
Original Paper

Teaching Health Informatics to the Net Generation: A New Baseline for Building Capability?

Kathleen Gray, PhD; Gregor Kennedy, PhD; Terry Judd, PhD

The University of Melbourne, Biomedical Multimedia Unit, Faculty of Medicine, Dentistry and Health Sciences, Melbourne, Australia

Corresponding Author:

Kathleen Gray, PhD

The University of Melbourne

Biomedical Multimedia Unit

Faculty of Medicine, Dentistry and Health Sciences

Victoria 3010

Australia

Phone: +61 3 8344 8936

Fax: +61 3 8344 4998

Email: kgray@unimelb.edu.au

Abstract

Background: The current generation of medical students are the Net Generation. However there is a dearth of data on their Internet use to inform universities' approaches to using the Internet, especially Web 2.0, most effectively in medical education. In particular, we have little information on students' skills base to use in planning to build greater informatics capacity in the Australian health workforce.

Objectives: Collecting evidence of current students' Internet experiences and preferences will help to determine how, or indeed whether, our approach to developing students' informatics capabilities needs reform. This study addresses longstanding issues, by telling us what Internet capabilities students may have acquired or be likely to acquire by osmosis. Such evidence is required to help educators to develop students' focus on essential clinical uses of the Internet.

Methods: Data on Internet use by 207 incoming medical students were collected as part of a four-page survey at a major Australian university, on first-year students' experiences with information and communications technologies and preferences about their use in higher education. Findings about Internet use by this cohort were compared with informatics education standards, frameworks and curricula for Australian medical undergraduates, to identify key issues for teaching and learning.

Results: Students' Internet use is extensive, intensive and competent, but students do not have uniform experiences or preferences and are not major users of emerging Web technologies. In the undergraduate medical curriculum, it is difficult to determine accurately what types and levels of informatics capabilities are specified where, the details of related objectives, activities and assessment, or any picture of student learning outcomes in this area.

Conclusions: It remains most important that educators identify and address gaps in students' Internet experiences and preferences, in relation to Internet uses that the profession considers most targeted and productive in building students' essential informatics competencies. Educational issues that need to be addressed include: - deficits in Internet skill, knowledge and attitude of individuals (including some teaching staff); requirements for customising teaching about informatics to varied student experiences and preferences and within classroom and clinical settings; and considerations of appropriateness and efficiency in Internet use in professional practice.

KEYWORDS

Clinical informatics; medical students; World Wide Web; competency-based education; Internet; medical informatics; undergraduate medical education

Introduction

Background

The use of information and communication technology is an increasingly important part of medical education, in evidence-based practice and in preparing students for continuing medical education

and professional development, as well as being essential to a student-centred learning approach. [1 p14]

The use of the Internet including in health information systems, telehealth services, electronic health records, and clinical and administrative decision-support systems - is an increasingly influential part of the working environment of medical

professionals. Sharma et al speaking of North America but with equal relevance to Australia assert that “The shift in the nation’s attention, resources and interest toward internet-related healthcare activities, often called ‘e-health’, is dramatic and a most significant development in the healthcare environment.” [2 p50] Clinical trainees and qualified clinicians can expect to work routinely, via Web interfaces, with electronic patient records, computerised treatment protocols, prescribing databases, intelligent monitoring devices and video-based specialist consultations, for example.

However, there is “little substantive information on the current skills base” [3 p3] in information and communications technologies (ICT), including Internet technology [3], to use in planning how to build greater health informatics capacity in the Australian health workforce. The skills base of medical students is part of this unknown quantity. The current generation of medical students are often referred to as the Millennials or the Net Generation, born since 1982 and said to have developed, informally during their upbringing, distinctive attitudes and practices in the use of Internet-based ICT [4]. According to Frand [5] these students believe that: computers aren’t technology; the Internet is better than TV; reality is no longer real; doing is more important than knowing; learning resembles Nintendo more closely than it resembles logic; multitasking is a way of life; staying connected is essential; delay is intolerable; handwriting is inferior to typing; and the roles of consumer and creator are blurring.

