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# The national broadband network and the challenges of creating connectivity in education: The case of Tasmania

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Tasmania, one of the first locations to have communities connected to the national broadband network (NBN), provided the context within which to ask significant questions about the implications of the NBN for all levels and sectors of education. This paper reports findings from a research project that developed innovative methodology to explore the issues with 21 respondents categorised as "leaders" in the field of information and communication technology in education. The aim of the research was to conduct an audit of actual and planned implementation of new technologies in classroom teaching through in-depth interviews, to assess challenges faced in implementation and to facilitate dialogue between leaders in disparate education areas through provision of forums online and face-to-face. In this way the action research both contributed to an understanding of issues and acted as a change agent in stimulating the sharing of new approaches to what turned out to be a set of highly complex "wicked" problems. Resulting models using a causal layered approach demonstrate that whereas the NBN did not become the immediate solution to connectivity for these leaders, it provided the motivation to consider what a connected educational environment could be like.

## Introduction

In 2009 The Australian Government announced the development of a $40 billion national broadband network (NBN) with some of the first roll-out towns in rural Tasmania. The rollout of the NBN began after the commencement of the Federal government's digital education revolution (DER) (DEEWR, 2008, 2009) whose seven year strategy included a vision for student-centric learning, parental involvement, teacher professional learning, development of learning resources, infrastructure such as high-speed cost-effective broadband connectivity to schools and provision of laptops.

At the time of the announcements and subsequent information forums for the NBN in Tasmania there was little information or research on the implications for education in Australia. The NBN corporate brochure (NBNCo Limited, n.d.a) titled *Nation Building Infrastructure: Broadbanding Australia - National Broadband Network* mentioned education four times and stated, "The NBN is not just delivering speed, it also brings ubiquity. A network that connects all Australians to broadband will transform access to health and education" (p. 2). In Tasmania, however, while homes and businesses were beginning to be connected to the NBN, connectivity for educational institutions was problematic.

In response to the lack of conversation around the implications of the NBN to education, the authors established *The Tasmanian NBN in Education project* in late 2009. The intent of the project was to find out how far the implications of the NBN for education were already being considered and discussed and to provide opportunity for further dialogue among educators about the issues and opportunities for education such as:
- What are the implications of the NBN for education in the state?
- How might high speed connectivity in schools or in homes help bridge the current educational divides between rural and urban areas?
- What educational affordances might high speed connectivity offer and is the educational sector ready? What might be the issues and challenges of implementation?

The project was developed as action research. This involved the gathering of research data from project participants, recognising that the issues were more complex than anticipated, developing processes and heuristic models to help participants consider the issues, providing a conduit and a forum for the exchange of information and ideas between participants, and working with a core group of e-learning leaders who shaped the direction of the project within the context of shifting educational policy.

Different countries (such as Korea, Japan, the Netherlands, Britain, the USA, and Canada) have been at various stages of implementing high speed internet access over the last decade, providing not only an understanding of its potential technological and social affordances in e-business, e-health, e-government and e-education, but also an analysis of the issues of implementation and the impact of different policies (Bouras, Giannaka, & Tsiastos, 2009; OECD, 2008; Siddharta, 2011). Among the technological affordances are improved management of supporting infrastructure and networks (e.g., cloud computing, virtualisation, security), the use of collaborative technologies for problem-solving, and the opportunity for development of new products and services leading to economic growth (Boulos et al., 2011; Brabham, 2008; International Telecommunication Union, 2012). High bandwidth technologies have enabled enhanced individual experiences through greater access to information (including authoritative databases), products, services (including educational courseware); enhanced online relationships (allowing telepresence and sharing); connection to online communities; breakdown of the isolation of distance; and greater flexibility in the way people study and work (Missingham, 2009; Van de Sluis & Diederiks, 2004). Some research suggests that broadband acts to encourage greater civic participation, can strengthen local communities and help to mitigate social disadvantage (Office of Communications, 2009; Stern, Adams, & Boase, 2011; Wellman et al., 2003).

Recent research in the education field has considered general issues related to information and communication technology (ICT) implementation in the field of education, for example the disconnect between policy and operational practice (Tondeur, van Keer, van Braak, & Valcke, 2008; Ward & Parr, 2011), the importance of school support and a focus on pedagogy (Neyland, 2011), the lack of student online information and critical evaluation skills (Ladbrook & Probert, 2011), and the difficulties for beginning teachers in tying their pedagogical beliefs about ICT with the actual practice in the classroom (Bate, 2010). In terms of affordances of NBN for Australia, Spies (2011, p. 1168) notes the potential accessibility and low cost of audio podcasts for distance tertiary students and McShane and Thomas (2010, p. 150) survey the opportunities for Australian libraries. From the perspective of equity in education in a digital world, Reedy (2011, p. 1067) considers issues for Indigenous students, Broadley (2010, p. 63) looks at professional development for rural teachers, and Willems (2011, p. 1308) attempts to set benchmarks for students and staff as directions and demands change in higher education.

NBNCo Limited (n.d.b, pp. 67-72) has itself presented three case studies based in two schools in the far northwest of Tasmania and in Skills Tasmania, where hands-on training is provided to vocational education training (VET) teachers in these schools. Their research claims that early implementation of the NBN has encouraged retention of teachers in a rural area, allowed simultaneous use of sites by students, allowed international video exchanges, provided professional development for VET teachers, and increased engagement and enthusiasm of students, parents, and teachers. Bell (2009), as "Thinker in residence" and anthropologist for South Australia, travelled to communities interviewing people about the implications of the NBN for them, creating a vivid picture of current practice and coherent vision that unites community-building, education, life-long learning, infrastructure and policy. Although recommending greater connectivity for South Australian schools and linking this to a larger picture, the report did not have the scope to explore the deeper issues and affordances of NBN connectivity for education.

Although such research on the NBN has referred to specific issues or affordances of the NBN, there appears to be little research on the complexity of its implementation in the education sector. It has all the characteristics of a "wicked problem", which include: the nature of the problem being largely unknown, having multiple stakeholders, uncertainty, continuing change, complexity from the multiple activities and interactions across multiple scales, multiple and contested interpretations of the problem, and multiple and contested solutions with possible perverse effects (Rittel & Webber, 1973). Being aware that implementation of the NBN has the attributes of a wicked problem alerts project teams that different approaches may be required to achieve traction, application of best practice solutions may not be easily transferrable to local contexts; the way the problem is being framed is crucial to what is seen, and the problem is likely to cut across greater networks or knowledge areas than have been predicted (Hasan & Kauslaskas, 2009; Kurtz & Snowden, 2003; Snowden, 2002; Weber & Khademian, 2008; Westbrook et al., 2007). In addition, the incomplete or ambiguous data required for problem solving, diverse perspectives and values, and technical, social and political dimensions may lead to collective cognitive breakdown. The solution involves new theories, design tools and practices created through dialogue and

debates, based on decentralised networking (Ferlie, Fitzgerald, McGivern, Dopson, & Bennett, 2011), to create resilience, trust and new social capital (Shum 2010).

