

# **ELEARNING IN ART AND DESIGN: PERCEPTIONS AND PRACTICES OF LECTURERS IN UNDERGRADUATE STUDIO-BASED DISCIPLINES AND THE RHETORIC OF INNOVATIVE PRACTICES**

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## **Abstract**

The objective of this paper is to compare the noticeably prevalent perception among undergraduate studio-based art and design lecturers that elearning can contribute little or nothing to teaching and learning, against the rhetoric and literature of elearning associated with competencies for the knowledge economy. This study seeks to contribute to the present re-evaluations of art and design education in the context of the knowledge economy. The core question is: how do the perceptions and practices of teaching staff in art and design disciplines compare and contrast with the associated rhetoric and literature of elearning and innovative practices? Consistent with the phenomenographic approach to research, this study pursues a 'second-order perspective', i.e. through a qualitative analysis of interviews, this research deals with people's experiences of aspects of the world. It considers the pedagogies associated with elearning for the premise is that the competencies required for the knowledge economy cannot be provided for unless there is a corresponding change in teaching and learning methods. This paper confirms the prevalence of the perception that elearning can contribute little or nothing to teaching and learning. It attributes this to the historical evolution of art and design pedagogies, the persistence of didactic methods, the false understanding of elearning as replacing rather than enhancing teaching and learning practices, and the lack of sufficient and appropriate professional development and training opportunities for teaching staff. The implication is that there is a noticeable misalignment between perceptions and practices of elearning and the associated rhetoric and literature of elearning and innovative teaching and learning practices.

Keywords: elearning, art design education, competencies, knowledge economy, innovative teaching, constructivism, elearning, phenomenography.

## **1 INTRODUCTION TO THE TOPIC**

There is a noticeable perception among many of my colleagues who teach in undergraduate art and design studio-based disciplines that elearning can contribute little or nothing to teaching and learning. These colleagues argue that the learning environments of studio-based disciplines have a contextual influence on teaching and learning that makes them different from non-practice-based disciplines such as the humanities and sciences. The inference is that elearning is unsuitable for the teaching and learning methods associated with art and design disciplines.

There is limited research on the status of elearning in art and design in relation to the unique characteristics and context of studio-based disciplines in HE (Higher Education). For example, a study commissioned by the Art Design Media Subject Centre – Higher Education Academy (ADM-HEA) (Logan, Allan, Kurien & Flint, 2007), includes in the research remit disciplines such as media production, advertising and film studies; these are not exclusively or predominantly studio-based and are heavily computer-dependant. As a result, this study fails to identify if there are unique contextual or historical challenges to any widespread use or implementation of elearning in studio-based disciplines, and subsequently its conclusions are too generic.

A study by The Social Informatics Research Unit (2003) identifies resistance to online learning technologies in art and design, and attributes this – without further elaboration - to the situated nature of the related disciplines including teaching and learning strategies. Drew (2002, p.139) suggests that it is characteristic of art and design that the adoption rate of ICTs (Information and Communication Technologies) is generally slow. Drew (2003, p.38) explored some of these themes and referred to 'recurrent practices and implicit theories of learning and teaching' that stem from the vocational nature of the related disciplines. Similarly, Gruba (2001, p.225) admits that 'In the Arts, we've been a bit slower than some Faculties in coming to terms with the increasing use of IT & MM [Information Technology & Multimedia] in teaching...'

## 1.1 Purpose of the study, the research question

This phenomenographic study addresses questions about the perceptions of HE lecturers in studio-based disciplines *vis-à-vis* how they consider or engage with elearning, and then it compares their perceptions, practices and experiences against the literature and rhetoric of instructional approaches that support skills and competencies for the knowledge economy. The focus is predominantly on disciplines that reflect the teaching and learning culture characteristic of the art and design studio-based sector in HE and are under-represented in elearning research, such as Fine Arts, Graphic Design, Textiles, Photography, Ceramics and Fashion Design. The core question is: how do the perceptions and practices of lecturers compare and contrast with the associated rhetoric and literature of elearning and the knowledge economy?