The extent of distinctive attitudes and practices in the use of the Internet among Net Generation medical students, and the implications of such characteristics for their formal higher education, are unclear. While educators are being urged towards renewed “exploration and experimentation into how to use telemedicine and the Internet most effectively for medical education” [2], there is a dearth of data on students’ Internet use that could inform medical educators’ approaches to teaching about the applications of Internet technologies in medicine – and supporting this with appropriate uses of educational technologies. This is the case especially in relation to the group of emerging technologies sometimes described as part of “Web 2.0”, such as blogging, social bookmarking, platforms for social writing and media sharing, that emphasise microcontent, openness, connectivity and folksonomy [7].

Objective

One may ask of medical education, as Skiba [8] has asked of nursing education, “How do we begin to transform nursing education to prepare nurses to practice in an “informatics-rich” health care environment? Where should we start? Is there a foundation to build on? How can we expect faculty to transform nursing education for a type of practice that they have not experienced?” Academics teaching core aspects of medical degree studies may be equivocal about the inclusion of health informatics in professional training, finding it “difficult to conceptualize”, and assuming that students will learn what they need to know about it “by osmosis” [9].

For medical education to address the imperative for increased health informatics capacity in the medical workforce most effectively and efficiently, the design of medical students’

formal learning about health informatics needs to be informed by and built upon their current Internet skills. It is important that those who educate future clinical professionals’ access and share research into “understanding where we are now in relation to IM & ICT in order to clarify what practical steps are needed to move forward into the future” [10 p122].

It is not clear that online learning *per se* during a medical degree makes any contribution to health informatics skill building. Most current approaches to educational technologies in higher education are not significantly designed to develop students’ ICT capabilities for professional practice. A major educational technology focus in the university sector, implementing Web-based learning management systems, has been influenced more by generic educational and institutional considerations than it is by ICT uses and trends in the professional workplaces where university graduates will practice. This is described as “the reassertion of instructional industrialism via digital technologies” by Segrave and Holt [11 p8].

Evidence about current medical students’ Internet experiences and preferences can help to determine how, or indeed whether, our approach to developing and extending their health informatics capabilities needs reform. This study identifies what if any aspects of health informatics-related Internet use may be assumed in Net Generation medical students, and thus may not need to be taught or assessed formally, or on the other hand, what aspects may need to be unlearned or relearned for appropriate professional practice. This study provides an evidence base from which curriculum developers and educators can work when they seek to establish or enhance students’ focus on uses of the Internet that are in keeping with “essential clinical informatics skills” [12].

Methods

Student Survey

To provide evidence of current medical students’ ICT experiences and preferences, 207 commencing medical students at a major Australian university (82% of the incoming class of 251) completed a paper-based survey during an orientation session in a large lecture setting in March 2006, as part of a broader survey in the university.

Students were surveyed about their experience of ICT use during the past year outside of formal school environments, and also about their preferences regarding ICT uses during their higher education. As part of the broader survey, data specifically on their Web use were collected, including: type and level of Internet access; type and frequency of Internet use; skill level in relation to type of Internet use; and preference for type of Internet use to help with studies. Survey questions were based on Internet uses identified from current literature on media and culture, and pre-tested on a sample of similarly aged students.

The students surveyed were all commencing as first-year undergraduates and had not been to university previously. The survey findings capture gender differences (51% of respondents were men and 49% women) and reflect strong diversity in language and cultural backgrounds (51% English-speaking background and 49% non-English-speaking background; 68%

Australian or New Zealand citizens or permanent residents and 32% international students on study visas).

Curriculum Review

To relate these findings to students' formal learning about health informatics, a review of undergraduate medical curriculum and standards documentation was undertaken, using documents of the Australian Medical Council, the Australian College of Health Informatics and a major Australian medical school. This review sought to identify aspects of using the Internet that students

could expect to learn about or practice during their medical degree studies.

Students' Internet experiences and preferences were then considered in the light of formal aspects of health informatics education and training in their degree program, to identify gaps, overlaps, and implications for the curriculum and teaching.

