CONSTRUCTION STUDIES IN HIGHER EDUCATION AND THE USE OF DIGITAL TECHNOLOGY

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The construction industry wants graduate employees skilled in relationship building and information technology and communications (ITC). Much of the relationship building at universities has evolved through technology. Government and the ITC industry fund lobby groups to influence both educational establishments and Government to incorporate more ITC in education – and ultimately into the construction industry. This influencing ignores the technoskeptics' concerns about student disengagement through excessive online distractions. Construction studies students (n=64) and lecturers (n=16) at a construction university were surveyed to discover the impact of the use and applications of ITC. Contrary to Government and industry technopositivism, construction students and lecturers preferred hard copy documents to online feedback for assignments and marking, more human interface and less technological substitution and to be on campus for lectures and face-to-face meetings rather than viewing on-screen. ITC also distracted users from tasks which, in the case of students, prevented the development of the concentration and deep thinking which a university education should deliver. The research findings are contrary to the promotions of Government, ITC industry and ITC departments and have implications for construction employers where a renewed focus on human communication should mean less stress, fewer delays and cost overruns.

Keywords: information technology, education, social networking, disengagement

INTRODUCTION

The construction industry is caught between the demands of innovative technologies and the business environment according to Becker, Jaselskis and McDermott (2011) who argue that Information Technology and Communications (ITC) is no longer just the domain of the ITC Department – rather that "All construction professionals … must consider themselves part of the IT department. The daily work of construction professionals is immersed by technology." (*ibid*: 7). Much of the ITC infrastructure in construction universities is absorbed by the informal applications (e.g. email, Facebook, Twitter etc.) which are distractions from academic pursuits. ITC is efficient for routine tasks and skimming information and data. Construction students, however, are required to develop non-routine higher-thinking skills including new literacies, problem solving and face-to-face collaboration. The construction industry believes such people-skills will deliver competitive advantage by reducing conflict

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and ultimately reducing costs. The challenge therefore is to ensure that the installed ITC meets the development of higher-thinking skills – and that the consumers of such ITC are using it as productively as intended when it was procured.

ITC CHALLENGES

Government-ITC industry influence

There are many influences in ITC procurement including United Kingdom (UK) Government funding of pro-ITC lobbying groups (e.g. Joint Information Service Committee (JISC) and the Higher Education Funding Council for England (HEFCE) which incorporates the Online Learning Task Force (OLTF: 2011)). In Europe there is the European Schoolnet (ES) – another multi-government sponsored technopositivist group of 31 European Ministries of Education specialising in researching ITC development in schools (Balanskat and Balmire, 2007). Njenga and Fourie (2010), promoting dialogue on ITC, examined the higher education e-learning myths espoused by "technopositivists" (*ibid*: 199) with their "compulsive enthusiasm" (*ibid*: 200). Their view is that the technopositivist ideology is "… being created, propagated and channelled repeatedly by the people who stand to gain either economically, socially, politically or otherwise in due disregard of the trade-offs associated with the technology to the target audience." (*ibid:* 200). This group undoubtedly includes the ITC companies and the ITC departments in higher education institutes (HEI's). Dissenting groups of "technoskeptics" have not been provided with Government-funded support.

According to JISC (2008) students welcome ITC fir flexibility over time and location of lectures and for access to class notes and electronic note-taking in lectures and for research (JISC, 2008: 13). This was challenged by Wood *et al* (2012) (using 145 participants to test multi-tasking ability) who found that "attempting to attend lectures and engage digital technologies for off-task activities can have a detrimental impact on learning" (*ibid*: 365). Similarly, the technopositivists' influences and assumptions have also been challenged by Convery (2009). Convery, in his interrogation of the literature espousing the benefits of ITC noted that "…the imperative to learn *about* technology has been allowed to become confused with learning *through* technology…. to establish the myth that computing is inherently beneficial in education." (*ibid*: 27). (This is illustrated by the universities' requirement for students to collaborate on-line to fulfil team-based assignments.) Rowlands *et al* (2008: 300) in their "virtual" longitudinal study to determine the impact of ICT on young students found that they also have a propensity to prefer entertainment to text (*ibid*: 299).