As more locations become connected to the NBN in Australia, it is important to consider its implications for the education system in conjunction with the DER. This paper aims to present some of the issues around the implementation of the NBN in education in Tasmania and share some of the processes used in fostering dialogical thinking amongst some key educational stakeholders.

## Project overview and methods used

### Action research as a principle methodology

The project used a continuous dialogical approach in building stakeholder engagement with the issues, and using iterative and reflexive processes in reporting and integrating information. The aim of action research is to contribute to knowledge in the field or help solve a problem in the field, and help build the capacity of the participants (Kemmis, 2009). Participants develop their understanding through a better appreciation of what they value, constructing contingent "living educational theories" that can be built on, paying attention to and managing the contradiction of the self, and embodying new wisdoms into practice (Whitehead & McNiff, 2006).

Action research can also become a useful probe in making more visible context conditions, historicity, organisational practices, system regulations and dynamics when interventions are tried. It helps participants not only to interrogate their own values, but also to share them with other stakeholders through conversations about what they collectively value, enabling a refreshing of vision and intent. Action research processes where stakeholders are part of the process of inquiry means that everyone goes on a journey together. It is particularly suited when starting from a place of little shared knowledge and dealing with wicked problems requiring emergent practice (Ison, 2008).

### Development of the research

The interviews of key leaders across the Tasmanian education sector commenced in November 2009 and concluded in March 2010 with interviews accessible to all participants for sharing and modification on a wiki. This assisted decentralised networking between participants who often did not know of their counterparts in other organisations. The interview data were then analysed in March/April 2010 resulting in a synthesis of issues, detailed cross-sector comparisons within a number of key areas (infrastructure, inclusion, potential pedagogies, student pathways, education vision) and the creation of a number of heuristic models to give new insight into the way issues were being framed.

A meeting was held in May 2010 to review findings with six of the interviewees representing e-learning leadership across a range of different organizations (Department of Education (DoE) (K-10), Academy (Year 11-12 Colleges), Polytechnic (TAFE equivalent), Independent schools, University of Tasmania, and TASITE (the ICT teachers' body)). The group endorsed the findings and the models being developed, and their presentation to other stakeholders. One of the key issues identified was an absence of a coherent e-learning strategy for the state. The group suggested that more broadly-based questions about the future of education in a digital world were worth exploring beyond the implications of the NBN. Thus the aim of the subsequent forum was expanded to "*Exploring ways to develop e-learning in Tasmanian Education*" with the NBN as the initial focus. Significant change within the DoE at a policy level caused the project to be slowed down until a new Secretary was appointed. This highlighted the need for support at the highest levels for cross-educational sector dialogues to take place.

The first author and two of the interviewees presented the interim findings of the NBN in Education project at the *CSIRO Broadband for Society Summit* in November 2010 (http://research.ict.csiro.au/events/broadband-for-society-summit). This enhanced the presenters' understanding of the broader issues affecting key players outside as well as inside education, the emerging drivers, alternative ways of framing issues and experiences from other countries. New understandings were used by the e-learning core group and the authors to inform and structure the forum, held in December 2010, which explored a state-wide approach to e-learning in context of the NBN.

The introduction to forum participants of a number of models developed from the information provided by the interviews represented a key approach to re-examination of issues and possibilities. This process helped to help make visible the importance of identifying the problem as complex, the different perspectives or lenses key players were representing, and the mental models and spectrum of values that people were bringing to the issues. The forum was welcomed by participants as a rare opportunity to think expansively and deeply about a complex environment away from the practical realities of the classroom or management situations. Many remarked that they were particularly appreciative that the framing provided by the models enabled them to understand and value other perspectives, look for greater wholes and engage in more nuanced and dialogical thinking. In addition to considering the connectivity infrastructure issues (e.g., potentials of AARNet[1] versus NBN), the participants identified issues beyond e-learning central to the way people think about schooling and learning. Forum participants recommended a cross-sector strategic approach that takes into account the different perspectives and values, with implications for shared policies and practices into the future.

Initiatives arising from these discussions continued into 2012 despite a highly uncertain, rapidly changing design space, not only because of the rapid change of technology, but also because of the considerable changes in government organisation of the different sectors. Although no co-ordinated state-wide approach initially developed from the project, it created a "vision field" (Wheatley, 1994) that those working in the space have been able to bring into their own contexts.

## Identifying participants

A modified snowball technique (Cresswell, 2008, pp. 155-156) was used to identify potential interviewees and to gain their nominations of other experts as potential interviewees. Initially five leaders of ICT within different organizations were identified using research knowledge and networks. The density of the relevant networks was demonstrated by the fact that some people were nominated several times by others. The gaps in the interview lists were illuminated so that there could be an active search for those representing missing perspectives. The 21 interviewees were drawn from public education K-12, the independent and Catholic school sector, the University of Tasmania, the Community Knowledge Network, the youth issues sector, and the vocational sector. Table 1 details the numbers of people from each sector and their roles.

## Interview instrument

The challenge was to create an interview schedule that could be used equally well person-to-person or over the telephone and that would be at once broad enough for everyone to answer and yet specific enough to enable them to talk about their particular situation in detail. The aim was to go beyond "what might be the implications of NBN for you?" to get a sense of the current educational vision informing the organizations and where e-learning and NBN might sit within them. Of particular concern were the innovatory approaches, learning edges and the future directions of the organization. There was interest in existing and potential issues, whether technical or human. Feedback was sought for the questions before trialling them in interviews. A summary of the questions is found in Table 2. They proved effective in opening up conversation, though not all interviewees were able to respond to all questions. Ethical clearance was gained from the Human Research Ethics Committee, University of Tasmania, and the interviewees were able to withdraw and to withdraw their interview transcripts at any time. In the end only one transcript was withdrawn by a participant from the Wiki for reasons of organisational sensitivity.