Results

Survey Findings

Table 1. Type and level of Internet access by % of respondents

| | Exclusive | Shared | Limited | None | Not sure |
|-----------|-----------|--------|---------|------|----------|
| Broadband | 42.7 | 36.4 | 4.9 | 15.5 | 0.5 |
| Dial up | 22.8 | 19.9 | 7.3 | 47.1 | 1.0 |
| Wireless | 21.8 | 18.0 | 12.6 | 46.6 | 0.5 |

The findings suggest that the great majority of students are used to data- and media-intensive high-speed Internet applications. As shown in Table 1, broadband access, "exclusively for my own use" or "access anytime I need it, shared with other people",

is available to nearly 80% of respondents. But the findings also suggest that more than half of students are not yet used to being online "anytime, anywhere" or while mobile – reasonable wireless access is available to only 40% of respondents.

Table . Type and frequency of Internet uses by % of respondents

| | Daily | Weekly | Monthly | Yearly | Not at all |
|---|-------|--------|---------|--------|------------|
| Access a school portal | 22.8 | 37.4 | 7.8 | 7.3 | 24.8 |
| Browse for general info | 44.7 | 44.2 | 5.8 | 3.9 | 2.4 |
| Build and maintain a website | 1.9 | 3.9 | 4.9 | 18.9 | 68.9 |
| Buy or sell things | 1.9 | 7.8 | 12.1 | 30.6 | 49.5 |
| Comment on other people's blogs or vlogs | 11.7 | 14.6 | 6.8 | 11.2 | 52.9 |
| Contribute to a wiki | 2.4 | 2.4 | 3.4 | 6.8 | 84.0 |
| Download MP3 files | 23.3 | 29.1 | 11.7 | 10.2 | 23.3 |
| Instant messaging / chat | 60.7 | 24.3 | 4.4 | 3.4 | 5.8 |
| Keep your own blog or vlog | 7.8 | 8.7 | 9.2 | 6.3 | 68.0 |
| Listen to sound recordings | 15.0 | 28.6 | 13.1 | 14.1 | 31.1 |
| Look up reference info | 34.5 | 46.1 | 10.2 | 6.8 | 2.4 |
| Pastimes other than games or listening | 40.8 | 36.9 | 4.4 | 5.8 | 13.1 |
| Phone calls | 8.7 | 12.1 | 6.3 | 10.7 | 61.2 |
| Play networked games | 11.7 | 16.0 | 11.7 | 17.0 | 45.1 |
| Read other people's blogs or vlogs | 16.5 | 27.2 | 13.6 | 10.2 | 31.1 |
| Read RSS feeds | 3.9 | 8.7 | 5.3 | 6.3 | 76.7 |
| Send or receive email | 71.4 | 23.8 | 2.9 | 0.0 | 1.9 |
| Services other than buying and selling | 3.9 | 19.4 | 16.0 | 20.4 | 41.7 |
| Share photos or other material e.g. blinklist or Flickr | 7.3 | 15.0 | 11.2 | 12.6 | 51.0 |
| Social networking, e.g. MySpace or Trendster | 14.6 | 10.2 | 4.4 | 7.3 | 62.1 |
| Upload and share MP3 files | 15.5 | 16.0 | 9.2 | 12.6 | 43.7 |
| Web conferencing with a webcam | 7.3 | 9.2 | 5.3 | 10.7 | 66.5 |

The findings suggest that while students' experience with most "traditional" Internet uses can be assumed, their experience with emerging uses is still limited. As shown in Table 2, at least half of all respondents use the Internet once a week or more for: email (95%), general browsing (89%), chat (85%), pastimes other than games or music (78%), reference information (71%), downloading MP3 files (52%), or accessing a school portal

(50%). But at least half of all respondents never use the Internet at all for: contributing to a wiki (84%), reading RSS feeds (77%), maintaining a website (69%), writing their own blog (68%), Web conferencing (67%), social networking (62%), phone calls (61%), commenting on others' blogs (53%), sharing photos (51%), or buying and selling things (50%).