Technology acceptance (usefulness and ease of use)

The construction industry is becoming increasingly ITC-based. The technology acceptance model (TAM) explains the significance of users' perceptions of usefulness (potential enhancement of job performance) and ease of use (free of effort) in the acceptance of new ITC (Davis, 1989; Venkatesh, 2000). The perceived usefulness increases when an individual has focussed immersion and enjoys the interaction.

New literacies and skills are needed (not skim-reading)

However, new skills are needed to encourage self-directed learning which is accurate – and not just easy. These new skills, applied at speed, include the ability to challenge information during on-line reading. Rowlands *et al* (2008: 300) found that the favourable impact of ITC has been overestimated and that comfort with the

technology has meant reliance on search engines, viewing rather than reading and a lack of the ability to critique and analyse information. Visual methods of learning are becoming preferred to verbal. "Society is dumbing down." (*ibid*: 300) "…people exhibit a strong tendency towards shallow, horizontal, "flicking" behaviour in digital libraries." (*ibid*: 300). This has led to claims that students are not fully engaged in learning illustrated by the researched preference for "skimming" when academic sites are only briefly examined for perhaps one or two pages. Rowlands *et al* (2008) also noted that "…around 60% of e-journal users viewed no more than three pages and a majority (up to 65%) never return…" (*ibid*: 294). The frequent switching from one task to another also raises the challenge of how to manage the vast quantity of information now instantly available.

Head and Eisenberg (2010) examined how students (n=8,353) used and evaluated information in the digital age. Few respondents used Web 2.0 applications for collaboration on assignments often preferring instead to evaluate information using friends and/or family and instructors for academic work. The students' favoured researching strategies were driven by efficiency and predictability in order to manage the quantity of information available through digital sources. Lower order thinking skills (such as "…procedural memorized routines, techniques and rules for conducting research and finding information…" (*ibid*: 37) as well as higher order thinking skills ("…interpreting, synthesizing and creatively manipulating abstract concepts to generate new constructs, meanings, interpretations and knowledge...") (*ibid*: 37) are both necessary for information literacy and lifelong learning. The students in the sample considered themselves adept at lower order thinking skills in research but felt they were disadvantaged for applying the higher-order thinking skills (possibly because they felt swamped with the amount of digitally-available information). Rowlands *et al* (2008) also speculate that (based on previous research) social networking sites produced by the HEI may have only limited support – implying that students prefer social networking for social purposes only (*ibid*: 298).

ITC DISTRACTIONS

Easy attainment

Ferneley and Sobreperez (2006) discuss the different facets of user engagement where users can comply, workaround or resist – the latter being two means by which users can undermine the planned use of (expensive) ITC systems. Commercial tools such as Googlescholar which encroach on academic search domains (but which are easy) are also seen as a threat to the traditional institutions such as libraries (Rowlands *et al*, 2008: 296). "Young scholars are using tools that require little skill: they appear satisfied with a very simple or basic form of searching..." (Rowlands *et al* (2008: 297) supporting Davis' (1989) TAM theory).

Memory, multi-tasking and disengagement

ITC is designed to support and integrate multiple tasks. However, multitasking, interruptions and lack of concentration can all lead to disengagement from task as discovered by many researchers. Bennett *et al* (2008:779) found that "…multi tasking may not be as beneficial as it appears and can result in a loss of concentration and cognitive "overload" as the brain shifts between competing stimuli…". Rowlands *et al* (2008: 300) found that the impact of ICT has been overestimated and that comfort with the technology has meant reliance on search engines, horizontal "flicking" behaviour, skimming rather than reading – all resulting in lack of the "critical and

analytical skills to assess the information" (*ibid*: 290). "Society is dumbing down." (*ibid*: 300). Ophir, Nass and Wagner (2009) found that heavy media multi-taskers (n=49) had poor results when tested on task-switching ability possibly due to reduced ability to filter interference in tasks. Similarly Greenfield (2009) recognised that cognitive skills are changing to adapt to a background of interference from informal learning environments (television, video games, internet). She also decided that weaknesses were developing in higher-order cognitive processing skills (including problem solving, critical thinking and imagination) previously developed through stimulation from reading hard copy and listening to radio (*ibid*: 69). Nicholas, Rowlands, Clark and Williams (2011) also concluded that the Google Generation have poorer working memories.