## 2 RESEARCH METHODOLOGY

This study follows the phenomenographic approach to research, i.e. it is an empirical study of the different ways in which people experience, conceptualise, realise and understand aspects of the world around them. The premise of this research method is that we cannot separate the structure and the content of the experience from one another (Marton, 1981, p.180). This study pursues a 'second-order perspective'. Marton (1981) makes the 'fundamental distinction' between research methodologies that deal with 'first-order perspective', i.e. they aim is to describe various aspects of the world, and 'second-order perspective', i.e. the description of people's experiences of aspects of the world. Marton (1981) argues that the latter perspective, is worthwhile due to 'the pedagogical potentiality and necessity of the field of knowledge to be formed', and secondly, the outcomes arrived at from a second-order perspective are autonomous from descriptions arrived at from the first-order perspective (Marton, 1981).

When conducting interviews for phenomenographic research, Webb (1997) states that emphasis must be placed on the ability of interviewer to understand the 'lifeworld of the Other' – of the interviewee – through 'authentic openness' (Webb, 1997, p.198). This relates to the concept of '*bracketing*' of presuppositions, i.e. the need for the researcher to set aside assumptions, in order to document the interviewee's own point of view. Some kinds of presupposition that must be bracketed include the use of earlier research findings, the assumption of pre-given theoretical structures or particular interpretations, and the researcher's personal knowledge and belief (Ashworth & Lucas, 2000, p. 298).

This research is limited to specialist art and design HEIs (Higher Education Institutions) in the UK. Compared to universities that offer a wider variety of disciplines, art and design institutions offer mostly a range of studio-based disciplines at undergraduate level, and thus reflect better the teaching and learning culture characteristic of studio-based disciplines. Although the use of heterogeneous samples can increase the *generalizability* of research outcomes (Schofield, 2002, p.101), there is no claim of universal application but of exposition and illumination. In addition, it is good practice in phenomenographic research that the sample is chosen for '*heterogeneity*, rather than for *representativeness* in terms of distribution along demographic and other lines' (Akerlind, 2002, p. 12).

## 3 BACKGROUND

In the aftermath of the Dearing Report (1997) in the United Kingdom (UK) there is a proliferation of national and international policies on various aspects of implementing Information and Communication Technologies (ICTs) in Higher Education (HE). It is possible among the plethora of policies and strategies to distinguish emerging common themes and a prevailing rhetoric. It is argued that ICTs can contribute towards the development of skills for the knowledge economy when combined with appropriate teaching and learning methods. More specifically, elearning can promote flexible and independent learning, and can contribute to the development of competencies required for professional progression in the information-driven and changing global environment. If there were any doubts on the implications for Higher Education Institutions (HEIs), these were dispelled with the release of the Higher Education Funding Council for England (HEFCE) strategy for elearning (2005). This document pronounced a ten-year strategy to develop benchmarks and discipline-specific standards, and to embed elearning as a core function of teaching and learning in HEIs.

There is considerable consensus that the structure of work in advanced economies is shifting away from traditional manufacturing modes of production, towards the provision of services and the production, management and circulation of knowledge through ICTs (Saunders, 2000, p.1006). The

terms knowledge economy and information society are used in parallel to suggest a strong association. States who adopt an interventionist approach through education and training as well as labor market policies, aim to facilitate the development of a high-wage, high skill economies (Dudley, 1998, p.23). The need for a more highly skilled workforce to service new industries and participate in the knowledge economy is now a high priority for many countries. To this can be added the need for re-skilling and life-long learning. According to one estimate, a person will need to retrain at least five times in a working lifetime and such retraining requires the equivalent of three months of full-time learning (Bates, 2000, p.10-13). The changes to the nature of manufacturing both reflect upon and effect HE curricula. Themes that emerge from the research literature call for embedding elearning in the curricula, and this entails the re-evaluation and re-consideration of pedagogies to allow for new ways of teaching and learning to develop. It is explicit in this literature that innovation involves a change of perceptions and practices at both the teacher and organizational levels, and that the former require appropriate professional development (Commission of the European Communities, 2000, p.8).

Parallel to the calls for lecturers to engage with elearning, there are calls for students and graduates to develop skills and competencies suitable for the knowledge economy and information society. This group of skills and competencies is encapsulated in terms such as '21<sup>st</sup> Century Literacy' (Bertelsmann Foundation & AOL Time Warner Foundation, 2002) and 'Information Literacy' (American Library Association, 2000). The dominant theme in this often alarmist rhetoric is that skills and competencies acquired by students and graduates ought to reflect and correspond to the milieu of the global information society. In this context, knowledge and use of Information Technology (IT) is perceived as both a significant contributor for the acquisition of the required knowledge, as well as a facilitator for further professional development (Bertelsmann et al., 2002, p.4). The consultation paper by the Department for Education and Skills titled 'Towards a Unified elearning Strategy' (2003), makes explicit not only the connections between skills, education and the knowledge economy, but also government intention to embed elearning in HE curricula in a systemic manner.