Table . Skill level in relation to type of Internet use by % of respondents (excludes those who don't use at all)

| | High | Medium | Low |
|---|------|--------|------|
| Access a school portal | 55.9 | 33.6 | 10.5 |
| Browse for general info | 73.7 | 23.2 | 3.0 |
| Build and maintain a website | 26.2 | 31.1 | 42.6 |
| Buy or sell things | 40.0 | 34.0 | 26.0 |
| Comment on other people's blogs or vlogs | 52.8 | 31.5 | 15.7 |
| Contribute to a wiki | 25.9 | 48.1 | 25.9 |
| Download MP3 files | 64.9 | 21.4 | 13.6 |
| Instant messaging / chat | 79.6 | 13.6 | 6.8 |
| Keep your own blog or vlog | 47.5 | 27.9 | 24.6 |
| Listen to sound recordings | 50.0 | 31.2 | 18.8 |
| Look up reference info | 67.7 | 25.8 | 6.6 |
| Pastimes other than games or listening | 69.0 | 24.7 | 6.3 |
| Phone calls | 46.1 | 32.9 | 21.1 |
| Play networked games | 48.6 | 24.3 | 27.0 |
| Read other people's blogs or vlogs | 55.6 | 30.4 | 14.1 |
| Read RSS feeds | 23.3 | 44.2 | 32.6 |
| Send or receive email | 89.8 | 8.2 | 2.0 |
| Services other than buying and selling | 42.7 | 34.2 | 23.1 |
| Share photos or other material e.g. blinklist or Flickr | 36.2 | 45.7 | 18.1 |
| Social networking, e.g. MySpace or Trendster | 54.9 | 25.4 | 19.7 |
| Upload and share MP3 files | 52.3 | 27.1 | 20.6 |
| Web conferencing with a webcam | 43.8 | 26.6 | 29.7 |

The findings suggest that overall students don't regard Internet use as difficult, and are confident in their abilities as Internet users. As shown in Table 3, at least half of all respondents estimate their skill level at 3 out of 5 or better, among those who use the Internet for: email (98% of the students who use it), general browsing (97%), pastimes other than games or music (94%), reference information (94%), chat (93%), accessing a school portal (90%), downloading MP3 files (86%), reading

others' blogs (86%), commenting on others' blogs (84%), sharing photos (82%), listening to sound files (81%), social networking (80%), uploading and sharing MP3 files (79%), phone calls (79%), services other than buying and selling (77%), writing their own blog (75%), buying and selling things (74%), maintaining a wiki (74%), playing games (73%), Web conferencing (70%), reading RSS feeds (68%), or maintaining a website (57%).

Table . Preference for type of Internet use to help with studies by % of respondents

| | Agree | Neutral | Disagree | Don't know |
|---|-------|---------|----------|------------|
| Access a school portal | 83.7 | 13.3 | 2.0 | 1.0 |
| Browse for general info | 87.7 | 10.3 | 0.5 | 1.5 |
| Build and maintain a web-site | 28.1 | 42.9 | 25.6 | 3.4 |
| Buy or sell things | 44.6 | 34.8 | 18.1 | 2.5 |
| Contribute to a wiki | 25.1 | 41.5 | 21.5 | 11.8 |
| Download MP3 files | 65.7 | 21.9 | 10.0 | 2.5 |
| Instant messaging / chat | 81.3 | 14.3 | 3.9 | 0.5 |
| Keep your own blog or vlog | 30.7 | 39.6 | 24.3 | 5.4 |
| Listen to sound recordings | 66.2 | 26.0 | 5.9 | 2.0 |
| Look up reference info | 95.6 | 2.9 | 0.5 | 1.0 |
| Phone calls | 47.5 | 28.4 | 19.6 | 4.4 |
| Read or comment on other people's blogs or vlogs | 37.4 | 37.9 | 19.7 | 4.9 |
| Read RSS feeds | 35.5 | 39.0 | 15.0 | 10.5 |
| Send or receive email | 94.1 | 3.9 | 1.5 | 0.5 |
| Services other than buying and selling | 88.7 | 7.4 | 3.4 | 0.5 |
| Share photos or other material e.g. blinklist or Flickr | 51.5 | 33.2 | 10.9 | 4.5 |
| Social networking, e.g. MySpace or Trendster | 35.3 | 34.8 | 24.9 | 5.0 |
| Upload and share MP3 files | 50.2 | 32.0 | 14.8 | 3.0 |
| Web conferencing with a webcam | 45.5 | 31.2 | 17.3 | 5.9 |

With regard to using the Internet in learning overall, students' preferences in favour of every use are stronger than their opposition to any use. This suggests that students have quite high expectations about what they should be able to do on the Internet as part of their studies. As shown in Table 4, at least half of all respondents agree or strongly agree that, to help them university studies, they want: reference information (96% of students), email (94%), services other than buying and selling (89%), general browsing (88%), accessing a school portal (84%), chat (81%), listening to sound files (66%), downloading MP3 files (66%), sharing photos (52%), and uploading and sharing MP3 files (50%). Internet uses that students most disagree or strongly disagree that they want, to help them with university studies, are maintaining a website (26% of students opposed), social networking (25%), writing their own blog (23%), contributing to a wiki (22%), reading or commenting on others' blogs (20%), and phone calls (20%).