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[1] AARNet is a very high bandwidth network (10GB/s) designed to connect higher education research institutions globally. It uses a subscription per student costing model, rather than cost per download volume. It is more than just a carrier and also includes on-net services such as Clickview and access to many learning organisations already connected.

Table 1
*Background of interviewees*

| Education Sector | Number | Interviewees |
|---|---|---|
| Public education K-12 (over 220 schools, 9 colleges) | 8 | District learning leader responsible for state-wide e-learning strategies, state-wide professional learning leader, network manager, 2 high school leaders, e-school leader, flexible learning leader for the Academy (year 11 & 12) and board member for the Academy |
| Independent and Catholic schools | 1 | Representative for the sector from The Hutchins School (which was already connected to high speed Broadband) |
| Vocational sector Post year 10 | 4 | Board member of the Polytechnic, flexible learning leader for the Polytechnic, ICT resource manager (for the Academy and Polytechnic), the e-learning leader from Skills Tasmania (a hub for Registered Training Organizations (RTOs) across industry and government departments) |
| Youth services sector | 1 | Clearinghouse for Youth Studies – hub for the sector |
| University | 5 | e-learning leader, ICT resource manager, flexible learning facilitator, professor of ICT, Faculty of Education ICT lecturer |
| Community Knowledge Network | 2 | Director of Library and Access Centres, Leader of Adult Learning |

Table 2
*Interview questions*

1. What is the current use of ICT to enhance student learning? Challenges?
2. What are the leading edges in your organization?
3. What potentials do you see for ICT in education with the advent of NBN?
4. What is the impact of ICT on disadvantaged students?
5. How might learning environments change?
6. What professional learning networks exist or could exist to support new learning initiatives?
7. What are the issues surrounding teacher professional learning in ICT?
8. What do you think the NBN delivers?
9. What might be technological limitations?
10. What is your organization's strategic vision for ICT in education, if it has one?
11. How does your organization's vision connect with those in other sectors?
12. What metaphor best describes your organization's vision?
13. What would you like to share at the forum? And what would you like to hear about?

## Wiki – a collaborative dialogical space

The research method involved a dynamic process for engaging people in a conversation, among themselves as well as with the researchers, during which the "process" of information and ideas exchange and flow became as important as the research "product" in the form of reports and academic papers. To this end it was decided to use a wiki platform (http://tasnbn.wetpaint.com) where the summaries of the interviews would be put online and made available for the interviewee to correct or change (which some did), and accessible for the other participants to view and discuss in person or on line. Some interviewees took advantage of the access to other participant interviews and followed up by building new relationships and networks that led to project collaborations with other participants. This was also promoted by the interviewer (the first author) who was able to suggest potential beneficial connections.

The interviews planned for 30 minutes usually lasted longer, sometimes for 2.5 or 3.5 hours. The time taken reflected the complexity of the topic, the interest level of the participants and the in-depth exploration of the issues. The interviews were mainly conducted at the interviewees' places of work so they were able to provide demonstrations, strategic plans, research that they had conducted, future

reports, power points or diagrams, adding to the richness of the picture that was being developed. The interviewer used a hermeneutic process, giving the interviewee opportunity to refine the meaning of the response. The interview was summarised according to the question categories on the wiki. In general people did not modify the substance of what they said on the wiki, demonstrating confidence in the reliability of the reporting of the interviews.

**Analysis**

The original intent was that the research component of the project would stop after the interviews had been conducted and that people coming to the forum would read the individual interviews beforehand to get a sense of each other's views and issues. Although the interviews usefully provided a sense of the organizations at a particular point in time, it was not felt that by themselves they could explain the complexities of the issues, educational and organizational cultures and value systems of the people tasked with implementation. The many dimensions and perspectives had all the characteristics of a wicked problem (Rittel & Webber, 1973). It was thus difficult to progress the analysis to common definitions of problems and shared solutions without delving deeper into the thinking and value cultures of respondents with the possibility to help people develop beyond these (Beck & Cowan, 1996). As noted by Frame (2008), "agonistic" processes allow different perspectives to be kept alive without reducing them to one view or simple solution, and hence it was decided to use analysis that could capture more than just the surface issues and enable people to engage in triple loop learning (Flood & Romm, 1996) through dialogue. This meant being able to make visible the invisible – making apparent assumptions, mindsets, mental models and values, and being able to sense into a wider view than might normally be seen. The method used of causal layered analysis (Inayatullah, 1998) aims to go beneath the issues and challenge existing frames and worldviews to help people into a new visioning of the future. There are four layers of analysis and these were used to give shape to the analysis approaches that are listed in Table 3. This is diagrammatically represented in Figure 1, which was used on the forum flyer.

Table 3
*Layers of analysis*

| Layer intent | Research approach |
| --- | --- |
| *The issues layer* – this layer aims to capture the initial issues and concerns that people raise. | Amalgamations of issues from the interviews. |
| *The social analysis layer* – this layer aims to understand the dynamics and dimensions of the issues, determining key perspectives or lenses to consider the issues, illuminating the drivers, trends and situational contexts. | Development of a Perspectives model of seven standpoint perspectives that captured key perspectives exhibited by the interviewees. Cross-sector comparisons in terms of approaches to inclusion, infrastructure, pedagogy, vision. Scanning the ICT in education sector for policy drivers and future scenarios or trend predictions. |
| *The worldview or values layer* – this layer aims to understand cultural motivations and values and the way different people frame issues, aiming to reveal unquestioned assumptions. | Collation of different metaphors used or different ways of framing of the issues. Mapping the different values expressed into Beck and Cowan's (1996) "spiral dynamic" framework. |
| *Visioning/metaphor layer* – this layer aims to move into a space where underpinning values may have changed and people are able to articulate alternative possibilities. | It was intended that the forum would begin to enable movement into this space following sharing of the findings in a way that could encourage agonistic processes, triple loop learning and moving into more imaginative wholes. |