At least at policy level many universities accept the political and economic agenda associated with the knowledge economy. In fact, '...a consensus has emerged with regard to diagnosing the needs of the future economy and the prognosis of the skills base...' (Bennet, Carre & Dunne, 2000, p.106). There are calls to re-consider what constitutes gradueness and preparedness in the context of employment in the knowledge economy. Here, too the rhetoric is hegemonic and common themes emerge to provide an account and range of desired skills. For example, Goodyear (2001, p.5) argues that '...[Employees] value intellectual flexibility, logical analysis ability to conceptualise issues rapidly and to deal with large amounts of information...'

The role of ICTs is to support and facilitate appropriate competencies as well as new forms and opportunities for teaching and learning. Distance education, networked learning, lifelong learning, student-centred learning and work-based learning are possible with ICTs. A summary of the themes indicates the characteristics of the prevalent discourse. Firstly, the almost universal acceptance that there are skills and competencies that should be developed and advanced. These are congruent with participation in the knowledge economy. Secondly, the significant role of HEIs in fostering and promoting this set of skills. HE is to provide graduates with ICT competencies, and to cater for the delivery of flexible, modular and in-time learning for the professional development and lifelong learning needs of the workforce. Lastly, lecturers are identified as a key group requiring training and support to develop appropriate knowledge and skills.

#### **4 THE CHALLENGE FOR ART AND DESIGN EDUCATION**

With the rapid advancements in ICTs and the establishment of the Internet as a global medium of communication, there are persistent calls within the art and design community for the re-evaluation of teaching and learning methodologies and the re-definition of what constitutes *design* education and *designer* in the context of the global economy and the wide-spread use of ICTs (Swann & Young, 2000; AIGA/NASAD, 2004). Inevitably art and design education - not immune from such pressures - is confronted with the complexities of dealing with what Kirschenmann (2001, p. 12) described as the 'electronic Prometheus'. Visual information can be extensively modified and thus impact upon what is perceived or experienced. Subsequently, there is a need to encompass in art and design curricula new forms of visual literacy and competencies that cater for the interpretation of digitally generated visual outputs, and address the ability and skills to create them.

In addition to the pressures from above, i.e. the role of HE in preparing graduates for the knowledge

economy in response to the dominant rhetoric on the skill set needed in the employment market, there are also pressures from below in the form of the current generation of art and design students; they are comparatively more computer literate than lecturers who were educated in the pre-digital world of the early 1960s. The use of the WWW, including email, blogs, Twitter, Facebook, and online virtual worlds, plus the widespread use of mobile devices such as ipods and iphones, is a common characteristic among a younger generation of students, who often turn-up in the design studios holding laptops with the latest software. '...Design schools today employ an entire generation of disillusioned pre-computer design educators who feel increasingly irrelevant...' (Maeda, 2002). In a similar vein, Kirschenmann (2001, p.12) stated 'Art teachers are especially reserved when it comes to placing a computer next to their easel.'

The form this discourse has taken the last few years, brings forward issues that go to the core of what is *design* and what is a *designer* in the context of the knowledge economy, and inevitably this discourse seeks to inform the structure and delivery of art and design curricula (Friedman, 2004, p. 31). The notion of the primacy of synthesizing information from different forms of evolving cross-disciplinary knowledge in constantly changing working environments, combined with vocational know-how and expertise to produce an outcome, is the prominent theme that emerges out of the current discourse on art and design education (Friedman, 2001, p. 20).

## **5 SUMMARY OF PERCEPTIONS**

All interviews were categorised in two stages. In the first stage, interviewee responses were divided into groups according to individual questions. In the second stage, emerging themes from each group of questions were identified. Within each group of questions, different categories of themes were formed whenever distinct overall meanings were identified.

### **5.1 Categories of describing elearning**

Five distinct categories of describing elearning were identified.