Curriculum Findings

The Australian Medical Council (AMC) standards for the assessment and accreditation of medical schools [1] make no specific mention of using the Internet in medicine, only making very general references to ICT. The AMC lists as the twelfth out of twelve skills required of graduates [1 p14]: "the ability to use information technology appropriately as an essential

resource for modern medical practice". The AMC requirements for medical school provision of educational resources include three ICT standards [1 p41]: "The medical school has sufficient information technology facilities for the staff and student population to ensure the curriculum can be delivered adequately"; "The medical school effectively uses and evaluates information and communication technology in the education program"; and "Teachers and students are able and encouraged to use information and communication technology for self-learning, accessing information, managing patients and working in health care systems".

More detail about health informatics capabilities that need to be developed in undergraduates is found in the Australian College of Health Informatics (ACHI) educational framework for health informatics [14 p6-7]. It recommends that undergraduate clinical curricula— through integrated as well as elective learning – should equip students with standard levels of competency, in relation to 23 general elements of computing as well as 20 specific elements of health informatics. The use of the Internet is implied in many of these competencies, but the ACHI framework is silent as to how students might build skill in these areas based on their existing Internet use experiences and preferences.

The university's Bachelor of Medicine / Bachelor of Surgery course guide [13] treats the Internet explicitly and implicitly within four general categories of how students will use ICT to support their learning across their degree studies: (1) learning framework – the use of a Web-based learning management system to support problem-based learning; (2) IT-based learning resources – the use of interactive multimedia resources to support self-directed learning; (3) World Wide Web access – the use of the Web for information search and retrieval to support learning; the use of Web-based email; and (4) IT skills – basic skills, the use of IT as learning tool, to complete assignments and for learning administration. These Internet uses do not directly translate as support for students' learning about the Internet as part of "essential clinical informatics skills".

Learning to use of the Internet as part of "essential clinical informatics skills" may occur during the undergraduate degree in two ways, although these are not discernable from the curriculum review: (1) The structure of the medical degree offers "medical informatics" as one of over ten options from which students may select a research project for the Advanced Medical Science subject in semesters 6 and 7 (of 12 semesters). (2) A search of the medical course curriculum database, using terms such as 'information literacy', 'information needs' and 'patient information', suggests that some relevant units of study also may be embedded in core curriculum, for example, in Health Practice subjects.

Discussion

Students' Technology Baseline

In summary, students' Internet use is: extensive – 22 different Internet uses by students are identified; intensive – between 5% and 95% of students engaged at least weekly in every one of these different Internet uses; and competent – at least half of all users report good skills in relation to every one of these different Internet uses. But students do not have uniform experiences or preferences; their Internet use is also diverse and idiosyncratic and not strong in many aspects of emerging technologies. This seems to belie the existence (as yet) of a wholly Web-acclimated and Web-capable Net Generation who can be relied upon to construct knowledge and skills in the use of the Internet in medicine from a particularly useful base of informally acquired knowledge or skill.

While the survey data are comprehensive and quantitative, they rely on self-reporting by respondents of their experiences and preferences, and would be strengthened by additional data using methods such as actual usage audits and focus groups. Variation that may be explained by personal style, demographics or equity factors is another subject of further investigation.

Health Informatics Capabilities to be Developed in Students

Curriculum documentation can be read as giving in principle scope and support for the teaching and learning of essential clinical uses of the Internet. However, documentation does not systematically address principles or processes for learning experiences that would scaffold or guide a student's transition

from social Internet uses, to those that are necessary or desirable in contemporary clinical practice.

Some aspects of the use of the Internet in medicine may be embedded within theoretical or practical studies, but from an educational quality perspective, it is difficult to determine accurately what types and levels of health informatics capabilities are specified where, the details of related objectives, activities and assessment, or any picture of student learning outcomes in this area.