The collection of models, cross-section comparisons and future influences were used by the authors as heuristic devices with different stakeholders to give an appreciation of the spectrum of perspectives, mental models and values that people were bringing. They aimed to stimulate dialogue between these perspectives so that any tensions might become visible in a way that would deepen understandings rather than creates divisions.
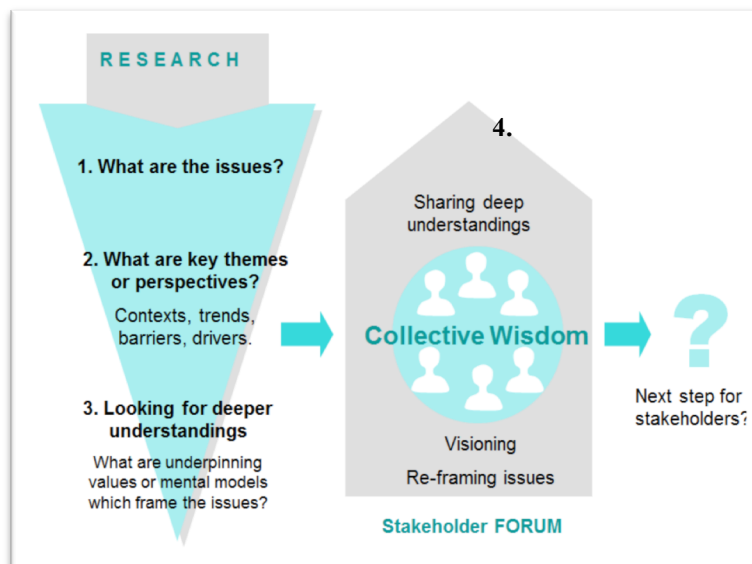


*Figure 1*. Layers of analysis.

## Limitations of the research methodologies

The focus of the project was initially to provide an opportunity for the educational sector to engage in debates about the NBN and therefore it targeted those who were more likely to have informed perspectives that could be used as starting points for wider conversations. These people represented a small cohort of the wide range of stakeholders working at multiple levels across different industries and communities who may also have made important contributions to conversations about education had they been contacted. Further, the view that education is a separate concern to other aspects of work and life in the technological age is one of the issues that participants challenged. It is recognised that this project might seem to create artificial boundaries by focussing on education per se and in particular by capturing complex dynamics into models that reflect the perspectives of those interviewed. It is argued however that the models open up for wider debate the application of NBN in a broad range of other societal contexts. The report of the project (Stack, Watson, & Abbott-Chapman, 2011) gives a more detailed and more nuanced analysis of the dynamics than can be discussed here.

# Results

## An overview of findings

Interview conversations revealed that interviewees had only moderate information about the specifics of the NBN as they related to their sphere of operation. They were keen to find out more, and to explore the implications for education with other interviewees. Although Tasmania is a small state, it appeared that people were often isolated within their organizations as well as from other educational organizations, operating in "knowledge silos," despite the "conceptualisation of learning as informal, connection-based and ICT enhanced networking" (McWilliam, 2008, p. 154), which the affordances of the NBN were designed to promote. It appeared that those engaged in the pedagogy and those providing the supporting technology and infrastructure operated across a divide, especially in terms of where decisions were being made and what was informing them.

The interviews also revealed different perspectives and different ways of framing issues. Some interviewees suggested that a solution to poor school connectivity was to provide a whole-of-education network to support learning, whereas others framed the issue as a need for "end-to-end performance" that may involve other solutions. Still others wondered why education remained within a paradigm where the institutions are responsible for the ICT provision when the potential for future connectivity networks centres on personal learning through individual devices connected to a public network.

Some people seemed more interested in exploring new learning technologies and products and their affordances for learning, while others were more person-centric, imagining the seamless experiences of students, teachers and parents where education was only one part of the story. Some framed the issues in terms of systems thinking (networks, infrastructure, delivery models, and adaptive cycles), while others framed it in terms of moving to new cultures. It seemed that there were multiple languages being spoken, a variety of conceptual starting points, multiple perspectives, and very different desired end points. These are depicted through the causal layer analysis presented below, with an introduction to some of the key frameworks used as heuristic devices with stakeholders.

## What are the issues? (from the issues layer)

A range of issues emerged directly from the opinions of the interviewees in the interviews and reported in the wiki. They are extracted and summarised from the full report (Stack et al., 2011). It should be noted that these were current for 2011.

*Connectivity.*
Lack of connectivity for many educational institutions prevents engagement with current demands for e-learning quite apart from high bandwidth applications such as video conferencing, immersive worlds, data set visualisation and manipulation and remote experimentation. In the case of public institutions (schools, colleges, polytechnic, libraries, and adult education) barriers to connectivity include budget constraints to reduce the cost of access to the Internet, limited bandwidth connection, filtering/security issues and the contractual arrangements of being part of the whole of government network. Creating connectivity for Tasmanian learners is complex, not just related to technology, and needs to consider whether existing paradigms of institutional provision are the optimum for the future. Figure 2 provides a schematic overview of the internet capabilities for Tasmanian education systems in 2010/2011, with state schools operating within the Tasmanian Public Service, the University and some independent schools using AARNet or other individual arrangements. Although the NBN might be an option for schools in providing high speed bandwidth it does not solve the cost constraints or other issues. How might a system be created where teachers and students can enjoy the affordances of high bandwidth e-learning?

*Digital divides*
There is an increasing digital divide between home and school, between public and private schools, and between those who use technology and those who do not. Although public schools are experiencing e-learning restrictions, most students at home can currently access the equivalent bandwidth of an entire school. Private schools are beginning to connect to AARNet, the high speed bandwidth network for the university sector based on a subscription per student model, giving unprecedented connectivity as well as access to high quality educational learning technologies and networks. Meanwhile there are still many people who are not engaging with the digital revolution and there are likely to be increasing economic and participation gaps between the connected and disconnected. Digital access needs to be supported by development of digital media literacy to deal with the challenges of the new participatory, media-oriented culture. What are the options that enable all students to experience connected learning?

*Relevance of schools*
The relevance of the current role and organisation of schools is being challenged as a result of students having access from home to high quality open courses, engaging interactive learning technologies and networking to communities of interest. There are likely to be new roles for schools in the future, with increased "importance of opening up schooling both literally and figuratively as spaces in which multiple forms of engagement are not just possible but also desirable" (McWilliam, 2008, p. 156). A number of interviewees speculated about the changing roles of teachers and learners as co-creators of knowledge, and the impact on curriculum, pedagogy and inclusivity. Virtual learning provides the opportunity to reimagine the nature of schools as part of the "big picture" linked with other knowledge sharing and

