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Clash of the Titans

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Clash of the Titans

Harry E. Pence, SUNY Oneonta, Oneonta, NY, 13820

The death of Steve Jobs caused me to stop and reflect on how much computing has changed since he returned to Apple in 1997. At that time, Microsoft ruled the world of desktop computers; MySpace was the predominant social network site and Facebook had just been registered as an online domain; Nokia was the big name in cell phones having released the first mobile phone to enable wireless email and internet connection in 1996; Larry Page and Sergey Brin, Ph.D. students at Stanford, had just announced a new search engine, called Google; several companies had introduced tablet computers but none had achieved much popularity; and Amazon was beginning to establish itself as a leader in online book sales, having served 1.5 million customers that year. There was intense competition within various types of computer applications, but that competition was still fragmented among several different companies.

At about this time, I began writing a series of articles for *this Newsletter* with the title, "What is the best search engine for Chemists?" When I began writing, there was a plethora of different search engines available, and this seemed like a topic that might be helpful to my colleagues. With passing time, however, Google became so dominant that my focus narrowed to the competition between Google and Microsoft. Despite Microsoft having spent over six billion dollars on Bing, their latest attempt to dominate search, Google has continued to dominate, and this competition never became the Clash of the Titans that I expected [1]. The articles I wrote were predicated on the assumption that the main way Chemists would access online information was by using search software on desktop or laptop computers. This assumption is no longer viable; mobile devices are becoming the new standard for many tasks, including search, that were traditionally done on desktop and laptop computer.

The real clash of the Titans may already be underway, but contrary to my expectations, the battle to determine which company will control the future of personal computing is being fought over mobile devices, like phones and tablets, rather than search. Apple and Google have pushed aside the early leaders in cell phone technology, including Motorola and Nokia, to become the innovation leaders. Recently Nokia, the Finnish mobile company, has agreed to replace its mobile operating system with that provided by Microsoft. It remains to be seen if the Nokia/Microsoft combination can overcome the technological lead of Apple and Google. The companies competing with the iPhone, mainly use the Android operating system, created by Google. Google is in the process of buying Motorola Mobility, presumably to secure the treasure trove of mobile patents held by Motorola. Recently, both Nokia and Microsoft have released new phones, but this news was largely lost in the blizzard of publicity for the iPhone 4s. The dark horse in the race is Amazon, which already dominates ereaders with the Kindle, and has now released a low-priced tablet, the Fire. The important message from these developments is that some very innovative companies with large amounts of cash are going to be focused on the development of mobile computing in the next few years.

In addition, more and more young people have smartphones and use them to access the World Wide Web (WWW). Globally, there are about three cell phones for every computer, and in the year 2008, for the first time sales of smartphones were greater than the sales of laptop computers [2]. A recent study by the Pew Trust reported that "87% of smartphone owners access the internet or email on their handheld, including two-thirds (68%) who do so on a typical day. When asked what device they normally use to access the internet, 25% of smartphone owners say that they mostly go online using their phone, rather than with a computer. [3]" The report notes that these percentages are higher for some groups, including those younger than 45. A recent article in *The Chronicle of Higher Education* indicates that 40% of college students use the Internet on mobile devices every day, and students increasingly expect that all their college services will be available from their phone [4].

Taken together these developments suggest that mobile computing use is continuing to expand rapidly and that increasing numbers of the students in our Chemistry classrooms will be carrying mobile devices that are connected to the World Wide Web. Currently, the use of mobile devices is at about the same point that electronic calculators were a couple of decades ago. There are still many teachers who may remember the efforts to ban electronic calculators from the classroom. It is clear that these efforts were unsuccessful, and it is likely that similar attempts to ignore or ban classroom use of mobile devices will fail. It is time to begin thinking about how the mobile ecosystem can be integrated into Chemistry teaching

It is possible that some of the antipathy towards these devices arises from a misunderstanding based on the word phone. A modern cell phone is no more like a conventional telephone than a modern automobile is a horseless carriage. Both the automobile and the smartphone have capabilities that much greater than their antecedents. The cell phone has become a powerful, handheld, web-enabled, image processing

computer. It is the most powerful research device created since the desktop computer, and many of our students already recognize this. It is true that cell phones can serve as a communications device that may be a distraction in class, but focusing on this aspect is no more productive than focusing only on the fact that automobiles create junkyards when they are discarded. In each case the problem is real but is solvable and does not represent a reason to ignore the potential usefulness of these technologies. In addition, banning smartphones at this stage is probably as likely to succeed as was the attempt to ban all electronic calculators.