Similarly, the impact of ITC on memory was the subject of four studies by Sparrow, Liu and Wegner (2011) which showed that "…when faced with difficult questions, people are primed to think about computers…" and instead of recalling the information they recall where to access it. In this way, the internet has become a form of "…external or transactive memory where information is stored collectively outside ourselves…". (*ibid*: 1) (this is also known as the "Google effect"). In a multi-tasking environment the opportunity for interruptions fractures the periods of reflection needed for thinking. By making it "easy" (i.e. dumbing down) for students with internet keyword searches and journal abstracts as substitutes for in-depth searching, reading and absorption, there is a possibility that students are not really participating in the learning experience. The continual distractions and interruptions available through ITC applications prevent brains from forging the neural connections that give depth to thinking thereby weakening memories and preventing joined-up thinking. Kirschner and Karpinski (2010) in their research (n=219) into the use of social-networking site Facebook and its relationship to academic performance found that students who admitted to being avid Facebook users had lower grades than non-users (also supported by Rosen, Carrier and Cheever, (2013) in their study of 263 students' on-task behaviours).

RESEARCH

The foregoing raises many beliefs surrounding the use of ITC in a construction faculty and whether it will prepare employees who can concentrate on task, collaborate and problem-solve. An attitudinal survey was compiled to test key findings from the literature. The applications choices comprised emails, podcasts, blogs, wiki, filesharing, Facebook, Twitter, YouTube, music, news streams (e.g. newspapers, BBC), iplayers (t.v. replays), Skype, Wikipedia, Excel, Word, Photoshop, AutoCad, Googlesearch, Wikipedia and "other". Following an investigatory pilot survey and subsequent amendments to the instructions and content, the one month availability of the on-line voluntary, anonymous Google-documents questionnaire was notified to 263 students and 33 lecturers in the same construction studies faculty in a UK construction university. The return rate was 24% (n=64) for students and 54% (n=18) for lecturers.

RESULTS

The students' sample comprised 50 males, 12 females and two transgenders with a mode of 20-25 years. The lecturers were 11 male and seven female with a mode of 46-55 years. While self-reporting surveys should be treated with caution, the results nonetheless support many of the findings of researchers examined in the literature search.

Ease of searching techniques

The non-academic search engines were preferred by 73% of students for academic research (vs 22% for lecturers) and only 32% of students agreed or strongly agreed that university search engines are easy to navigate.

Flexibility over lecture time and location

A clear majority of lecturers (89%) had a distinct preference for on-campus lecture delivery rather than off-campus delivery over the internet. Of student respondents, 75% claimed to attend all lectures and 22% "sometimes".

Skimming

As a test of in-depth document reading vs skimming 13% of students noted they only ever read the journal abstract 37% read the abstract and some of the journal pages, and 20% said they read the whole article.

Face-to-face vs on-screen contact

Table 1: preference for contact for feedback, marking and tutoring

Preference	Scale	Students receiving feedback %	Lecturers giving feedback %
I prefer face-to-face feedback for assignments	always	69	50
	sometimes	22	44
	never	9	6
I prefer to receive/read feedback on hard copy	always	76	78
	sometimes	19	22
	never	5	0
I prefer to receive/give feedback on screen	always	33	6
	sometimes	45	44
	never	22	50
I prefer marks returned/marking student assignments on-screen	always	33	0
	sometimes	45	33
	never	22	67
I want more time with lecturers and tutors	strongly agree	44	N/A
	agree	31	
	neither	20	
	disagree	3	
	strongly disagree	2	

Contrary to the exhortations of ITC departments and the ITC industry, the results above (Table 1) show a preference for human contact and hard copy feedback.

