Can Computer Science Students Do Without the Desktop?

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Abstract
Prompted partly by potential space release and reuse, and also by international trends in moving away from desktop computer learning environments and traditional classroom set-ups, we have begun exploring alternatives to computer science (and other) students' use of fixed desktop computers in traditional computer laboratory configurations. Although many studies and reports detail how mobile computing, especially tablet and smart phone use, have been replacing desktops, certain disciplines (particularly engineering and sciences) have continued to rely on the greater computing power available in the desktop. This has resulted in, amongst other things, a continued enforcement of older classroom seating arrangements where rows of individual students face a single teacher at the front --- an arrangement widely viewed as non-conducive to optimal student collaboration and learning. This paper looks at a new institution of higher education in the People's Republic of China, HEI-A, and examines how suggestions of reallocation of computer laboratory space are being received by some students and staff within the computer science department.

Keywords: Learning Environment, Mobile Learning, Higher Education

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1. Introduction

We have witnessed many changes in education, including the reform of classroom practice made possible by evolving computing device use, particularly personal mobile devices and the Bring Your Own Device (BYOD) trend (Sangani 2013).

With the advances in pedagogical practice that we have seen, an observed irony is that many of these changes which have been facilitated by computer science (such as the mobile devices) have impacted mainly on disciplines outside of computer science and engineering — computer science students, for example, are often still constrained in the devices that they can use, sometimes still needing the greater processing power of the older desktop computer set-up, often configured in a traditionally laid out classroom of rows of computers facing a single teacher's computer (Hollingsworth & Powell 2011).

The economy of the People's Republic of China (PRC) has been developing very strongly, and linked to planned future economic success are recent reforms in higher education (HE), including an opening up of the sector to foreign input. The institution under study, HEI-A, one of the newly introduced Sino-foreign partnerships, has developed very successfully over the ten years since its establishment in 2004. HEI-A has been able to introduce many innovations, and has grown both significantly and quickly. The rapid growth at HEI-A has led to pressure on space allocation and usage, a phenomenon common to many other educational institutions. This pressure has included recent suggestions that perhaps the time has come to cease provision of larger computer laboratories containing only desktop computers, and reassign these spaces.

The rest of this paper is structured as follows. In Section 2, some background information is presented, including China's economic growth, and some recent changes in Chinese higher education. The institution involved in our study, HEI- A, is also introduced. Section 3 describes how student use of computing devices has been changing, which has partly prompted an examination at HEI-A of how current computer laboratory space might be revised. Section 4 looks at how computer science students, amongst others, face challenges in adoption of many of the modern smaller devices, and, by extension, how they may not be able to benefit as easily from some advances in classroom techniques. Some initial reaction to computer laboratory reallocation suggestions from HEI-A computer science students and staff is also included. Finally, Section 5 concludes the paper.

2. Background

2.1 PRC Economic Growth

As discussed in Towey (2014), China has seen incredible economic growth over the past thirty years, fuelled by a manufacturing industry boom that, it has been suggested, may now be coming to an end (The World Bank 2013). It has been argued that the best hope for continued economic growth may involve the Chinese economy changing from manufacturing to a more service-oriented economy (Brown 2012, Morrison 2013, Phillips 2012). A challenge to this is a predicted shortage of appropriately skilled workers, especially in terms of tertiary-level education (Marsh 2012, Ray et al. 2012): Figure 1 shows the predicted 2020 Chinese labour demand and

supply (by education level), according to which the PRC will face a shortage of university and vocational labour of about 24 million workers (Chen, Mourshed & Grant 2013). To address this problem, China has already initiated strategies to enhance its HE provision.

2.2 Changing PRC HE Landscape

Higher education in the PRC refers to that "conducted on the basis of the completion of senior middle-school education" (PRC MoE 1998). It has been noted that an interesting feature of recent PRC educational reforms has been the focus on tertiary level, rather than on primary or secondary (Li et al. 2012). These reforms have included a number of projects aimed at enhancing the quality and prestige of some of China's universities, such as: Project 985, Project 211, and the C9 League (CEC n.d., Lixu 2004, Sainsbury 2009, THE 2011).

Since joining the World Trade Organisation (WTO) in 2001, the PRC has allowed foreign investment in the education sector in the form of Chinese-foreign cooperatively-run schools (CFCRS), which require a partnership with a Chinese institution. By 2013, there were 775 approved Sino-foreign projects (including joint venture universities and programmes leading to foreign degrees) (QAA 2013, p.6), and estimates of over a thousand foreign institutions expressing interest in establishing private universities in the PRC (Tsang 2013, p.655).

