A technology’s capacity and capability is never transparently obvious and necessarily requires some form of interpretation; technology does not speak for itself but has to be spoken for. (Grint & Woolgar, 1997: 32)

Computers are now so commonplace in the overdeveloped countries of the world that their absence is more noteworthy than their presence. To the young—or those who have grown up with computers as a more or less natural part of their environment (Green & Bigum, 1993)––they are almost akin to furniture: unremarkable among an array of electronic appliances, gadgets and home entertainment devices. Similarly, the computer has become a routine part of many aspects of schooling and can be found in most classrooms and in the support of administration both within a school and in school systems.

There was a time when the presence of computers in schools was more remarkable. In the late 1970s and early 1980s, the commercial availability of a range of 8-bit microcomputers made it possible for some schools to acquire computer hardware and software. From these simple and largely hobbyist beginnings, computers in schools have moved from being seen as an expensive curiosity to being widely regarded as an essential component of most schools’ profiles. In a world in which the deployment of computer technology is strongly associated with progress and competitive advantage, the use of computers in schools is no longer a matter of real choice. If not materially then at least symbolically, computers provide schools with the technocultural capital of appearing to respond to an increasingly technologised world by giving them a semblance or veneer of being up-to-date and contemporary. In conditions of increasing marketisation, computer technology in schools has become a central part of marketing of some schools (Arnold & Gilding, 1994; Kenway, Bigum, & Fitzclarence, 1993).

For almost two decades in Australia and in other Western countries, schools have invested relatively large sums of their limited financial resources in hardware and software, teachers have spent large amounts of their own time and, often, their own money in
engineering computers into their classrooms, and schools have allocated a large portion of their curriculum resources to teaching associated with computers and related technologies (Bigum, 1990). Although the educational impact of such technologisation has been disappointing, the unrelenting advocacy of proponents has ensured that material developments have been impressive nevertheless. Interestingly, these developments have occurred in a context of broad ranging and often highly public debates concerning the use of computers for educational purposes.

Understandings and interpretations of what has happened in schools, what is still happening and what might be seen as desirable have varied widely since the early days of computer use in schools. The different sets of language and practices used to represent the world of computers in education and in schools particularly constitute a complex, contradictory and confusing terrain in which teachers and schools navigate. Drawing on recent work (Bigum & Kenway, forthcoming), I will consider in this paper the educational roles that have been assigned to computers and related technologies in schools by four sets of discourses. I use the term discourse to refer to a set of textual arrangements or practices which reflect a particular set of beliefs about computers and schooling (Thwaites, Davis, & Mules, 1994). In collapsing the large number of discourses that pertain to computers in schools to four sets or clusters, I want to draw attention to a particular feature which is common to each cluster, a reliance on assigning to the computer particular, intrinsic properties. These essential attributes are the basis for assigning roles to computer technology in educational settings and, as I will argue, the consequent assigning of roles to the people and institutions which use them. Using an approach which focuses on the formation and collapse of networks of human and non-human actants, I will offer an account which makes the role assignment of each cluster of discourses explicit and the construction of many of the givens of computers in schools similarly transparent.

Confusing roles
The four clusters of discourses briefly described here represent broad but common sets of interests and practices associated with the new information and communication technologies both in schools and in the community. Each set is clustered around a strong and particular perspective of computers in schools. The naming and clustering arose from work I have done with teachers over recent years. Teachers and policy makers have found the categories useful in thinking differently about their practices and the influences that are shaping computer use in education. At the very least they are useful ‘intuition pumps’ (Dennett, 1995).

I have used the terms Booster, Anti-schooler, Critical and Doomster to label the four clusters. The labels offer a shorthand to talk about both a particular set of ideas and the individuals who promote them. Each category represents the characteristic ideas of the discursive set, a signature for the set rather than an averaged position over all possible discourses in the set. Using this nomenclature, broad camps of people who are largely positioned in one of these sets of discourses can be named. Thus, for example, boosters are those people who position themselves in one or more of the discourses that are gathered under the Booster category of discourses which collectively offer a broad range of promotional support for computer use in schools. The categories allow a shorthand for writing about the
prominent thinkers together with the practices that are evident in schools that can be associated with each of the four positions.