creating "learning hubs." The divide between school, work and life is likely to become less and less. How might education leaders engage students, teachers, parents, business and the community in conversations about the future of learning in a connected world?
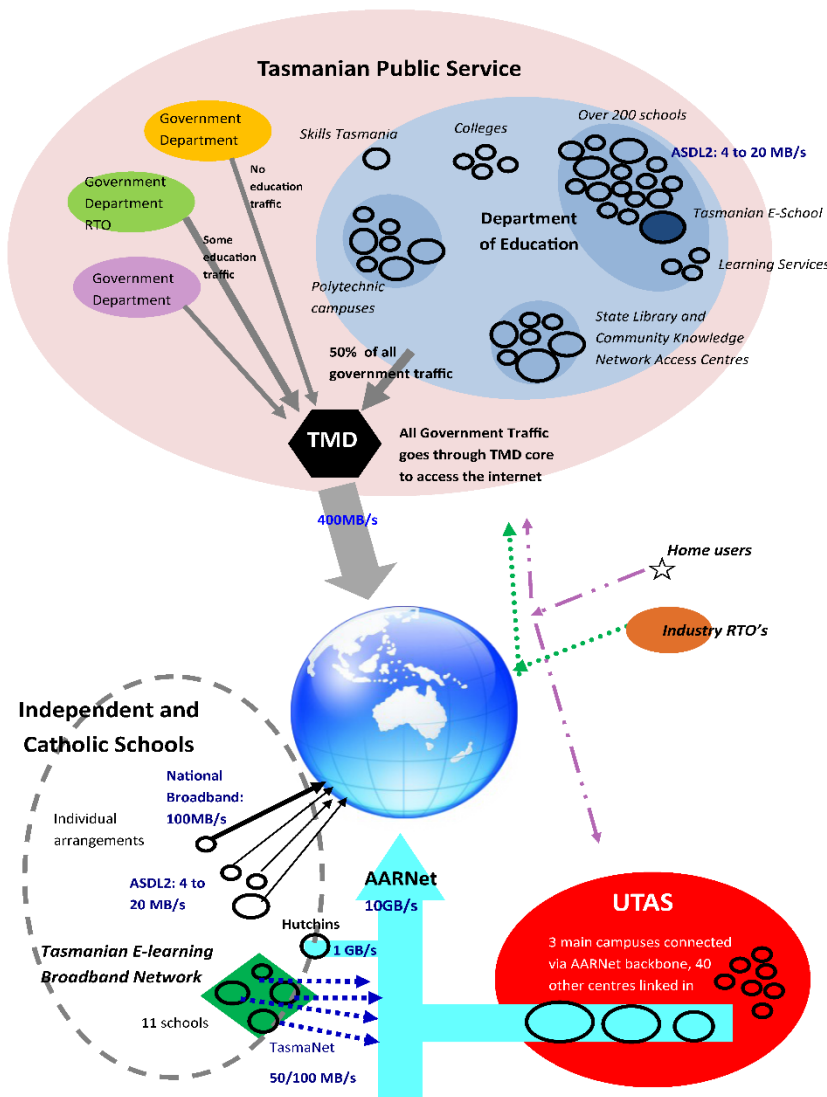


*Figure 2*. Connectivity for education in Tasmania in 2010/2011.

*Innovation*
It is important to support innovation of learning spheres, technologies and pedagogies through technology support, policy and funding. Innovation in e-learning has put institutions in an excellent position to take advantage of high speed broadband but these need to be strategically supported to utilise future developments and opportunities with technology. Innovation in ideas, visions and problem solving need to be better matched with technological innovation for the opportunities that the NBN offers to be seized. Innovative individuals need to be supported by innovative systems. *How might systems and policy support innovation that acts to vitalise the whole system?*

*Scaling up*
Educators already know many of the educational affordances of high speed bandwidth. e-learning is far more than just using interactive technologies to engage students within their accustomed milieu; it can deliberately enhance development, learning and citizenship. The challenge is scaling up in vision as well as technology. This requires connectivity solutions and technological support, as well as support for

cultural change in teaching and learning practices. How might the education sector effectively scale up while still enabling diversity and being mindful of teachers' needs?

*Cross-sector e-learning strategy*
There is no current cross-sector state-wide strategy for e-learning in Tasmania, though it has been on the drawing board at various times. Although individual institutions have their own forward looking e-learning plans, based on preferred frameworks (such as the International Society for Technology in Education (ISTE), DER funding proposals or the Balanced Scorecard approach (Kaplan & Norton, 1996)), the relative lack of an overall co-ordinated approach for a whole-of-education network means that ways of managing open resources, encouraging innovation, collaborating between institutions, and identifying and addressing common issues are as yet embryonic. In times of increasing economic stringency the need to avoid duplication of ideas, initiatives, effort and organisation has become imperative, yet the cross-cultural issues and values are impeding progress. How might educators develop a collaborative cross educational sector vision/strategy for e-learning?

## What are the key perspectives? (from the social analysis layer)

The perspectives model (Figure 3), a key heuristic, depicts seven standpoint perspectives that emerged from the syntheses of information from the interviews. The perspectives are expanded in terms of questions reflecting the dilemmas raised by participants.

*Educational vision*
What are the underpinning philosophies of education (such as one-child-at-a-time policy) in different institutions? Is there alignment between vision and provision within institutions? How might educational philosophies and their supporting technologies align with the nature of a connected learner: someone who requires open access, is always connected, expects personalised learning, is looking for wholeness and immersive experiences, and contributes as an active citizen? Can virtual learning enable educators to re-imagine schooling and "always on" learning in the wider community?

*Inclusion*
How might inclusion be re-conceptualised, discarding the old paradigm of disadvantaged "equity groups" that label and stigmatise, and moving to an individual learning needs entitlement and contribution policy that links with the educational vision stated above? How can fair e-learning be ensured for all, particularly in regional areas? Although institutions have inclusion policies for those that "attend" a learning centre, a key challenge is to engage with those who are not part of formal learning, or who are not "connected." How might education build literacy, digital literacy and digital citizenship learning opportunities for all? How might the NBN encourage institutional responsiveness to students' learning needs and learner resilience, especially students disadvantaged by vertical or horizontal stratification of opportunities (Abbott-Chapman, 2011)? How can the valuable aspects of local "place" attachment and identity be preserved while putting students at the centre of global borderless learning networks (Stewart & Abbott-Chapman, 2011)?

*Pedagogy*
What are the affordances of new learning technologies? What is their impact on pedagogy? Many of the new learning technologies involve teachers moving from teacher-directed pedagogies to student-centred ones, requiring shifts in practice and roles, and change in teaching and learning culture. How might teachers' professional learning convey the affordances of technologies in a way that connects deeply to what they value as teachers?