#### *5.1.1 An alternative environment to explore ideas*

Accounts associated with Category A, are not uniform or specific as to *how* elearning can enhance and complement 'traditional' and face-to-face teaching and learning methods. A variety of possibilities and options are expressed but no real examples. The common characteristic discerned from these accounts, is that elearning can assist or complement teaching and learning practices through providing an alternative environment for exploration of ideas, through catering for a wider range of learning styles, and as a useful additional tool to support students.

#### *5.1.2 Emphasis on the technology*

Similarly for Category B, i.e. elearning as learning facilitated exclusively through electronic means, the identified statements share common notions as to what this entails, and are either specific in naming the methods or general; they state a number of options. The emphasis in this theme is the association of elearning with, or equating it to a range of electronic technologies.

#### *5.1.3 Associated with distance education*

Category C comprises of accounts that emphasise the potential for students to pursue a programme of study without the need to be physically present at the site of teaching and learning. The distinguishing characteristic of this theme is that elearning is synonymous with distance education, and the focus is on elearning allowing for dispersed learning.

#### *5.1.4 Access to a variety of study material*

A group of views was identified that considers elearning as a means for the provision of access to instructional material and related study information. This characteristic, which distinguishes Category D from other categories, places emphasis on one of the obvious affordances possible with electronic facilities, accessibility.

#### *5.1.5 What is it about?*

It was possible to distinguish in some accounts an element of ambiguity and no experience or awareness of elearning in practice. The characteristic of Category E is the emphasis on vagueness and lack of any understanding of elearning.

## **5.2 Categories of describing the use of online learning technologies**

Three distinct categories of conceptions are identified.

### *5.2.1 Satisfaction with current use*

Accounts associated with Category A, include the provision of online databases, web sites with references, online virtual portfolios, discussion forums and emoderation.

### *5.2.2 No satisfaction with current use*

In Category B it was possible to identify interviewees who consider that they are restricted in using online learning technologies by resource-related and technical or other challenges and problems such as lack of training. The difference between this group and Category A is that in the latter there is expressed satisfaction with the way online learning technologies are used in teaching and learning. This category reflects an aspiration to go further and a view that more can be achieved.

### *5.2.3 No use*

Category C identified a group of interviewees who do not use online learning technologies for a variety of reasons, such as the perception that these technologies are not appropriate for studio-based disciplines, due to computer illiteracy, preference for paper-based and other means of communication, and lastly due to technical problems.

## **5.3 Categories of motivation for the use of online learning technologies**

Five categories of motivation are identified.

### *5.3.1 Motivation due to development of skills*

The additional skills identified in Category A, include independent learning, information management and life-long learning skills.

### *5.3.2 Motivation due to independent learning*

The accounts that comprise Category B, share in common the view that online learning technologies help students to depart from a teacher-centred model of instruction towards more independent learning.

### *5.3.3 Motivation due to access of study material at student pace*

Category C comprises of statements that focus on the ability of students to access through the use of online learning technologies support material *at their own pace*. It is the element of accessibility at any time that distinguishes this theme from the others.

### *5.3.4 Motivation due to accessibility of study material from different sources*

In Category D there is emphasis on the accessibility of information and learning material and the issue of student pace does not feature, but rather the accounts focus on online learning technologies as repositories or banks of learning support material and information.

### *5.3.5 Motivation due to ease of dealing with administrative tasks*

The defining feature of Category E is that online learning technologies can function as spaces for administrative and management tasks normally associated with paper-based work. There is no connection with the learning and teaching affordances associated with online learning technologies.

## **5.4 Categories of espoused teaching and learning methods**

Five distinct categories are identified.

#### *5.4.1 Combining instructional approaches*

In Category A Interviewees combined a variety of teaching and learning strategies and described this in terms of addressing different learning styles, trying to encourage the development of specific skills or making the teaching and learning experience more diverse and interesting for students.

#### *5.4.2 Student-centred learning*

Category B comprises of statements that place emphasis on student-centred learning. This entails reversing the teacher-centered focus of the instructional process and putting students at the centre of the learning process, with the latter having some input on what is learned, how it is learned and when it is learned. This category entails more flexibility in terms of teaching and learning objectives.

