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Converging technologies:

the implications for vocational and workplace educators

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Abstract:

The convergence of information, communications and biological technologies has become a key global issue for countries across the world. Manifestations of this convergence are evident in the growth in the use of the Internet, e-commerce, on-line services, interactive broadcasting, and interactive multimedia entertainment and education. For vocational and workplace educators in Australia and New Zealand, these trends have major implications for what needs to be learned in vocational education and training, as well as how it is learned. The trends are impacting significantly on the roles of vocational educators and workplace trainers. The paper discusses the nature of the trends, their impact on VET curriculum and instruction methods and the likely impact on the functions and required skills and knowledge of VET educators and trainers. It identifies relevant existing research on the topic and also the scope for future research. The author draws upon his experience in reviewing the impact on VET curriculum of the growth in e-commerce, on-line services, interactive multimedia and the general convergence of technologies; as well as the results of his postgraduate research work on the way workplace communities deal with new situations and change.

Introduction

The rapid development of information technologies and telecommunications in recent years is impacting on all industries and vocational occupations. Computers are becoming an integral part of most equipment. The increasing speed and memory capacity of computing technology, the improved bandwidth and switching capacity of telecommunications networks, the increased capacity and retrieval speed of storage devices and opportunities that have been made available for more user-friendly interfaces are all contributing to opportunities for new integrated services and products limited only by one's imagination. Reports in the media and elsewhere confirm that e-commerce, email and the Internet are increasingly becoming integral components of the work of most industries and occupations. The digitisation of broadcast media is expected to lead to a new interactive services that will involve the integration of IT, telecommunications, broadcasting and a range of other technologies. On-line and multimedia technologies are now being applied to a growing number of key industry areas such as: retailing, entertainment, real estate, banking, training, gambling, newspapers and TV news bulletins, etc.

The convergence of these info-technologies with bio-technology is yielding even more extraordinary possibilities that are likely to influence our lives in the immediate and short term future. A recent special edition of *Scientific American* canvassed the emergent possibilities of this convergence. Zorphette and Ezzell (1999, p. 4) in their introduction paint a picture of cloned human beings, food that has been tailored to counteract ailments, virtual reality as an integral part of occupations and community life, and an increasing merging of mind and machine. The subsequent articles in the popular science magazine portray a bizarre, fantastic world that would appear unbelievable but for the evidence of actual incredible advances of convergent technologies in recent years and the correlation of the content of these popularist articles with more serious projections of the convergence and the potential impact of info- and bio- technologies. In 1995, ASTEC published a report looking at the likely future developments in telecommunications technology. The project team which produced the report undertook a detailed scenario analysis in which researchers produced a chronological projection of likely info-technology developments over the twenty five year

period from 1995 (ASTEC, 1995). In the five years since the report was released, many of the projected developments are already being realised well in advance of their projected date. The project team forecasted that, by the year 2020, implanted IT chips will be used to enable direct interaction and communication between human beings and info-technology systems. Recent reports in the media describe advanced experiments in the United States in which implanted microchips are already being used to allow the brain to directly control computer functions. The rate of change in info-technology is accelerating apace and the evidence is that with the imminent advent of broader-band, faster communications systems and the use of interactive, digital television as the new focus of interface with the world wide web, e-commerce, entertainment and education, our vocational and community lives are about to be changed in major and far-reaching ways.

Kenway (1996), Goodenow (1996) and others have drawn attention to the potential impact of converging technologies on our lives. They point to the need for educationalists to better prepare students in schools and post-school learning for the impact on their lives of social and technical aspects of the technologies. This includes work, leisure, health, lifestyles and national and cultural identities and social relationships. Kenway suggests that we must do more than just teach students about **how to use** technologies. We must teach them **about** the technologies and the way they **affect** our economic, social and cultural lives. Goodenow notes that educators in the future will need to have a more interdisciplinary base of skills and knowledge spanning many different professional and occupational areas in order to meet the challenges of the new network environment being spawned by the convergence of technologies.