*Professional learning*
What professional learning is needed to assist teachers, educators, managers, technologists and policy makers to understand the potential challenges and benefits of maximising affordances of the new technologies? How might understanding of adoption patterns assist in thinking about this? How might cultural change across sectors be supported coherently? How might collaborative agility in development of e-learning capacities be developed?
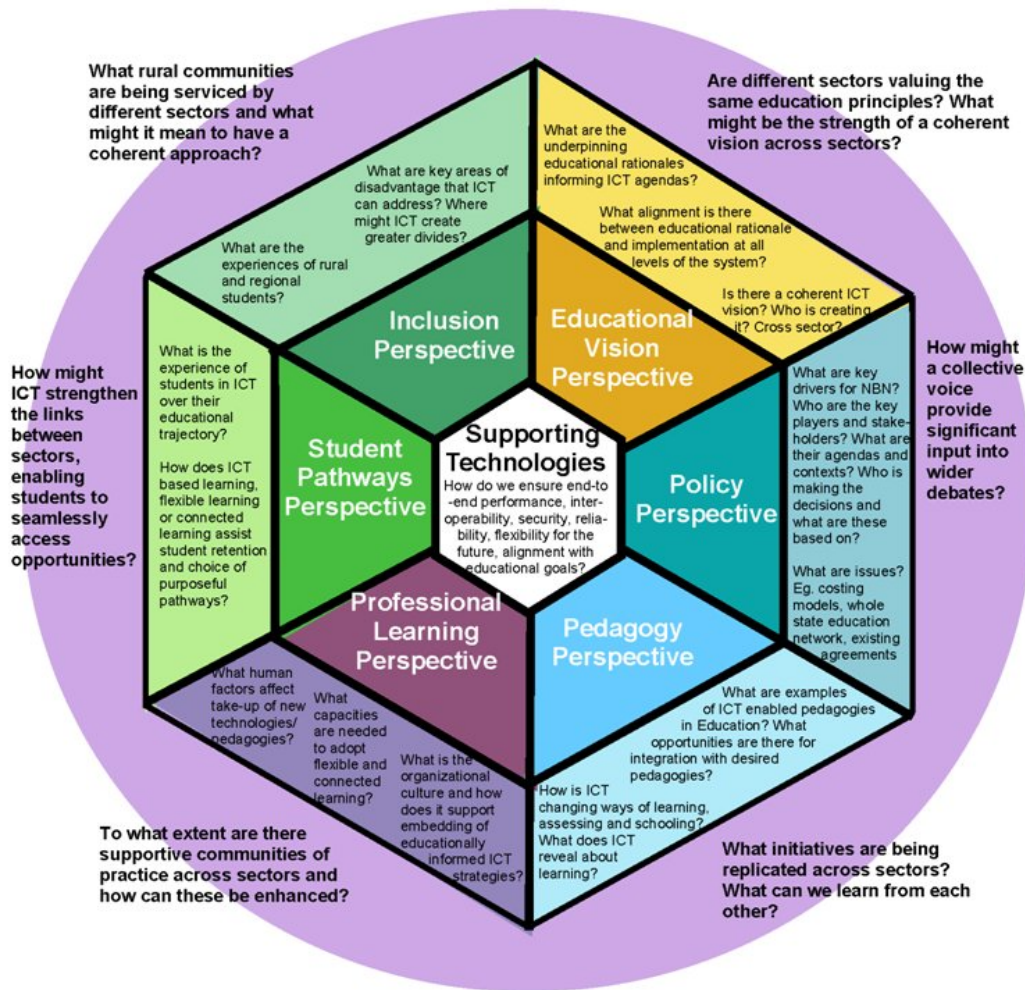
*Figure 3*. Seven perspectives of NBN in education.

*Student pathways*
How might the different educational philosophies of different organisations shape the technology experiences of students at these institutions? How might technology encourage or hinder movement between institutions? What is the portability of student work?

*Policy*
Who is making ICT and e-learning decisions and what is informing the decision-making? Who has the mandate for working in this area? What are the policy contexts and how might they enhance or hinder? What infrastructure might support a more co-ordinated approach?

*Supporting technology*
What is needed in terms of provision of or access to networking, bandwidth, learning platforms and applications to support pedagogy, inclusion, educational vision, professional learning and student participation, as discussed above? High bandwidth speeds provide many technological solutions enabling far more cloud management; the challenge is, how will this enable access to high bandwidth providing end-to-end performance?

Most of the interviewees only represented one or two perspectives, though one person worked across all. The model's usefulness for participants included the following.

- It illuminated some key perspectives that were considered important by the different participants in decision-making around the NBN and e-learning, providing a reflection of their experiences.
- It helped the participants see that there were broader perspectives that they may not have considered, and provided an inclusive place where this range of perspectives could be valued, recognising that some were in tension.
- It enabled interviewees to identify where the decision-making around connectivity issues was being primarily made. This appeared to be located in the Supporting Technology and Policy perspectives involving ICT leaders and Finance people based on cost and practicality rather than e-learning or learning leaders based on learning affordances.
- It provided a shared mental model that participants could use to explain the tensions, the inter-relatedness and their own stories.
- Some participants used it to create conversations around e-learning in their own organisations.
- It provided a starting point to ask what is missing and what is not being seen when shaping the issues as perspectives in this way.

## What are underpinning values? (from the worldview layer)

The values model (Table 4), another key heuristic, explicates a spectrum of operating cultures, motivations and values in the e-learning arena, such as those discussed above, based on the interviews and drawing from an existing Spiral Dynamics framework (Beck & Cowen, 1996).

The idea for using this framework emerged from one of the later interviews with an ICT resources manager whose interview seemed to progress through these different value systems, naming multiple and often competing values under which he was trying to operate and where, if given enough time, he would like to operate in the future. Stack (2010) mapped a number of ICT issues against this values framework, considering perspectives of students, teachers and system support. Although the values framework was exploratory it provided a useful heuristic device to reflect upon the underpinning values behind certain ways of framing issues, policies or actions.

The key to understanding the model in Table 4 is the notion that multiple value cultures co-exist. Each can be expressed positively or negatively. To enable the vitality of the whole system a healthy expression of each value culture is needed, rather than collapsing to one value culture. It is this diversity that builds a more resilient system and it was evident across the interviews.

The participants were tuned into different value cultures as a result of their roles, and found it difficult to reconcile some agendas coming from other value cultures. In the education arena there was a suggestion that certain value cultures and approaches (particularly the order and corporate value cultures) were colonising others, causing unhealthy reactions and potential conflict. A people oriented approach to teaching that valued relationships, meaning and processes could at times, for example, be at odds with a corporate model requiring measurable products, set teaching plans and performance indicators, in a climate of performativity (Lingard, 2010).