#### *5.4.3 Independent learning*

The accounts in Category C highlight how lecturers deliberately surrender prerogatives to promote the acceptance of responsibility by the students, and encourage the latter to act autonomously and appraise their own performance. In comparison to Category B, this category entails a more structured and deliberate approach as part of an objective to meet specific learning outcomes.

#### *5.4.4 Demonstrations, show-and-tell*

In Category D the accounts share and reflect the primacy on show-and-tell approaches to teaching and learning, with the main strategy consisting of demonstrations. This entails a significant amount of control by lecturers who direct the process with defined instructional objectives in mind.

#### *5.4.5 Teacher-centred learning*

Category E consists of accounts that focus on the lecturer as the main source of the teaching and learning process. It is about what the lecturer knows and this is usually based on personal or professional experience. Students can ask questions or request explanations from the lecturer who is the expert in a subject and the one that can impart knowledge.

### **5.5 Categories of views about elearning in studio-based disciplines**

Three distinct categories are identified.

#### *5.5.1 Useful for demonstrations*

The accounts in Category A share the common characteristic that elearning in studio-based disciplines is useful for teaching and learning by enabling students to access demonstrations or examples of related instructional material. These accounts emphasise that elearning does not replace teaching and learning methods but rather supports them.

#### *5.5.2 Useful for access to information*

In Category B the accounts consider elearning useful for studio-based practices because it can facilitate access to various online information and resources. There is no emphasis on demonstrations or other instructional methods as part of an overarching objective, but rather the focus is on the ease of accessing material either for the purpose of keeping in touch with areas of interest or to retrieve useful information.

#### *5.5.3 Not useful*

In Category C elearning is perceived as having no value for teaching and learning in studio-based disciplines. Statements that emphasise the inability of elearning to replace hands-on practice and the experience of dealing with tangible materials, outcomes and artifacts, support this view.

### **5.6 Views about professional development and training in elearning**

Five distinct categories are identified.

### 5.6.1 Professional development is useful

Category A comprises of statements that place emphasis on reasons why lecturers who undertook professional development and training found it useful for teaching and learning. The reasons include participation in well-organised workshops that addressed issues of pedagogy and recognition that this enhanced knowledge of elearning.

### 5.6.2 Professional development wanted but not undertaken

In Category B the accounts share the view that professional development and training are essential. It differs from Category A in that the statements reflect that such training was not undertaken yet and the interviewees stated the reasons for wanting to undertake it.

### 5.6.3 Non-satisfactory professional development

Category C consists of accounts that emphasise the unsuitability of professional development undertaken by the interviewees and the lack of suitable training. The accounts emphasise the different reasons they consider such training to be unsuitable. This includes training structured for a basic or elementary level of understanding elearning, sessions confronted with technical problems, and inability to identify courses that offer appropriate training.

### 5.6.4 Obstacles to professional development

Obstacles that inhibited professional development and training are characteristic of the accounts in Category D. Barriers include lack of sustained institutional support, no provision of incentives, and no available time to undertake professional development and training.

### 5.6.5 Professional development not wanted

The accounts in Category E highlight *why* some interviewees do not want to undertake professional development and training. The stated reasons are that other priorities take precedent, lack of interest and lack of incentives.

## 6 CONCLUSION

Art and design education has roots in the mediaeval guilds of the thirteenth and fourteenth centuries, and what emerges from the analysis of the historical evolution is the master-apprentice model of training. This general model of instruction informed further evolutions of art and design education (Macdonald, 1970, pp. 21-22). The slow and gradual weakening and dilution of the master-apprentice instructional method and didactic teaching started to occur with the academicisation of art and design education during the early 1960s (Owen, 1998, p. 238). It is possible to speak of an unstoppable – albeit slow - impetus towards change in design curricula and related pedagogies despite the persistence of the transmissive model of teaching and learning.

According to this study, the most widely held conception of elearning among lecturers in art and design disciplines is the one that emphasises the electronic aspects of the term, i.e. elearning is learning facilitated through electronic means. This places the focus on the electronic aspects of the technology and not the communicative affordances that are possible. This perception is followed by an understanding that elearning is synonymous with distance education. Further conceptions focus on the online provision of access to instructional material and study related information. Among these three groups of perceptions we consider that there is potential for further development and awareness of the affordances possible with elearning.