Though the clusters have proved to be useful as a means of thinking about the competing influences which shape computer use in schools, I have used them in this paper to illustrate their dependence and, indeed, the dependence of most discourses concerned with computers and education on an essentialist account of computer technology. Essentialist accounts distinguish human and non-human elements. The dualism between technology and ‘the social’ is dealt with in a variety of ways (Bromley, 1997). What remains is a machine with a set of intrinsic, fixed, essential properties and human elements who are temporary: the providers of a context in which the technology is used. I argue that the intrinsic properties assigned to the computer are the basis of the rationales developed for computer use in schools in each cluster of discourses.

When teachers speak of different computers they most frequently mean different makes or models. What I am arguing here is that regardless of the make or model, the discursive positioning of the computer that occurs by assigning essential attributes to it generates a machine that is intrinsically different to one that is positioned by a different discourse. As Grint and Woolgar (1997) argue, “contested accounts of technical capability are endemic to technological systems”. In schools, technical capability rarely moves beyond disputes about the merits of particular hardware platforms. Educational debates, as represented in the four discursive clusters, operate as if the computer is a given, with agreed upon technical capacities. The separation of ‘the social’ and the technical sustains a framing in which the inherent capacities of the technology are not at issue. Not drawing a distinction between these elements or viewing them as a “complex unity” (Bromley, 1997: 64) is a difficult task. Anti-essentialist approaches offer ways of rethinking the issues around computers in schools. The approach I take in this paper, based on one anti-essentialist approach, actor-network theory, traces the processes by which all of the sociotechnical actants of a setting, human and non-human, mutually constitute roles and work towards establishing a stable assemblage.

What follows is a brief account of each cluster of discourses. I draw attention to the roles that each set of discourses assigns to the computer. In doing so, I want to highlight the nature of attribution that occurs for computer technology and the way such attributions work to establish and sustain particular practices, beliefs and roles in schools. By assigning particular, essential and different attributes to computer technology, each set of discourses effectively speaks for a different machine; the computer the booster speaks for is not the same as the computer the doomster speaks for. Consequently, the roles assigned to teachers and schools by a particular set of discourses differ according to how teachers and schools are positioned by a particular discourse so as to complement the essence of the machine.

**Booster discourses: the computer as a learning technology**
The most visible and dominant set of discourses belong to the boosters. Their discourses promote a strong sense of inevitability about using computers in schools and demonstrate an unshakeable faith in the capacity of computer technology to solve most, if not all, of the problems of schooling. These discourses position computers as ‘learning’ technologies—
artefacts to learn with, to learn through and to learn about. What is assumed is an implicit capacity of the technology to support learning and importantly to improve the learning that occurs in the classroom. Justifying computers on the basis of improving existing practices is characteristic of the adoption of most new communication technologies, as Sproull and Kiesler (1991) report. It also characterises the basis of booster justifications for each new computer technology that is promoted in schools.

In this discursive space, computer technology has a ‘natural’ capacity to improve teaching and learning, so much so that teachers’ roles are changed to that of facilitator, see for example, Tiffin and Rajasingham (1995). The computer brings much needed ‘interactivity’, ‘responsiveness’ and ‘engagement’ to the learning process. The association between learning and computer technology can be linked to the unproblematic use of the term ‘information technology’ as a means of talking about computers (Boal & Lakoff, 1995). The highly privileged category of ‘information’ has been successfully articulated with a range of practices in schools so that the step from information technology to learning technology appears obvious.

The unproblematic assignment of a ‘natural’ capacity to the computer as a learning technology by boosters is underlined by the booster preoccupation with ‘how’ questions: how to make best use of computers in classrooms, how to teach a particular piece of content with a computer, how to use a particular type of software, how to persuade the school community to purchase more computers, networks or improve Internet access, and so on. If the nature of the technology is certain then the only work to be done is to make good educational use of it. In this perspective, undesirable ‘side effects’ that might be drawn into any debate are commonly dismissed as implementation problems, things to be overcome so that the technology can reach its full potential.