Recent research suggests that users are already changing their mental habits to take advantage of the computer software, like Google [5]. There is a tendency to use the computer to offload information that is needed less often. This is consistent with transactive memory theories proposed by Daniel Wegner thirty years ago, namely that humans often depend on shared memories to complement their own remembering. For example, a husband might depend upon his wife to remember some facts, or, in the modern day, a student might use the computer as an auxiliary memory, where facts could be recovered as needed [6]. In a similar way, classroom work might discriminate between essential facts, that must still be learned, and less critical information, that can be looked up on a computer as needed.

When thinking about the classroom of the future, it is better to think in terms of the mobile ecosystem rather than specific devices, like smartphones. Many young people seem to be quite satisfied to watch videos and read text on a phone screen, but those of us somewhat further along in years may well appreciate the larger screen on a tablet computer, like the iPad. As the recent explosion of interest in tablet computers demonstrates, the world of computer devices is constantly changing, and so there may be some new device is the offing that will be more attractive. The mobile ecosystem can be defined as the combination of mobile devices, apps, operating systems, physical objects, and networks that integrates information retrieval and communications. Of course, there will still be some jobs that are better done on a laptop or desktop computer.

Apple has recently released the latest version of the iPhone, the 4s, which expands the already impressive capabilities of the previous versions. In addition to a faster dual core chip and improved camera, the new version includes a "personal assistant," Siri, which understands verbal commands, so that you can now tell your phone, "Remind me to turn on the coffee maker when I get to work," and the phone will not only remind you, but the Global Positioning System in the phone will know when you get to work and remind you then. Siri accepts vocal commands to search the web for information. The search is currently directed to Wikipedia or WolframAlpha, but it is quite likely that soon this capability will be expanded to Google or Bing. If Apple decides not to do this, some other smartphone maker will surely seize upon this as a competitive advantage.

How will this change the chemistry classroom? Several faculty are already trying to answer this question. For example, McDonald recently reported in this Newsletter, that she was using smartphones in her high school classroom [7]. There are already a large number of chemistry-related apps available [8] including Chemspider, which is an excellent data base of chemical information [9]. Williams has made a number of presentations about using the Mobile Internet for Chemistry, and many of these are available on Slideshare, including one titled, "Taming The Wild West Of Internet Based Chemistry You Can Help [10] and another on Mobile Chemistry and "Generation App" [11]. Some entire campuses have whole-heartedly made a commitment to mobile technology. For example, Abilene Christian University, a small college in Texas, is entering its fourth academic year of implementing mobile technologies, like iPhones, iPods, and iPads, across the campus, and according to a recent survey, "89 percent of faculty members bring mobile devices to class; 84 percent regularly use the devices in class; and half of faculty report using the devices in every class [12]." Private communications from some of the Chemistry faculty involved in this effort suggest that they are enthusiastic about this change.

Cloud computing does not require commitment to mobile devices but access to the computing cloud does expand the capabilities of mobile computing. Many of the same major corporations are behind this initiative as are behind mobile technologies, Apple, Google, Microsoft, Amazon, etc. Software like Google Docs and Dropbox create opportunities for even undergraduates to learn about manipulation of large data sets [13]. Hey et al have argued that this is an essential skill for science students in the Digital Age [14].

Earlier in this online session, there was considerable discussion of the future of lecture as a teaching method. If mobile learning becomes as widely adopted as expected, all the current methods will probably need some revision. In some cases, like the traditional stand and deliver facts lecture, extensive adjustment will be needed. When students will carry in their pockets the equivalent of a major research library, classroom work can, and should, go beyond focus on individual facts. There will be many different ways to use mobile devices, but at this stage it is critical that these possibilities be explored.

The Clash of the Titans is coming soon to a classroom near you, and, unlike the movie of the same name, it will not be a spectator event; don't bother to bring popcorn. Some of the largest and most innovative companies in this country will be trying to convince you to explore new ways for teaching and learning, and your students are already using their products. It looks like interesting times ahead for chemical education, and I should continue to have plenty to write about, even if the Microsoft-Google battle over search never meets my expectations.

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