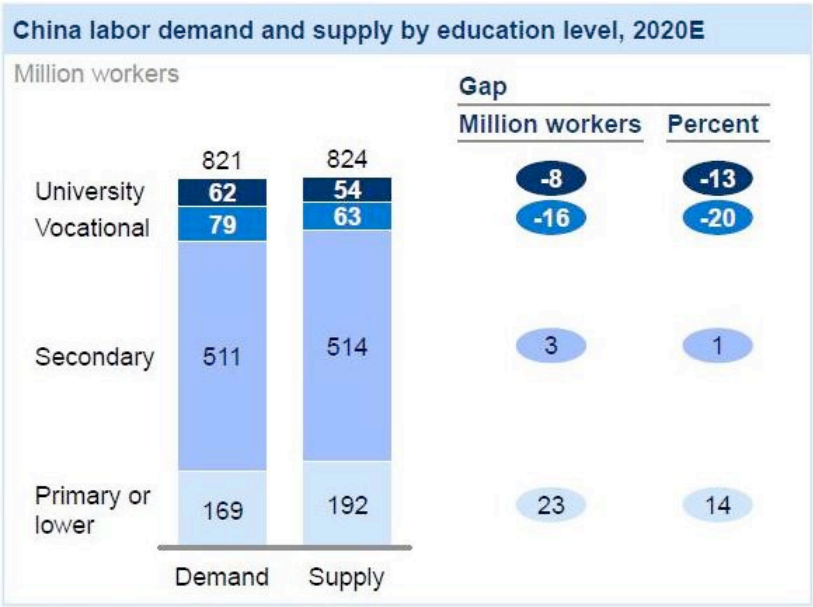

Figure 1: Predicted 2020 PRC labour demand and supply, by education level (from Chen et al. 2013, p.4).

2.3 HEI-A

The institution under study, HEI-A, was one of the first Sino-foreign partnerships resulting in a tertiary institution. It was established in 2004, and has since then grown in both student numbers and provision of academic programmes. Due partly to its successful development, HEI-A has recently faced space challenges, in particular, the pressure to schedule classes and to house staff and tutorials has meant that the institution has had to look again at its allocation and usage of all university spaces.

One suggestion currently being examined by the administration at HEI-A is to reduce the number of large computer rooms currently housing desktop computers. It has been argued that these computer rooms, which have been laid out in a traditional configuration of rows of computers on desks facing towards a single teacher's computer and desk at the front, are no longer necessary, and would represent an opportunity to reuse significant space on campus. Some of the arguments for reducing the desktop computer room provision include the reported changes in how students are using and owning computing devices.

3. Changing Student Computing Device Use

Over the past twenty or so years, we have witnessed many changes in how university students (and others) have made use of computing devices. In the late eighties and even early nineties, most students made use of the university provided desktop computing environments (Allan 2001). In the nineties, as laptop computers became more affordable and accessible to students, we saw more students making use of these more portable devices, although, often in addition to, rather than in place of the university desktops.

A smaller version of the laptop, often referred to as the netbook (Descy 2009), began to appear over the last ten years. Typically, the netbook was less powerful than the laptop, but was also usually considerably cheaper, and more portable (Demb, Erickson & Hawkins-Wilding 2004, Surry, Stefurak & Gray 2010). Interestingly, it seemed that few students actually used netbooks instead of their laptops — Smith & Caruso (2010) found that only about 13% of students favoured the netbook over the laptop; while Cassidy et al. (2011) found only about 8%.

Perhaps the most well-known innovation in mobile computing devices has been in the advent of the iPad[1]: the tablet computer. Tablet computers — and their smaller cousin, the smart phone — have become ubiquitous devices. Johnston et al. (2013) reported that more than 85 million iPads had been sold by 2013, and predicted that this would rise to over 377 million by 2016. Similar devices (such as the Amazon Kindle Fire, Samsung Galaxy, Google Nexus and Microsoft Surface) have also reportedly seen a significant increase in their adoption (John- son et al. 2013). Although many of the tablet devices lack the computational power of the desktop (or even the laptop or netbook), we have been seeing their processing power grow, and Bradley (2011) has noted that they already suffice for most users' computing needs. The power of the apps (applications, especially those designed to run on mobile devices), and the recent trends for Cloud computing have made it possible for the tablet to replace other computing devices for many students (Hollingsworth & Powell 2011). One of the most exciting things about the tablet devices has been the impact that they have had on the classroom, and on how lectures and classes can be delivered (Eichenlaub et al. 2011, Fischer et al. 2013, Keller 2011, Mang & Wardley 2012).