Assigning a computer a ‘natural’ role as a learning technology also derives from the association of the computer and most other technologies with the notion of progress. It positions resisting teachers as anti-progress in much the same way that particular discourses of progress positioned the Luddites in 19th century Britain. Thus to boosters, the problems of using computers in schools have to do with resisting teachers and inadequate resources being allocated to computerisation. Boosters envisage transformed schools in which computers are ubiquitous and in which the technology has been allowed to reach its educational potential. Each new generation of technology is to be embraced and explored so that no opportunities for realising the inherent characteristics of this powerful learning technology are missed.

**Anti-schooler discourses: the computer as defining technology (good)**

An important sub-group of the set of Booster discourses is associated with anti-schooling. In these discourses, the computer is still identified as a learning technology, but it is ascribed such importance and significance that less efficient knowledge technologies such as schools no longer have a role to play and are simply to be done away with. Speed, efficiency and convenience are the emphases placed on learning which enables anti-schoolers to position schools as inefficient, slow, industrial-age social structures and teachers as dull and boring compared to the engaging nature of multimedia.
(1992) makes the point by suggesting that putting computers into schools is akin to putting an internal combustion engine into a horse.

Anti-schooling discourses are part of a larger discourse which identifies the computer as defining a new era, a technology with the capacity to render epochal social, economic and political change (Drucker, 1993; Toffler, 1980). The utopian imaginings of the likes of Kelly (1994), Negroponte (1995) and to a lesser extent, Davis and Botkin (1994) are paralleled to some degree in the educational imaginings of writers like Papert (1993), Spender (1995) and Lemke (1994). In all of these writings, the computer is invested with an inherent capacity to bring about change by redefining relationships between people and social structures.

Some of the new relationships imagined for people and computers are being explored in virtual ‘schools’ and ‘universities’ in which classrooms and curriculum are constructed in software, that is as computer programs which are available to students and teachers who have access to the Internet. A common theme in anti-schooler discourses is the computer as revolutionising. Schools and teachers, in this view, only serve to block the revolutionising potential of the technology and are defined as redundant.

While the Anti-schooler discourses have much in common with Booster discourses, when speaking of the capacity of computer technology, they do not describe the same machine: to boosters, computers have inherent capacities to improve learning, among other improvements; to anti-schoolers, computers have an inherent capacity to revolutionise learning and the social institutions associated with it. It is not that the two discursive sets differ about how the technology might be used, they begin from very different assumptions about the capacity of the technology per se.

Critical discourses: the computer as politics by another name
A range of critical discourses address a broad set of concerns about the deployment of the new information and communication technologies in many aspects of Western society. Unlike the promoters of the new information technologies, critics question the effects of computer use and point to things like job loss arising from the deployment of computers, the deskilling of workers in occupations where computers are used, the use of computers for surveillance, the threats to privacy posed by so much computer use, and the ways in which much computer usage reflects a disregard for important access and equity issues. These discourses reflect an ambivalence about the inherent capacities of the computer. Some focus largely on the social shaping of the technology and directly or indirectly argue for a technology that is ‘neutral’. Other discourses point to the values and politics that have been built into the technology.

Making a distinction between having values built-in or subsequently attached to computer technology may appear to be unnecessarily quibbling but it has important implications for policy and practice. In effect, the two positions frame two different machines. One computer presumably can be stripped of the values and politics attached to it by changing the circumstances of its use. The other cannot. So for those concerned about the gendering of computers for example, one position would encourage women to work with computers in ways that negated attached masculinist values and politics, the other would require that
an alternative feminist technology be developed. In both of these positions, assumptions are made about the essential attributes of the technology. The assumptions give computers and their users particular roles that appear as a natural consequence of the technology being as it is.

When teachers talk about these issues, the computer is often represented as being neutral, ‘just a tool’ and so solutions to problems of access and equity assume that the computer plays no role in patterns of access in the classroom or in shaping differences of computer use that are associated with differences in gender, race, disability or socioeconomic background and that, in the case of gender, patterns of computer usage merely reflect the social construction of masculinity in ways which demand technological literacy of boys, and marvel at technological literacy in girls. Depending on the position taken here, people respond with the ‘give a girl a spanner’ approach: but access to a spanner or wrench means nothing if there isn't also legitimation of the right to the wrench and attention to the context within which the wrench can be used (Sofia, 1995).