The centralisation of technology support (order value culture) was felt by the participants on one hand to provide efficiency through uniformity yet on the other hand could impact on the ability of individual campuses or schools to respond to local needs or issues. While central education administrations are still grappling with financial and organisational constraints associated with setting up new networks, in some places the interpersonal learning situation is actually moving ahead unplanned. An increasing number of teachers and students are being introduced into e-learning through social media. What is attracting teachers is not necessarily being able to put courses online, but rather being able to engage with students in online learning communities – facilitated through Facebook groups, or the e-folio community network. In many classes most students already have a Facebook account and are users, hence it is easy to make them part of a class learning group. The teachers are enthusiastic and cloud solutions, easily controlled by the actual teacher, and not centrally managed, are a successful and creative entry point. If teachers want something more they can move to the Mahara (cloud) e-folio system. Such an e-learning solution is in contradiction to the setting up of a centrally controlled, closed system. McWilliam (2008) highlights the

tensions involved in moving from a "supply side, provider obsessed culture" to "demand-side thinking focussed on learning as a social and networked practice" when she states, "At the very time when openness and experiment are being widely acknowledged as optimal conditions for 21st century learning, policy makers seem to be intent on nailing everything to the floor" (pp. 74-75).

Table 4
*Cultures, motivations and values for e-learners and their defining characteristics*

| | |
|---|---|
| Survival – reliable access, online safety, time to complete tasks, basic ICT needs, resilience, digital literacies – *Innovation born out of necessity*. | How to ensure connectivity for all? |
| Tribal – different groups with different milieus, languages and values; traditional or habitual ways of operating; legacies of the past; urban myths; conformity to a group; sense of belonging and culture; learning communities – *Innovation to belong*. | How to take account of different groups and benefit from the power of groups? |
| Break-out – drive, passion, energy for change, exploration, play and creativity, re-mix, risk-taking; recognition of previous assumptions and limitations; spontaneous, bold, opportunism that may become irresponsible risk-taking or power play – *Innovation for playfulness or to break down barriers*. | How to encourage vitality of expression? |
| Order – centralisation; control, one solution, coherence, standards, interoperability, structures; body of knowledge; factory model of schooling; system over individual – *Innovation in system solutions (policy, infrastructure)*. | Where to most effectively provide central coherence? |
| Corporate – strategic planning, productivity, value for money, responding to clients' needs; evidence based; self-directed, achievement oriented, entrepreneurial, meta-cognition of self and organizational processes; applied learning, problem solving; team work, task or product oriented – *Innovation to find points of advantage*. | How to enable prosperity and individual empowerment? |
| People Oriented – caring, sharing, listening; diversity, plurality, inclusion; deep relationships, being ethical, building social capital; making meaning together, deep understanding; enabling voice and agency; self-aware, discerning; critical of disempowering structures, practices and relationships; critical literacy, postmodern perspectives*; processes – *Innovation for social change*. | How to create cultures of care, support social justice and develop global citizenship? |
| Integral – agile, adaptive, reflexive, dialectical; system-aware, trans-disciplinary, understanding complexity and underpinning paradigms; looks at unique contribution to whole; presencing, turning points; insight, social foresight – *Innovation in sustainable transformation*. | How to understand and ensure the health of the whole system? |
| Holistic – deep connection to the world and the universe; wise action for living in the world; drawing on many ways of knowing and being; visionary, expanding consciousness; awe and wonder, fulfilment, happiness – *Innovation of new imaginaries*. | How to connect deeply and contribute to the potential of the whole e-learning environment? |

There was also felt, however, to be a significant role for central bodies to guide implementation of ICT providing a more systemic approach. The *Australian Flexible Learning Framework* (http://www.flexiblelearning.net.au/), for example, for vocational education had addressed many of the value cultures by:

- providing funding (survival) and professional learning to support teacher champions to innovate and *break-out* from existing teaching cultures and build capacity within their organizations;
- establishing learning communities (tribal);
- creating strategies for corporate leaders to use in supporting innovation;
- developing standards to build inter-operability of systems (order); and
- providing an online learning resource repository for teachers to share and re-mix resources (order).

Many of participants found the values framework very useful and recommended that it be used in strategic planning as well as helping to communicate to others the various affordances that e-learning might enable. The danger of using models and frameworks, however, is that important understandings or questions might be missed because they do not quite fit the model (Edwards, 2009). The models are a visual tool or lens to help people map greater wholes, while providing some coherence to issues that may be initially too complex to make sense of. They provide temporary scaffolding to a more nuanced understanding.

## The forum (from the visioning layer)

The one-day forum was designed in collaboration with three participants. Ten of the original interviewees were able to participate and a further 12 people represented the different perspectives. The intention was to build a deep understanding of the issues through using the models from the social analysis and worldview layers (Table 3) to illuminate the issues, helping people to reframe the way that they might be seeing the issues, and then to move into a more visionary space to imagine the future. The architecture for the forum (http://www.authorstream.com/Presentation/regor2012-710228-tas-nbn-forum/) included the following.

- Framing of the problem as a wicked or complex problem. The Cynefin framework (Snowden 2002) was used to help participants understand how identifying the problem as either simple or complicated, rather than complex can lead to actions that might be naive. Treating it as complex requires approaches that are more reflective of the frames that are brought to the problem, and more alert to the probes and indicators across the system. This was important framing for the introduction of the different models and agonistic processes.
- Providing opportunities for people to reflect in small groups on their current issues and situate these within the perspective model, developing an appreciation for the range of perspectives. It enabled each person to see beyond the constraints of organisation and resourcing to a greater understanding of the whole. It also acted to diffuse potential tensions springing from different viewpoints and values.
- Constructing a larger narrative of some of the issues and the dynamic relationship among them, where key leaders could provide part of the story, enabling a sense of coherence and a greater appreciation of the complex interactivity. These began to make evident the complex interweaving of issues and enabled dialogue that sought to understand the dynamics.
- Providing an introduction to policy contexts, information about high speed broadband options and opportunities (AARNet versus NBN), and a brief look at future trends (e.g., KnowledgeWorks, 2009; New Media Consortium, 2010) and what other broadband enabled countries are doing (e.g., Office of Communications, 2009).
- Naming up the different mental models and values framework, and providing opportunity to relate the issues back to the values framework.
- Providing an opportunity for sharing imaginative possibilities and looking for ways forward.