Effects on occupations and VET

Probably one of the most significant implications of the convergence of technologies is its impact on occupations and vocational education and training. The convergence of technologies is leading to convergence of occupations. Many occupations that were previously very different from each other are increasingly sharing common components related to info-technology. Whether you're a plumber, a librarian, a farmer, a truck driver, a banker, an engineering technician, a nurse, or a shop assistant, you are increasingly using elements of info-technology. It may be a PC, a mobile phone, computer-controlled systems, or integrated computing technology where computer processors and/or communications devices have been designed into equipment used on a day-to-day basis. This is having a significant effect on all occupations. Many occupations that previously had a reasonably stable set of skills and knowledge are now being drawn into the cycles of rapid change that characterise info-technology. For example, truck drivers need to understand and use equipment involving a range of info-technology such as global positioning systems, mobile phones, and on-board computers to communicate with base for scheduling, control and a range of operational functions. Micro-processors within the vehicles control a range of truck functions from emission control, engine efficiency, navigation and the processor control of auxiliary truck equipment such as craneage, refrigeration systems, etc. A similar picture of info-technology integration can be painted for every occupation. Because they are increasingly locked into the use of the ephemeral and rapidly-changing converging technologies, all occupations now tend to also be subject to similar rates of constant, continuous change. The challenge for school, VET and university educators is how to prepare people for occupations when the technology in those occupations is being constantly upgraded often in cycles that are less than the length of the vocational courses concerned. In most cases, two generations of upgraded technology have been introduced into an occupation within the 'lifetime' of the vocational courses preparing people for that occupation.

Implications for curriculum and competency standards

Given this background, there are several ways in which educators and educational systems can respond to the challenge of converging technologies

1. Content of school and post school curricula as they relate to the overall effects of converging technologies on society and the economy

School and post school curricula should include components that promote a better understanding of converging technologies and how they are affecting society, the economy and our daily lives. The curricula should seek to promote critical thinking and reflection on the effects of converging technologies on society generally, and people in particular. Learners should be made aware of the choices they have and the ways they can take more control of the way technologies impact on their lives.

2. Content of the VET Training Packages and curricula as they relate to the application of converging technologies to work and occupations

School and post school VET Training Packages and curriculum need to reflect the way in which occupations are being affected by converging technologies. This should include the dynamic nature of their effects on occupations and the resultant need for people throughout their lives to update and adapt their skills and knowledge as successive generations of converging technologies change the nature of their workplaces and occupations. We will be not so much preparing people to '**do**' things in their future careers but rather to '**adapt**'. By the time an average trainee in almost any occupation graduates and obtains a job in the world of work, the technologies involved will probably be different from that which they studied in their course. They will need to be able to adjust and adapt what they learnt in their course to the new situation

3. Skills and knowledge of students to use converging technologies when learning

Another effect of converging technologies in the new millennium will be changes to the way students learn. Many more options will be available because of the revolutions about to occur in info-technology. Broadband communications, interactive digital television and further development of computing and internet technologies will enable modes of learning that will challenge traditional learning environments. As the efficacy, efficiency and user-friendliness of interactive on-line and CD-ROM options improve so too will the extent of application of them to education and training. This in turn will create a need to assist learners to exploit the new opportunities. Students will need to learn how to learn with the new technological options.

4. Skills, knowledge and attitudes of trainers and teachers when teaching and assessing subjects involving aspects of converging technologies

Trainers and teachers will find that they will need to have a better understanding of converging technologies to be able to teach vocational courses and to assess students and trainees in areas that are affected by technologies. This includes a 'dynamic' real-time tracking of the effects of converging technologies as they progressively affect occupations and related required skills and knowledge. Teachers, trainers, assessors and course designers will be required to adapt their own knowledge on an ongoing basis. They themselves will need to be adaptive.

5. Instructional methods that exploit converging technologies

Converging technologies open up opportunities for their use within innovative instruction methods using advances such as interactive television, interactive multimedia, distance education by the internet, provision of resources and information through on-line databases, virtual classrooms, remote workplace simulation, and virtual classes that may use combinations of chatrooms, videoconferencing, on-demand multimedia, voicemail, real-time audio, and email communications. These alternatives will tend to complement existing classroom, workshop, laboratory and distance education methods to provide unheard of potential flexibility in instruction and learning methods.