Classroom computer use that is framed by one or more critical discourses assigns the computer particular, intrinsic qualities which give rise to particular roles for the computer, and consequential roles for teacher and students. These different discourses effectively produce different machines whose capacities for dealing with difference in classrooms vary significantly.

**Doomster discourses: the computer as defining technology (bad)**

A noteworthy subset of critical discourses is that associated with a nostalgia for practices and institutions associated with print technology. These discourses challenge both the need to and the wisdom of converting many print-based practices and institutions into a digital form. Like the broad set of critical discourses, doomster discourses are typically not explicit about the essential attributes of the computer but they are clear in pointing to the destructive role that the computer and related media play. Like the anti-schoolers, they recognise the computer for its capacity to bring about epochal change and are strongly opposed to it. They offer oppositional accounts of the developments celebrated in anti-schooling discourses.

The doomster discourses, most notably seen in the work of Postman (1993) and Stoll (1995) resonate with a broad conservative discourse in education that emphasises the value of past educational practices and knowledge (Bowers, 1988). Doomster discourses in schools are expressed as concerns by teachers for students who appear dependent upon calculators, spelling checkers and other computer aids. Also of concern to doomsters is the unfettered access to information on the Internet. Postman argues that the Internet is unnecessary because we already have an over-abundance of information. Lakoff (Boal & Lakoff, 1995) argues that what is confused is the amount of information that is available and the amount of information a person can actually use, an argument that can be applied to the use of libraries as well as the use of the Internet.

The essential attributes of the computer in this set of discourses is effectively the same as that found in anti-schooling discourses, that is an inherent capacity to redefine relationships between people and social structures. The difference in this cluster of
discourses is that the changes wrought by the introduction of computer technology are seen as bad. The roles for teachers and students, from this perspective therefore is to resist and work to preserve past practices and structures that are largely print-based. In these discourses there is little or no room for accommodating the new technologies in traditional educational practices.

An anti-essentialist account of computers in schools

So far I have argued that different discourses frame the uses to which computers should be put in schools, and in doing so, attribute essential capacities to the technology, thereby determining in the broad the role of the computer and consequently of teacher and learner. Thus, for example, boosters are concerned with ‘how’ questions because, to them, the inherent capacity of the computer is that of a learning technology. In the accounts of computer use in schools described above, the implicit assignment of particular capacities to the computer makes any debates between the different discursive camps difficult if not impossible as each discourse effectively is talking about a different machine. When a computer is placed in a classroom its discursive framing is the basis for engineering the social setting of the classroom. Typically, an interaction between the discursively framed computer with the social dimensions of the classroom is the basis of interpretation. The separation of technical and social characterises accounts which rely on a technicist or essentialist rendering of the computer. It is a boundary that is increasingly difficult to sustain, as Law and Bijker (1992: 290) argue:

Purely social relations are found only in the imaginations of sociologists, among baboons, or possibly, just possibly on nudist beaches; and purely technical relations are found only in the wilder reaches of science fiction.

Actor-network theory (ANT) (Callon, 1986a; Callon, 1986b; Latour, 1988; Law, 1988; Law, 1991) avoids the social/technical dualism. ANT employs a notion of heterogeneity to describe the mixed nature of all sociotechnical ensembles or networks (Callon & Latour, 1981; Hughes, 1983; Latour, 1986), that is, they are made up of people and things and embody "social, political, psychological, economic, and professional commitments, skills, prejudices, possibilities, and constraints" (Bijker & Law, 1992: 7). This approach to understanding the development and implementation of technologies generally has been used to describe a wide range of sociotechnical systems but has enjoyed little use in education (Bigum, 1997; Bigum, Green, Fitzclarence, & Kenway, 1993; Gilding, 1997; Roth, 1996). ANT focuses upon how sociotechnical ensembles are made up and come into being, how they emerge and compete with other ensembles and how they are made more durable over time. ANT draws attention to the processes by which technologies and their users are spoken for and emphasises the contingent nature of networks or assemblages and their building.

