It is within this discursive view that technological literacy can be developed as a way of understanding technology, as opposed to using criteria described or defined in scientific models.

The problem of trying to understand the nature of technology and its development in non-technical terms is especially difficult because it is a foundational premise of modern Western societies that the technical and non technical are distinct domains of discourse and expertise.[4] To what extent people employ particular forms of discourse when speaking on a technological theme is the focus of the research that contributed to this paper.

Thinkers and talkers; talkers and doers-an ethnographic study

In order to provide an account of how people discuss technology and technological issues it is necessary to take note of the extent and nature of their vocabulary. To achieve this an ethnographic study was set up to explore the nature of the perceptions of technology held by people from defined groups.

The author has so far investigated Year Ten students about their understanding of technology and in this paper outcomes of this work will be used to exemplify the methodologies for the study. It is necessary to point out that this study is not to see what it takes to become an effective practitioner of technology, but rather to see how people draw an everyday understanding of technological matters.

The study employs a multi-method technique to provide not just an extensive overview of the subjects of the study, but to allow a deeper enquiry in to the range of perceptual differences between social groups. The methods are:

- an image-based questionnaire along with a combination of open questions and a ratings table;
- *repertory grid* elicitation;
- an informal interview to validate the questionnaire responses and to give an account of an illuminative experience with some particular aspect of technology;
- (where appropriate) an examination of students work.

The questionnaire

The questionnaire (see appendix) has been given to 197 Year Ten students under controlled conditions and later analysed to see if there were any patterns within the responses. The questionnaire was used as a means of selecting a smaller party of students to focus on them and their perceptions of technology. These students had been chosen on the basis of how stereotypically they ticked the images as being technological, or how idiosyncratic their image choice was.

Most of the questionnaire images were of a technological nature, though this point was often transparent. They included Stonehenge, music score, cereal plant, an explosion, printed page, an advertisement, and a microscope beside the more stereotypical images, such as a computer and mobile phone. Two images were inserted as a control. These images depicted two "wild" or "natural" creatures (the fox and the butterfly). The images also provided the elements for the series of *repertory grid* tables, for which a number of constructs about them were elicited and then added to the table.

The Repertory Grid?

The repertoire of conceptual resources available to individuals can be revealed by the use of repertory grids. The repertory grid, as shown in Figure One, is a psychological tool invented by an American clinical psychologist, George Kelly[5] and described in his two-volume opus, *The Psychology of Personal Constructs.* Kelly explained how repertory grids can be used to show how individuals make sense of the world around them according to how they organise their constructs. A construct is a personal creation in the mind that allows individuals to interpret or make discrimination between things they perceive. Figure One shows a proper grid from the study's data pool. The constructs of the person being interviewed are those words and phrases in the vertical list. Across the top are words naming specific items to which the constructs can be compared. These items, or elements, are chosen from a specific resource. They can be human, i.e. members of a family, they can be career titles, or movies of a particular genre. Typically, two elements are chosen together for their similarity of meaning and a third element is chosen as being the opposite in meaning from the first two. Constructs are then given as to why the two elements are different from the third. The elements and constructs are entered into a table and rated against each other on a scale of one to five. One or two agrees with the constructs in the left column, three is undecided, and four and five agrees more with constructs in the right column (see the table in Figure One). The analysis of tables like the one shown is aimed at finding out which constructs are consistently used to describe the same set of elements and which are broadly deployed. Also, it will show which elements are taken to be similar and in what ways, through the use of rating scores given for each element against the polar constructs, i.e. A - A', B - B'....

The process of eliciting constructs is a form of interviewing, but the interview that followed after the grids had been completed had the function of inviting the student to reflect on the questionnaire responses and his or her personal experiences of technology. It allows for the interviewer to assess the way the student's language is being used with regards to discussing a technical theme. This is also the justification for examining the students work.

Out of the 197 students who participated in the questionnaire suvey, 12 were chosen to be interviewed for repertory grid elicitation. The criteria for their selection was based on the following:

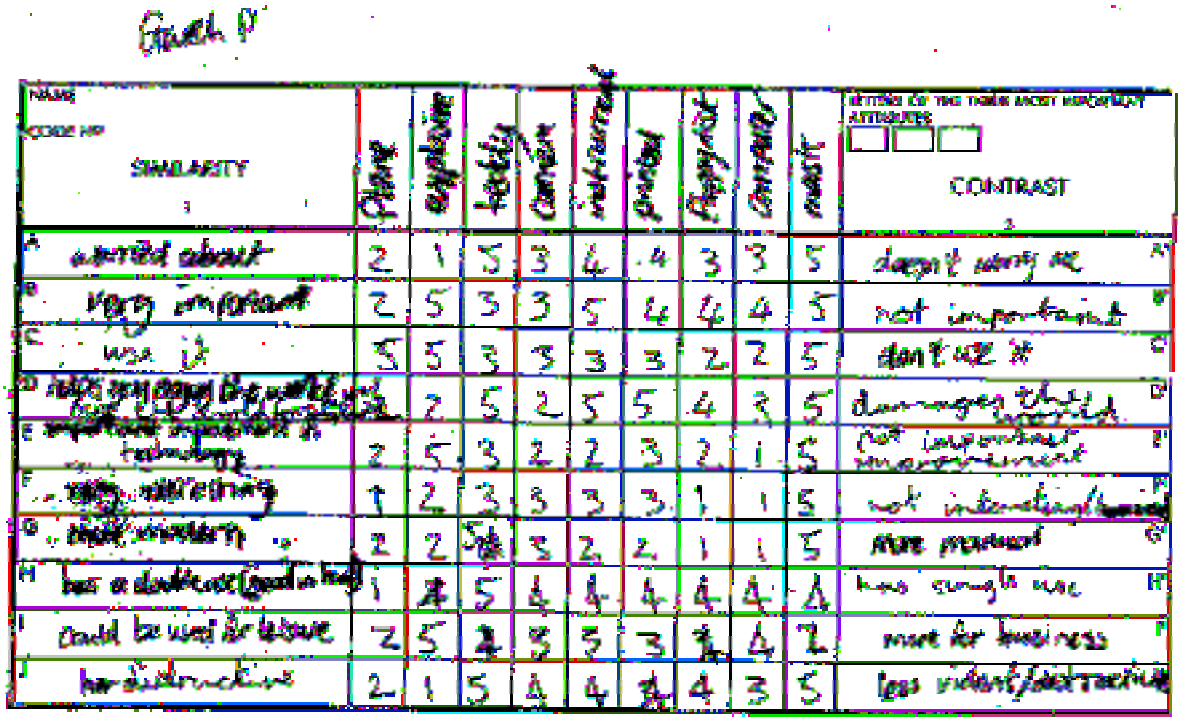


Figure 1: A Repertory Grid

a Two who chose the "correct" images, i.e. those excluding the 'wild' animals;
b Two who chose idiosyncratic images, i.e. those including one or more of the wild animals;
c Two who selected a low number of images;
d Two who scored high table ratings;
e Two who scored low table ratings
f Two students selected at random

Repertory grid elicitation is a very demanding affair and the analysis is time-consuming, yet it can provide a rich data pool. Within the time limits available 12 students out of 197 is sufficient to provide a series of profiles that can give an insight into how technology is construed by this group.

Though this study is still in its early stages, with the analysis of the student interviews not yet complete, some interesting details are emerging. Results from the questionnaire analysis show that organically-based images and archaic artefacts and art-based images were the images least frequently chosen as being technological. Modern artefacts, including the mobile phone, computer, and fighter plane were the most frequently chosen images. Results from early analysis of grid elicitation lead me to speculate that the age of the artefact and its purpose has as much bearing on the impressions of students' perception of the images as does the fact of whether the images depict something modern and functional. Stonehenge was considered spooky, scary and the reason for its construction unclear. It was deemed technological by only a quarter of the students. In the repertory grid above (Figure 1) artefacts, such as the mask, the printed page, the teddy bear, and the [musical] instrument (all of which are, it could be argued, are well-established artefacts by virtue of a long history) tended to be rated towards the contrasting viewpoints. This includes "does not worry me", and "not important". The computer, mobile phone and other 'relevant' images had very meaningful impressions to the students who were able to talk at length about them.

Conclusion

To anyone learning something new and unfamiliar, it is perhaps the existence of strange words, often idiosyncratic to a particular topic, that hinders the learning process. This is especially the case in education, where jargon pervades specialist

subjects such as science and technology, including information technology. Members of the public face the same difficulty with unfamiliar, specialist words used in scientific and technological texts, such as pregnancy tests, or manuals for setting up a desktop computer or configuring a video recorder.

Unfamiliar words in the teaching and learning of new subject areas are a major problem throughout education.[6] To overcome the potential for misunderstanding, a shared meaning of the words used needs to be established and this is important for those words that have very different meanings in other contexts. In a subject such as technology, the diversity of knowledge bases that could be called upon to provide concepts means there are greater opportunities for misinterpretation. In ordinary conversation, between a teacher and student say, things that are said are never a complete representation of what is suggested or indirectly signified.[7] What has to happen is that in a two way learning process the recipient needs to be informed about things that were not said. For this they must have prior knowledge to infer the meanings of what was said and build their own construction of meaning. To do this, they employ concepts, perhaps based on metaphors, in order to further their own knowledge. Developing concepts is a special form of social practice that leads to certain ways of thinking.[8] Words are used to develop concepts and the sorts of words used are reflective of the nature of the experiences one might have had, in addition to prior learning. To develop schemes for technological literacy it is an imperative to recognise that an individual's experiences of technology will later affect the way the technological reality is constructed. Learning how to understand technology has to take into account prior experiences and conceptual development and corroborate them within a pedagogy that can apply structured learning frameworks alongside interpersonal activities involving discussion. The use of repertory grids reveals the nature of the perceptions of technology and makes it possible to assess the extent of the language repertoire and how this might relate to the uptake of knowledge relating to technological issues. The outcome of this will be to suggest ways in which a process of self-correction and revision of concept structures and meanings can be instrumental in developing technological literacy.