Most used functions

Table 2: top five most used and most popular functions

Usefulness	Students when studying %	Lecturers when working %
top five most used functions	98= email, Word 89 Youtube 86= Excel, music, Wikipedia 73= Facebook, news stream 70 iPlayer	100 email 89 Word 78= Excel, YouTube 72= iPlayer, music 67 news stream (e.g. BBC)
top five most popular open functions when studying/ working	81 email 80 Word 38 Excel 36 music 28 Facebook	89= email, Word 56 Excel 39 news streams (e.g. BBC) 28 other (e.g. Powerpoint) 17= Skype, Wikipedia
top five most popular open functions when **NOT** studying/working	86 email 55 Facebook 50 music 48 Word 44 YouTube	89 email 44 Word 28 news streams (e.g. BBC) 17= iplayer, Skype, Excel 11= Wikipedia, music, YouTube

Switching from task to task

Table 3: switching ease

Switching ease	Scale	Students %	Lecturers %
I find it easy to switch from one task to another when working on my ITC tasks	always	65	56
	sometimes	17	44
	never	18	0
		100	100

Distractions: source and frequency

Table 4: applications open and interruptions per hour

Open applications/ source of interruptions	Frequency of interruptions per hour	Students when studying %	Lecturers when working %
open applications when studying/working	0-2	47	39
	3-5	41	61
	6-8	7	0
	9-12	3	0
	12+	2	0
self-interruptions e.g. to initiate or answer emails/Facebook© per hour	0-2	58	89
	3-4	27	11
	5-6	9	0
	7-10	0	0
	11+	6	0
externally-generated interruptions by social media per hour	0-2	36	100
	3-4	23	0
	5-6	30	0
	7-10	3	0
	11+	8	0

Interruptions and impact on anticipated degree success

Table 5: self interruptions and anticipated degree classification

Students self-interruptions per hour e.g. to initiate or answer emails, Facebook, Twitter etc.		Anticipated degree classification				
		First	2:1	2:2	TOTAL	
	0-2	16	15	7	38	59%
	3-4	5	10	2	17	27%
	5-6	1	3	2	6	9%
	7-10	0	0	0	0	0
	11+	2	1	0	3	5%
	TOTAL	24	29	11	64	100%

DISCUSSION

The findings indicate that many ITC-installation decisions have not taken full account of users' behaviours. The finding that non-academic search engines were preferred to academic search engines confirmed Ferneley and Sobreperez (2006). In other words, the computerising of existing systems rather using than the "Google approach" to start afresh does not make university search engines easy or useful and if search engines are not perceived as useful or easy they will be unused – an example of waste. Student skimming of journals was also a concern with 50% only reading the abstract and possibly some additional pages. However, this fits with Rowlands *et al* (2008) who noted that 60% of users read no more than three pages of journals. Effectively, this means that one third of the students did not engage with the formal research base. The findings that lower order thinking skills are more frequent (Head and Eisenberg, 2010) would appear to support this result as well.

The finding of students' high attendance at lectures (totalling 97%) could be because students who participate in voluntary questionnaires are possibly more motivated generally and therefore more likely to care about their studies and attend classes (which may bias these results). The availability of on-line lectures was to give flexibility to the students and save space costs at the university – but the research findings would appear to undermine both ideals. The lecturers' preference for on-campus delivery rather than on-line lecturing also indicates a different need for physical space. Research (JISC, 2008:13) claimed flexibility over location was an important factor in student university choice and a justification for more ITC – but in

fact it would not appear to be a major factor in students choosing the university construction courses.

The option for face-to-face contact with hard copy feedback (Table 1) (rather than on-line, electronic feedback) showed to be a clear preference for students – which is unexpected in an age of instant communication. In fact, students actually wanted more face-to-face time with lecturers and tutors. The majority of lecturers (72%) preferred reading and marking student assignments on paper (rather than on-screen). This possibly implies that the more established methods of teaching are more comfortable which could be a generational issue within the lecturing community (mode age 46-56 years) or that lecturers feel more in control of their work if they can physically touch the paperwork. Importantly for the construction industry, more face-to-face interaction was preferred by students and lecturers (confirming Njenga and Fourie (2010: 209)).