ANT describes the way actants mutually constitute and assign roles to each other in the process of network building. In this view, power is a consequence of building and maintaining a network. An actor-network is assembled by the enrolment of allies through a process of ‘translation’. The process has four stages and here I will use the example of the introduction of computers into schools to illustrate each stage. In the ‘problematisation’ stage, particular actants are identified and persuaded that the solution
to their problems lies with the actant(s) doing the enrolling. In schools, computer enthusiasts needed to persuade school communities that the solution to some of their problems would be found by taking computers into the school. The second stage, *intéressement*, is one in which the existing networks of the actants being enrolled, are dismantled and replaced by the associations of the new network. In the example, computer enthusiasts freed up sufficient curriculum and material resources to support the establishment of computer classrooms. The next stage, ‘enrolment’, occurs when the new network achieves sufficient stability to be regarded as an entity. In schools, computer studies and other computer-dependent subjects quickly formed a defined and often substantial part of the curriculum. The last stage, ‘mobilisation’ occurs when the network comes to be spoken for by one or more of its actants. In the example, the computer initiatives might be spoken for by the principal as helping the school achieve its mission to prepare students for work and life in a highly technologised era.

From an ANT perspective, the durability of a network and the strength of association between actants is of prime importance. Each actant negotiates its role with every other actant and achieves its capacities through participation in the network. The emphasis on mutual constitution between humans and non-humans gives ANT a strong anti-essentialist tone. All actants have their own purposes for becoming enrolled in a network and from the point of view of the actant attempting to assemble a network, sometimes termed the heterogeneous engineer (Law, 1987: 113), it is important to ensure that other actants conform to their role assignments.

**An actor-network perspective of computers in schools**

What follows is a necessarily brief account of how an ANT perspective would redescribe aspects of the take up of computers in schools. The advantage of this description is that it avoids any predetermined boundaries between the social and the technical, focussing instead on the formation and reformation of networks. Importantly, ANT gives voice to not only the human actants but also to the non-human actants in the struggle to form a stable network. The same terms of analysis are applied to human and non-human actants and network formation and maintenance becomes a process of ongoing negotiation between all actants.

The arrival of computers into schools added a new set of actants into an existing set of networks which were to prove robust and durable and not easily disrupted by the new actants on the block. Despite the claims made on behalf of the technology by boosters, the history of schools taking up a range of communication technologies was not good (Cuban, 1986). For the computer to survive it had to form alliances. In the early years of computers in schools, a key alliance was formed between the computer and one or more teachers who promoted its use in their classes. For the teacher promoting computer use, the computer provided technocultural capital. Teachers with good computer skills achieved status and were able to derive certain advantages in the school (Bigum et al., 1987). From the computer’s point of view the teacher made good use of it, cared for it and ensured it was not left in the hands of users who would damage or misuse it. ANT requires a symmetrical treatment of the mutual assigning of roles by both human and non-human actants. Latour argues that each actor, human or non-human, is invested with a ‘will’ with which to make “other elements dependent upon itself and translate their will into a
language of its own” (Callon & Latour, 1981: 286). This analytical position of assigning non-humans will and agency is clearly controversial and is the basis of a number of important debates in the field (Callon & Law, 1995; Lee & Brown, 1994).

Computer vendors have continued to be key actants in enrolling computers in schooling. They were and are keen to foster alliances between computers and schools and computers and teachers, particularly those who will provide evidence for the claims they have made on behalf of the technology in education. The translation they made was to declare that the technology would improve teaching and learning, a claim which quickly became an essential attribute of the technology. How flimsy these claims were in the early years of computers in schools is evidenced by the kinds of advertising that computer vendors produced. Their understanding of curriculum, teaching and learning was, to say the least, curious. But so successful has this approach been that each new batch of computer products invariably comes with claims about improving aspects of teaching and learning.

The mutual enrolling of vendor and school in the consumption of computer products appears to have worked well for vendors who have clearly established the computer as a learning technology and subsequently have been able to use this to promote the computer in the home for educational purposes. Despite the problematic nature of a good deal of classroom computer use, vendors have, with the aid of schools, been able to extend the notion of a learning technology into the home, enrolling anxious parents in an extended actor-network in which vendor, home, school, teacher, parent, child and computer are allied. The role assignments in this network are necessarily different from the networks assembled in schools.