6. The skills, knowledge and attitudes of adaptation

Central to many of the above implications and potential impacts of converging technology on vocational education and training will be the need for all persons involved, i.e. students, trainees, teachers, trainers, assessors and course designers, to be able to '**adapt**'. Over the past three years I have been engaged in a qualitative doctoral research study of how workers and managers in four workplace communities adapt and deal with change. Given the findings of this research, I believe there is a growing need for educators and trainers to focus on the skills, knowledge and attitudes needed for effective 'adaptation' to change. In the following section of the paper, I briefly discuss these findings.

Knowing, doing and adapting

Vocational education and training systems (VET) have long focused the importance of 'knowing' and 'doing'. While there has been much debate over what types and specific forms of knowledge is needed and how required skills should be defined, the dynamic changes of converging technologies that are increasingly embedded in all occupations are shifting the focus of educational need to be more inclusive of the knowledge and skills of '**adaptation**', i.e. how workers adjust and adapt their previously learnt knowledge and skills to new equipment, workplace activities and ways of working that probably were not even conceived of at the time of their original education and training. What are the skills and knowledge that help people to adapt their previously learnt skills and knowledge to the new work contexts being created through the ongoing implementation of converging technologies? Rumsey (1997, 1999) has studied the way in which workers in four workplace communities deal with change. In a qualitative, ethnographic, case-study research project, Rumsey has found that while it is important to establish a sound and appropriate foundation of propositional and procedural knowledge and technical skills to deal with change, this alone appears not to be sufficient. The technical skills need to be supported by people and metacognitive or thinking skills, i.e. reflection, interpretation, analysis, problem solving, etc. Similarly, the propositional and procedural knowledge must be complemented by appropriate dispositional, people and strategic knowledge. He found that people who were good at dealing with change in his study had well-developed people networking skills and used a range of coping strategies. They also were adept at managing their attitudes, cultivating positive attitudes and countering negative attitudes. These are summarised in Figure 1 on the following page. Rumsey noted that 'good adapters' to change know and deal change in a combination of three ways, (1) utilitarian or task-focused, (2) communicative or people-focused and (3) reflective or self-focused. Table 1 is a summary of his observations on the ways the 'good adapters' in his research know and handle change and new situations.

Table 1 Ways of knowing or learning about how to deal with change

<p>Instrumental <i>(Focus on tasks)</i></p>	<p>Communicative or collaborative <i>(Focus on others)</i></p>	<p>Reflective <i>(Focus on self)</i></p>
<ul style="list-style-type: none"> • Observing workplace operations of others • Sourcing information about the change • Analysing information about the change • Experimenting • Solving task-specific problems • Clarifying procedures and facts • Task-focused training 	<ul style="list-style-type: none"> • Networking with other people • Informal and formal learning from others i.e. trainers, supervisors, peers and associates • Mentoring • Modelling • Buddy systems • Questioning others • Seeking advice and support from others 	<ul style="list-style-type: none"> • Reflecting on own history and experience • Reflecting on own emotions and attitudes • Reflecting on own power situation within the workplace community and organisation • Reflecting on ,and interpreting, the implications of change for self (what if scenarios)