References

1 Brown, D. E. *Human Universals*. McGraw Hill, New York, 1991, p 40.

2 Living With Technology, Hacker and Barden 1988, quoted in Lewis, T. and Gagel, C. (1992) Technological Literacy. *Journal of Curriculum Studies*, 24(2), 117-138.

3 Grint, K. and Woolgar, S. *The Machine at Work. Technology, Work and Organisation*. Cambridge, Polity Press, 1997, p7.

4 *Ibid*, p66

5 Kelly, George *The Psychology of Personal Constructs.* 2 vols, New York, WW Norton & Company Inc, 1955

6 Jarvis, Tina and Rennie, Leonie (1996) Understanding Technology. The Development of a Concept. *International Journal of Science Education*, 18(8), 977-992, p977.

7 Shweder, R. A. *Thinking Through Cultures. Expeditions In Cultural Psychology*. Cambridge, Massachusetts, Harvard University Press, 1991, p197.

8 Shotter, John *Conversational Realities. Constructing life through language.* Inquiries In Social Construction Series, London, Sage Publications, 1993, p43

Appendix

TECHNOLOGY PICTURE QUIZ

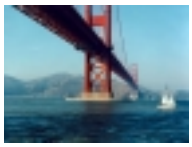
Please tick all of the pictures which you think are in some way technological.

sailing ship ☐

can of cola ☐

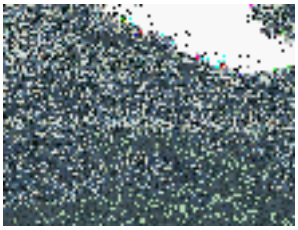
model of DNA molecule ☐

fighter plane ☐



bridge ☐

explosion ☐



university building ☐

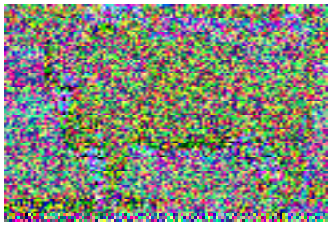
computer ☐

microscope ☐

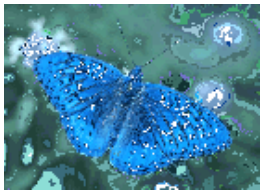
motor bike ☐

cathedral ☐

astronaut ☐



dairy cow ☐



butterfly ☐

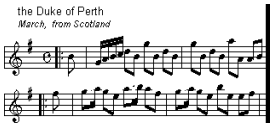
Roman temple ruins ☐

Construction site ☐

mobile phone ☐

X-ray image ☐

Please tick all of the pictures which you think are in some way technological.



music score ☐

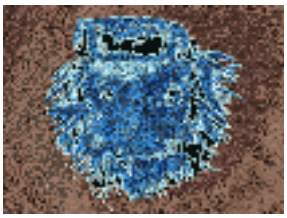
advertisement ☐

BigMac burger ☐

welding ☐

axe ☐

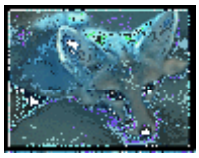
bike ☐



ornate mask ☐

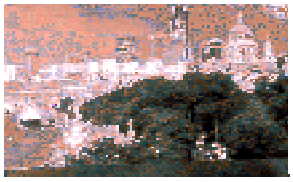
glass ☐

printed page ☐



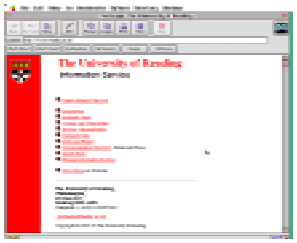
fox ☐

Stonehenge ☐



city of London ☐

musical instrument ☐



World Wide Web homepage ☐

ancient writing tablet ☐

cereal plant ☐

street map ☐

Disregarding the tchnical quality of the images...

1] Of those pictures you have ticked, which one interests you the most?

2] Why?

3] Of all those pictures you have looked at, which one causes you the most concern?

4] Why?

5] Below are some statements. For each statement circle the number which closely matches your own view.

	strongly agree	agree decide	can't disagree	disagree	strongly
I am interested in technology	5	4	3	2	1
technology benefits society overall	5	4	3	2	1
technology is the invention of new ways of doing things	5	4	3	2	1
most forms of technology usually results in some damage to the natural environment	5	4	3	2	1
technology is needed by everyone	5	4	3	2	1
the invention of the steam engine marked the beginning of technology	5	4	3	2	1
technology is the application of knowledge for finding solutions to problems	5	4	3	2	1
many people do not understand technology today	5	4	3	2	1
you need science to understand technology and technology to practice science	5	4	3	2	1
technology is what makes us human	5	4	3	2	1

Thank you for your help in completing this questionnaire