The most useful application for both students and lecturers (Table 2) was email for respondents when not studying (students) or not working (lecturers) followed by more frivolous student applications (Facebook, music, Word, YouTube) and more serious applications for lecturers (Word, news streams, Excel, Wikipedia). What was noticeable however was the importance of Facebook for students (second most popular) compared to Word (which was second) for lecturers – which may also be indicative of maturity (lecturers being older and perhaps not as technically savvy) or that lecturers have more self-regulation than students with regard to open non-academic applications. This supports the views of Bennett *et al* (2008) of perceived usefulness increasing when individuals are immersed and enjoy the interaction. Students enjoy Facebook (but not academic search engines). Although Twitter was offered as an option it never featured in the top five most used applications which may indicate that students and lecturers were not as involved in social media as the technopositives propose.

The potential for distraction is obvious with students finding it easy to switch from task to task when working (Table 3) possibly because they need to do it more often and is therefore practised – or because they have fewer formal applications open than lecturers. Since students generally have more distractions and more applications open than lecturers they are more likely to be superficial skimmers rather than deep thinkers concentrating on a single task (Head and Eisenberg, 2010) and this could be one of the root causes of any student disengagement (Convery, 2009). Some students admitted to more than 12 applications open (Table 4) when studying and two admitted to 11+ self interruptions per hour which equates to one interruption approximately every five minutes. If (in the most extreme example) these same students are also those interrupted 11+ times/hour from external sources then they will be entertaining around 22 interruptions per hour i.e. approximately one every three minutes. This makes them time-poor students with insufficient productive time forcing them to skim websites to gather information for their studies. It also sets a pattern of bad work habits for when they become employees and has implications for future construction employers with their need for increasing productivity – and increased use of ITC. It would appear that students are not self-regulating when working because they have so many applications open. Frequent interruptions minimise concentration. In contrast, lecturers had far fewer applications open simultaneously and fewer interruptions (both self-generated and from external sources).

Finally, Table 5 connects the potential impact of the number of self-interruptions and anticipated degree classification. For those with higher levels of self interruption (11+) there is a certain level of optimism (two Firsts; one 2:1) which conflict with Ophir *et al* (2009). However, realistically, these respondents could have been indulging in some flippant behaviour. The 16 Firsts and the 15 2:1's anticipated by those with 0-2 interruptions per hour would indicate engagement and concentration and support Kirschner and Karpinski (2010) and Bennett *et al* (2008).

CONCLUSION

The findings challenge the relationship between Government and the ITC industry to employ more ITC in education for the supposed benefits of the students and educators. Not all ITC is beneficial. The technoskeptics who could have provided the challenge have inexplicably been excluded from the debate.

Students and lecturers value human interaction more than on-line connections as shown by a preference for attending class and face-to-face meetings. This contradicts much of the technopositivists' argument. Similarly, students' prefer technologies which are easy and require little deep thinking indicated by shallow searching on commercial search engines when studying and a disposition for viewing rather than reading and absorbing information. This will not prepare them for the world of construction employment. The acceptance of the new applications of ITC in general (Table 2) among students and lecturers was lower than might have been predicted implying that perhaps the level of ITC literacy and speed of adoption for both groups may not be as high as was assumed by the ITC Department. The reason for this could be economic (e.g. cost of devices in an economic recession) or lack of interest – or even, perversely, lack of time.

ITC also provides distractions – particularly for students. Flexible switching between tasks, multi-tasking on a wide spread of tasks while entertaining multiple interruptions and (more worryingly) lacking the concentration time needed to develop critical and analytical information skills have an effect on students' anticipated degree classification. Furthermore, the increased availability of ITC-supported leisure applications has an impact on the time available for student concentration, in-depth evaluation, output, engagement and self-regulation. In order to achieve the deeper thinking required in higher-level education and in the construction industry, students need to use ITC more selectively and to be aware of its powers of distraction. Similarly, lecturers need to be consulted on just which of the vast range of ITC tools available they will actually use.

The ITC industry will continue to upgrade its products which in turn will require ongoing spending from user departments in order to retain technical support. The push to integrate ITC further into construction education for diminishing returns is almost inevitable unless the technoskeptics' voices have equal volume to match the Government and ITC-industry funded technopositives' promotions. Unintentionally, construction university ITC may actually be contributing to the "dumbing down" of construction education – and ultimately the construction industry.

FURTHER RESEARCH

Greater validity to the results may be derived from a similar study in another institution. In addition, follow up research as to the final degree classification matched to the number of interruptions would also yield some interesting data.

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