4. Challenges for Computer Science Students

While we have seen a number of changes in the classrooms of many disciplines, and these changes can be connected to developments in computer science devices, we

[1] http://www.apple.com/ipad/

have also noticed that some disciplines, including computer science, have continued to use older devices and classroom configurations, such as the desktop environment laid out in a traditional classroom arrangement of rows of student desks facing the teacher in the front (Hollingsworth & Powell 2011).

When HEI-A first began investigating the possibility of reassigning the space currently occupied by computer laboratories, some of the experience of other institutions, as reported in the literature, was examined. Current computer science faculty and students at HEI-A were also invited to give their opinion on this proposal, and to offer suggestions for either how best to implement it, or, if against the proposal, to suggest alternative, space-saving initiatives.

The rest of this section presents some of the main obstacles facing a removal of the desktop environment, including when proposing BYOD as an alternative.

4.1 Text Input

Text input has been identified as a challenge for students using both smart phones and tablet computers, especially when using a virtual keyboard, with interviewees often expressing a preference for traditional keyboards (Chaparro et al. 2010, Edwards & Barnette 2004). Given the large amount of text entry associated with programming and other computer science subjects, the view of computer science students that tablets and smart phones are ill-suited to their needs can be understood.

4.2 Display Size

As Bradley (2011) also found, reactions from both students and faculty at HEI- A to suggestions of replacing desktop computers with laptops or other devices were met with complaints that the screen size would not suffice. Indeed, in many cases, the larger monitors and displays attached to some desktop computers are augmented by second or third displays to further facilitate programming and debugging.

4.3 Multi-tasking & Processing Power

Bradley (2011) also found that more efficient multitasking is often needed than is (currently) possible with the smaller computing devices. When using iOS (Apple's mobile device operating system), apps behave differently in the *background* compared with when in the *foreground* due to system limitations, and battery life is also often adversely affected (Apple Inc. 2013). Therefore, for some very intensive operations, common in computer science and engineering, the only computing option is the desktop.

4.4 Collaboration

One of the major advantages identified with mobile computing devices has been the associated facility in collaboration in the classroom. In computer science, however, because of the greater need to share files and content, many of the current apps targeting, for example, software development, make this kind of sharing and collaboration more challenging. As Mang & Wardley (2012) reported, tablet operating systems lack a central file management system, which may mean that files stored within an app cannot be accessed without opening that app, and cannot be shared across apps. Although a possible solution may be to share files in a Cloud storage service (such as Dropbox or Google Drive), such an approach is not yet

supported by all apps, and may also represent a new challenge where such Cloud services are not available (Huang & Towey 2010).

4.5 Subject Identity

One of the major themes which has been emerging from conversations with HEI-A computer science students and staff is a sense of how strongly the identity of computer science seems connected to the computer laboratories (Stets & Burke 2000). Students report that, although they may also use laptops, netbooks, tablets, and smart phones, they still tend to gravitate to the computer laboratories to meet other computer science students, and to work on their coursework. This highlighting of the computer laboratory as an integral part of the university, and especially the student life of the computer science student, has been one of the most strongly voiced aspects of the stakeholder feedback.

5. Conclusion

As the use of computing devices by students has been evolving, and in particular with the economic and educational developments seen in the PRC, the need for traditional computing facilities, especially computer laboratories configured with desktop computers, will be further eroded. As seen in HEI-A, this declining need, combined with ever-increasing pressure on space, is causing a rethink of how universities can provide for the computing needs of all students. An ironic aspect of the many innovations brought about in the classroom through advances in computer science and computing devices is the fact that, in many cases, computer science students themselves are not yet able to be free of the desktop computer — they need, and express a preference for, not only the superior processing power, text input facilities, and displays, but also the actual physical space which they can identify with as their own. Even as the processing power, displays, and other current shortcomings of the mobile devices are overcome, this need for a space to identify with may well continue, and represent the most significant challenge to the BYOD culture and to the goal of freeing the computer science student from the desktop.

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