Matching Student Experiences and Preferences with the Needs of the Profession

There is much for curriculum developers and academic educators to respond to in the experiences and preferences expressed by students. Looking at these findings in light of the Internet use capabilities students ought to have as graduates, could inform teaching and learning improvements, on a surface level or more deeply, to make progress towards building health informatics capabilities.

Some student preferences may arise from students' sense of what would improve the convenience of student administration and learning management aspects of their studies. It would seem to be relatively easy to adapt student orientation and administration to be more Web-based or Web-complemented, in order to be more appropriately student-centred. A next level of change could be to implement further Web-based or Web-complemented flexibility and innovation in the their learning activities, resources, support, and assessment across the curriculum, particularly examining emerging technology options, and to assume that this will facilitate or inspire more health informatics-related skill building that students will do "by osmosis".

It remains most important that educators identify and address gaps in students' Internet experiences and preferences, in relation to Internet uses that the profession considers most targeted and productive in building students' essential informatics competencies. However, it is not straightforward to look to academic experts to initiate health informatics-related improvements to using the Internet in teaching and learning that may be suggested by these findings. Some of the Internet uses identified in the survey are likely to be beyond the capabilities of many academics. Expertise spanning clinical knowledge, ICT knowledge and pedagogical knowledge is not common in individuals in the academic teaching workforce, and projects may entail many stakeholders.

While it is unreasonable to expect students' imperfect knowledge of the Internet and of medicine to shape the design of learning, it is possible that new synergies between mode and content of learning could emerge from staff-student dialogue, exploratory learning or partnerships in improvement projects. Such activities will need to compete for time and attention with many other aspects of the medical curriculum.

The baseline of Internet uses and use preferences among incoming students that this study establishes provides evidence to support changes in standards and curricula for undergraduate medicine, in order to elaborate and address issues in health informatics education, including: deficits in skill, knowledge

and attitude of individuals (including some teaching staff); requirements for customising teaching about health informatics to varied student experiences and preferences and within classroom and clinical settings; and considerations of appropriateness and efficiency in Internet use in professional practice.

Acknowledgments

Financial assistance for this survey was provided by the Office of the Deputy Vice Chancellor (Academic) at The University of Melbourne.

Conflicts of Interest

None declared.

References

1. Assessment and Accreditation of Medical Schools: Standards and Procedures Australian Medical Council: 2002.
2. Sharma S, Xu H, Wickramasinghe N, Ahmed N. Electronic healthcare: issues and challenges. *International Journal of Electronic Healthcare* 2006;2(1):50-65.
3. Australian Health Information Council. Health Information Workforce Capacity Building National Action Plan. Commonwealth of Australia. Canberra: AHIC, 2003.
4. Oblinger D, Oblinger L, editors. *Educating the Net Generation*. Boulder, CO: Educause, 2005.
5. Frand J. The information age mindset: changes in students and implications for higher education. *Educause Review* 2000 Sep-Oct:15-24.
6. Wiecha J. Commentary. *J Telemed Telecare* 2004;10:361-362.
7. Alexander B. Web 2.0: A new wave of innovation for teaching and learning? *Educause Review* 2006 Mar-Apr:32-44.
8. Skiba D. Informatics competencies. *Nurs Edu Perspect* 2004;25(6):312.
9. Buckeridge D, Goel V. Medical informatics in an undergraduate curriculum: a qualitative study. *BMC Med Inform Decis Mak* 2002;2:6.
10. Iliffe J. (2005). Building the IM & ICT capacity of the health workforce. In: *Proceedings of the National Health Information Summit: Transforming Australia's health system*. 2005:121-123.
11. Segrave S, Holt D. Contemporary learning environments: designing e-learning for education in the professions. *Distance Education* 2003;24(1):7-24.
12. Coeira E. Medical informatics meets medical education: there's more to understanding information than technology. *Med J Aus* 1998;168:319-320.
13. Bachelor of Medicine Bachelor of Surgery Course Guide 2005. Melbourne: The University of Melbourne Faculty of Medicine, Dentistry and Health Sciences.
14. Garde S, Hovenga E. Australian Health Informatics Educational Framework. Australian College of Health Informatics; 2006.