Some private schools were quick to form alliances with the new technology less for learning benefits than as a means of enhancing their image in the community as offering something that other schools did not. From the computer’s point of view, here was an ally that promised a school full of computers, and an ongoing promise to maintain computer technology at the cutting edge. Private schools offer a kind of computer heaven in which support for and celebration of the technology is always strong.

In most secondary schools there has been an ongoing tension between the subjects which ‘require’ heavy computer use and those for which computer use is seen as less important. Cross-curriculum computer use has always been the poor relation to specialist computer subjects. A related tension is associated with the location and distribution of computers in a school. Specialist subjects tend to prefer a laboratory of computers whereas other curriculum subjects tend to prefer computers distributed in all classrooms. The interplay of translations is always complex. From the computer’s point of view the issue becomes one of the best place to be, the potential neglect by being isolated in a classroom or the heavy use found in a laboratory and in which alliances with other computers via a network is possible. From the point of view of the computer specialist teachers, they need to form an alliance with not only the computers, but the decision makers in the school, and, if possible, the teachers who would prefer the computers to be distributed. Other actants, like parents are also crucial allies in supporting the ‘need’ for specialist laboratories.
More generally in a school, the promoters of computer use need to secure allies to counter other networks in the school which seek school funds, like libraries, recreation facilities and so on. The transformation of many school libraries points to the successful enlisting of libraries which now press for computer expenditure ahead of expenditure on books.

These brief re-readings of developments around computer take up in schools offer a perspective in which the emphasis is on network formation and dissolution rather than relying upon a priori attribution of roles to computers, teachers and students. ANT underlines the need for ongoing work in the maintenance of any actor-network. Schools are well aware of the dependence of their computer-based enterprises on one or two teachers and the difficulty of re-establishing a network when a key actant is removed. In effect, a new process of mutual role assignment, the formation of a new network, needs to occur.

**Negotiating with computers in schools**

ANT offers a powerful means of rethinking the complex relationships that have located the computer as an educational technology in large numbers of classrooms and homes. Its emphasis on studying the formation of alliances and avoiding the social/technical dualism provides a more holistic and dynamic account than research which partitions out either much of the technical or much of the non-technical. Rather than understanding the use of computers in schools as one of speaking on behalf of the technology, ANT paints the adoption of the technology as a process of negotiation, not just with the human stakeholders but also with the non-humans as well. ANT is not merely another means for extending scholarship in this area, important as that might be, but is a useful resource for those seeking to change the world rather than simply describe it. As Grint and Woolgar (1997) argue:

> ...those seeking to change the world might try strategies to recruit powerful allies rather than assuming that the quest for the truth will, in and of itself, lead to dramatic changes in levels and forms of social inequality. (Grint & Woolgar, 1997: 168)

Essentialist approaches to using computers in schools have a poor track record in dealing with social inequality. They unnecessarily pre-empt and constrain the range and nature of possible negotiated alliances between all of the actants in an educational site. The ‘nature of the machine’ can be a convenient excuse for not addressing issues around access and equity. On the other hand, ANT makes explicit the relationships, negotiations and alliances that are employed in particular settings and provides a basis for moving from essentialist frameworks towards an array of new possibilities for computers and schools: futures which depend only on the ability/willingness of actants to negotiate particular alliances.

Advice to form powerful alliances not only applies to practitioners interested in more just and equitable forms of educational practice with computer technology, it also applies to scholars whose pursuit of truth can sometimes appear to be alarmingly ineffective in contributing to or supporting change in education. I appropriate some of Latour’s (1996: 33) words to conclude: “The work of generating interest consists in constructing these long
chains of reasons that are irresistible, even though their logical form may be debatable”. If you want to save computer use in education, promote anti-essentialist frameworks. “This implication is not logically correct, but it is socio-logically accurate”. In writing this paper, I have taken Latour’s advice and encourage others in the field to explore the potential of ANT in reshaping educational practice with the new information technologies.

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References


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1 The first stage in the adoption of many technologies (Franklin, 1990).
2 For example, gender-related access in classrooms, teachers without skills in the use of particular software, or injuries arising from prolonged use in non-ergonomic conditions.
3 A useful analysis of the Luddite rebellion can be found in Grint (1997: 39-64).
4 If the network extends beyond the school to millions of other computers (the Internet) then the potential for more powerful alliances becomes even greater.