Some conceptions focus on the instructional potential of elearning to complement traditional teaching and learning methods. Among the range of perceptions that were identified in this research, the latter we consider to be the most comprehensive view of elearning. It is among the group of lecturers who hold this view that the innovators and early adopters can emerge, i.e. those that will take advantage of constructivist learning to explore the affordances of elearning to support skills and knowledge for the knowledge economy. A small group of lecturers has no understanding of elearning or experience of it and consider the term as ambiguous. To some extent, the perceptions of the latter group can be attributed to not knowing about the affordances possible with elearning.

The role of the organisation is also evident among lecturers who are not satisfied with their current use of online learning technologies - the largest group identified in the data analysis – for the focus of their perceptions is upon the obstacles they experience that can only be addressed at the organisational level. Such barriers include not sufficient time to engage with elearning, resource restrictions, and lack of financial support, development opportunities and training.

Lecturers who are satisfied with their current use of online learning technologies revealed a variety of uses in teaching and learning, such as making available study skills online, references, a reflective journal, access to data bases, eportfolios, submission of assignments online and moderation of online discussions. This varied range of applications indicates that expectations and constraints are varied too. This research identified a group of lecturers who do not use any form of online learning technologies because they perceive that the latter are not appropriate for studio-based disciplines. Other reasons for non-use include computer illiteracy, a preference for paper-based and other means of communication and technical problems.

The biggest motivation for the use of online learning technologies in studio-based art and design disciplines, the provision to students of online repositories or banks of learning support material. A further motivation to use online learning technologies is because they enable students to access study material at their own pace. However, the nature of online study material can be varied in terms of complexity, and subsequently this motivation reflects more the incentive of lecturers to engage with the technology, rather than their level of awareness, skills or knowledge of online learning technologies as well as the instructional affordances possible. Some lecturers are motivated to use online learning technologies to promote a variety of skills and competencies such as independent learning and information literacy.

Similarly with lecturers who focus on the instructional potential of elearning to complement traditional teaching and learning methods, from this latter group will emerge the innovators and early adopters. This research identified that the laggards who are motivated to use online technologies due to the administrative and management efficiencies afforded by the technology and expressed no interest in the teaching and learning potential of such technologies, are a small group. In time, they too, similarly with those who perceive that such technologies are not appropriate for studio-based disciplines, will increasingly be replaced by more computer literate lecturers who value the instructional affordances of elearning.

Due to the vocational nature of art and design disciplines, instructional strategies that consist of demonstrations and show-and-tell sessions are common practice. Subsequently, it is not surprising that some lecturers consider elearning useful for student access to demonstrations. Others value the ability of students to access information and a small group consider that elearning is not useful at all. However, this research can confirm that lecturers apply a variety of instructional methods, such as teacher-centred learning, student-centred learning, independent learning, or a combination of strategies. The concern is with the expert teacher as a single source of knowledge and skills as well as overreliance on demonstrations to the exclusion of more suitable or better instructional methods.

The significance of appropriate professional development and training cannot be underestimated, particularly if one considers that the lecturers in this study who undertook it consider that they benefited by improving their instructional approaches and discovering new ways of teaching. However, it is of concern that a significant percentage of lectures who participated in this research were unable to undertake appropriate professional development and training and attributed the causes to a variety of reasons such as lack of time, lack of appropriate courses and other obstacles that point – once again - to the importance of comprehensive and appropriate institutional policies. It is a positive sign that the percentage of lecturers identified in this study who for whatever reason are not interested in undertaking professional development, is small and as such – based on this study - it is not indicative of a wider trend in art and design education.

It is argued that there is not complete but rather some partial congruence and significant incongruence with the rhetoric of elearning and competencies for the knowledge economy. The former relates to constructivist instructional methods that are widely practiced in art and design disciplines and the fact that didactic approaches are gradually and steadily declining. To this can be added the emerging practices of the early adaptors and innovators *vis-à-vis* online learning technologies. The incongruence relates to obstacles, misconceptions and resistance to the affordances possible with



elearning. In this respect, there is a noticeable misalignment between perceptions and practices of elearning and the associated rhetoric and literature of elearning and innovative teaching and learning practices. Overall, due to this noticeable lack of combining elearning with appropriate instructional methods, a significant number of art and design lecturers do not promote new forms of visual literacy, information management and 21st century skills. This impacts on graduates from studio-based disciplines in that a significant number do not acquire the skills and competencies associated with participation in the knowledge economy.

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