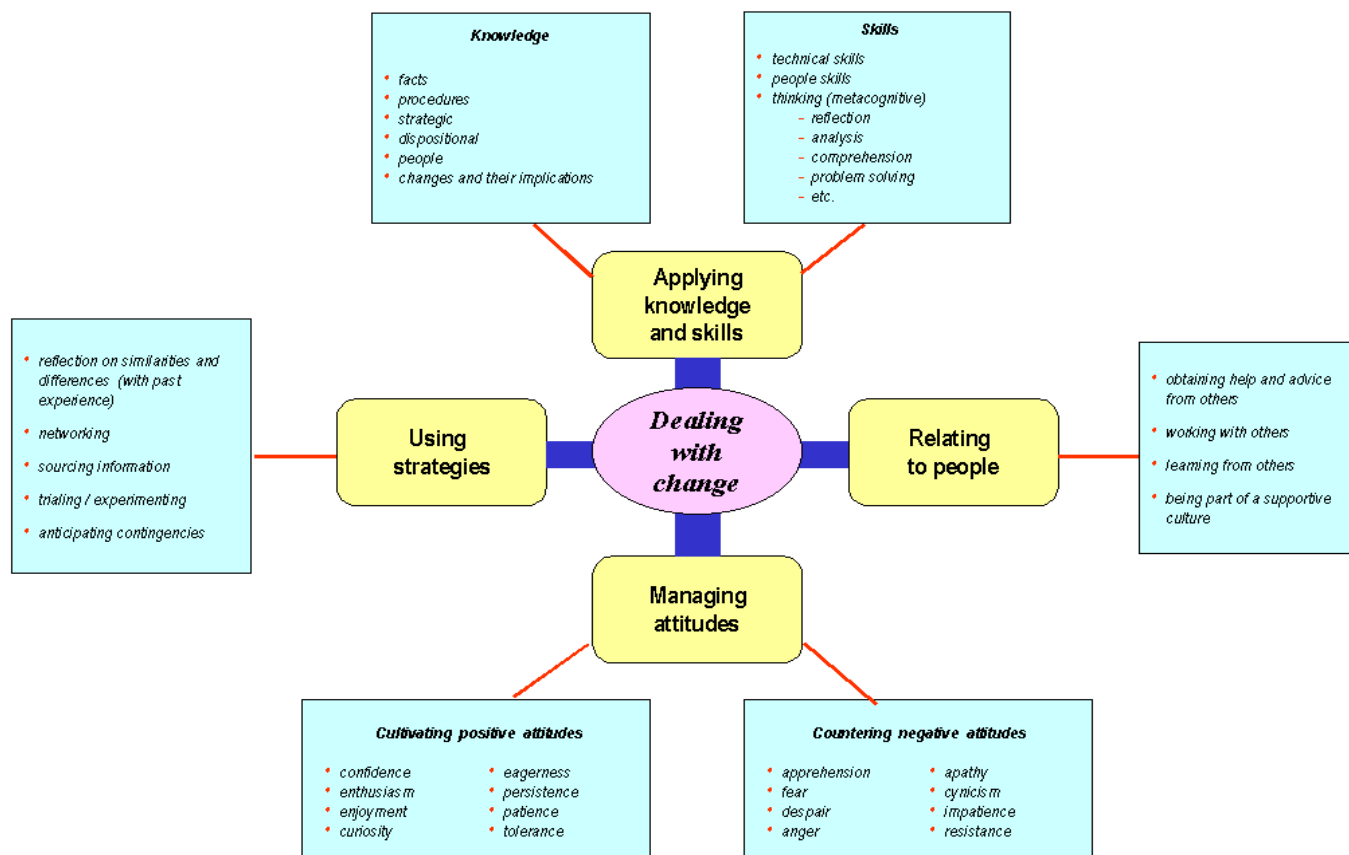


Figure 1 The skills, knowledge and attitudes people need when dealing with change

I suggest that while these observations and findings are significant for all types of changes people may meet in their lives, they have special significance for educators, trainers and students as they seek to cope with and adapt to the changes to occupations and learning environments arising from the ongoing impact of converging technologies.

Conclusion

The effects of converging technologies on all of us in the new millennium will be far-reaching. Both school and post school educators will be challenged by the need to be aware of the various ways the converging technologies will affect their professional work. Converging technologies will affect both what educators and trainers teach and assess, as well as how they teach and assess. Educators have an important role in assisting our communities to reflect more critically on technologies, our choices with technologies and their impact on our lives. Most significantly, converging technologies are affecting all occupations. As a result, people in these occupations face ever shortening cycles of constant changes in their work. Key skills and knowledge for future workers will focus not so much on 'doing their job' but rather 'adapting their previous skills in response to changes in their job'. Based on his research into how workers transfer their previous learning to novel and changed situations, Rumsey (1999) suggests that we need to provide students with a broader range of skills encompassing more reflective and collaborative ways of knowing and dealing with change. He proposes that to be well-armed to deal with the changing world of tomorrow people will need a combination of utilitarian (task-focused), collaborative or communicative (people-focused) and reflective (self focused) strategies for adapting their previous learning to meet the needs of change in their work and community lives.

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