The forum was welcomed by the participants as an opportunity to think expansively and deeply about the issues. The analysis had provided a base where people could value different approaches because their differences were already acknowledged as a necessary part of a bigger whole.

A key element that grounded the discussion was being able to discuss what was valued in terms of educational outcomes for students. Participants provided many inspiring stories of what their students were able to do with new technologies and in some cases, such as The Hutchins School, with high speed bandwidth. Rather than just speaking in terms of technologies – such as E-portfolios, virtual worlds, YouTube videos, serious online games, online storage, video conferencing, and cloud-sourced applications – the conversations were more linked to what students gained from these. Early in the day a spectrum of educational affordances was presented, which had been created from the values framework (Table 4):

- enabling safe access and use (e.g., digital literacies);
- helping students to connect to different learning communities;
- expressing passion and creativity, taking risks, innovating;
- sharing collective knowledge;
- contributing productively to the world of work and the development of work related skills,
- developing empathy, social justice, self-understanding, critical inquiry;
- seeing and contributing to higher perspectives of the whole; and
- relating profoundly to the universe, planet and humanity.

This range of values was very useful in helping people to situate their stories within different value cultures, although acknowledging that other people might be focussing on others. It was realised by the group that it was difficult to articulate explicitly these values in a coherent way; the values needed to be embedded within policy frameworks and be used in helping teachers understand the potential of learning technologies. Often values were left out in pragmatic strategies or policy documents. It was a significant realisation by the group that behind every inspiring story was something that they valued, that energised, and enabled them to imagine. By making this explicit it gave an opportunity to plan and encourage deliberately in a way that continues to inspire.

The participants recommended a number of strategies to take forward from the forum, including:

- advocating the need for greater connectivity in education;
- communicating for cultural change in teaching and learning, aiming to change values in this arena, encouraging re-imagining the role and purpose of schools;
- networking across sectors and education providers, including facilitating working parties that look at common issues and the provision of a cross-sector e-learning person responsible for driving a coordinated approach;
- using thinking tools such as the perspectives and values models to assist strategic planning; and
- developing a Tasmanian approach to open education resources, and better ways of sharing resources across sectors.

Although the forum was highly successful in creating an opportunity for sharing within a big picture framework, there was insufficient time to move into a truly visionary space where the group could collectively create and explore potential futures as was intended using the causal layered methodology. The forum enabled sharing deep understandings and re-framing the issues, enabled dialogue that revealed the deeper dynamics, and enabled appreciation of explicating and designing around values. It was clear, however, that more collective time was needed to imagine connected possibilities without falling back into old ways of thinking, doing and envisioning the future once back in the usual work climate. The group might have benefitted, for example, with a follow-up session exploring and developing a range of future scenarios that they could then use with their own stakeholders.

## Discussion

When the project began it was intended to initiate a dialogue on the implications of the NBN for education in Tasmania. In this it was successful but it rapidly took on a much broader scope, providing an opportunity for participants to reflect on where e-learning is now, what is valued about it, what it is delivering, what it is not delivering, and what might be the challenges for the future. These questions go beyond the impact of the NBN and are similar in many ways to the issues raised by Buchanan (2011) for the DER. In framing the problem as a wicked problem, and deriving from the data heuristic models as

springboards for thought and action, participants were enabled to explore diverse perspectives and cope with possible tensions, encouraging them to engage in wider conversations and decision-making and stretching the boundaries of their own learning and learning networks.

By creating a situation of trust between the researchers and interviewees the participants were also enabled to surmount existing institutional and cultural barriers to shared thinking and problem solving with the prospect of the development of shared visions of e-learning futures. The process employed, including the use of the wiki, engaged key stakeholders at each stage of the project as research partners and knowledge creators within complex learning networks. These overcame hierarchies and encouraged collegial capacity building. This resulted in an ownership of the issue and a desire for people to move it forward collaboratively, as well as individually within their own institutions. Some people were, however, restricted by a lack of mandate within their organizations allowing them to be involved in a cross-sector conversation, or by a lack of recognition that innovation was more than a technological solution. Economic constraints also restricted the power to move in new directions. Pruitt and Waddell (2005) suggest key roles for those dealing with complex problems at a governance level: bridging adversarial positions, brokering resources and activities, building learning communities, building consensus, promoting cross-sector collaboration, strengthening actors (to play a role in system transformation), and building systemic awareness among actors. E-learning leaders in particular are important bridges among ICT, corporate hierarchy, teachers and the community. The resilience of the system in coping with wicked problems relies on leaders' own resilience in climates of organisational change and uncertainty and this in part is helped by strong collegial networks and the opportunity to cut across hierarchies. Coyne (2005) argues that in fast changing societies the wickedness of problems is not "aberrant" but inherent in professional "operationalisation of an intellectual position," and that in bridging competing discourses "talking is a mode of action" (p. 15).

The researchers' role in this milieu became one of building systemic awareness amongst key ICT and e-learning leaders, and in some cases strengthening them to play a more active role in system transformation. Although able to initiate opportunities for participants to rethink the issues, in moving towards practical problem solving, the role of the researchers could not be sustained. All institutions and organisations in concert with others must come to their own solutions and their own ways of re-imaging education, creating forward-thinking policies, engaging stakeholders at every level, increasing funding for research in this area, and using social network and media oriented approaches in reframing students' learning (Searson, Jones, & Wold, 2011). The models presented in this paper are not applicable only to Tasmania but to other groups in Australia who are considering issues associated with connectivity, e-learning and the future of schooling. The perspectives model can be used to engage a diverse range of people in discussions around e-learning, even if they do not consider it their special area. This model requires technology to be contextualised within the wider socio-political and educational context, with all the complexity of factors this implies. Using agonistic processes (Frame, 2008) ensures the diversity of perspectives is valued rather than seen as a stumbling block and helps to create novel ways to assess and deal with the issues.

The values model, particularly the condensed spectrum of affordances, provides the opportunity to vitalise conversation, reminding people of the core values that underpin the education that they hold dear and enabling them to articulate and share these values with others. The model can act as a powerful explanatory device for understanding where energy in a system is centred, and how different value cultures might be used positively and collaboratively to channel that energy towards the achievement of new solutions to persistently wicked problems. The purpose of these models, however, is as a heuristic device to open up conversation not close it down. The models should be modified or discarded as part of building ownership of meaning-making between stakeholders.

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