Chapter VII

Peer-to-Peer Networks as Extensions of Web-Based Education—Handhelds in Support of Coordination and Autonomy

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ABSTRACT

In recent years, we have witnessed the rapid evolution of handheld computing devices from leading manufacturers, somewhat fueled by a battle being waged between Palm Computing and Microsoft Corporation. Handheld devices are attractive for educational settings, because they are inexpensive, portable, and customizable. Furthermore, most handheld devices come "out of the box" with infrared ports, enabling them to automatically form a peer-to-peer network with other handhelds. In this chapter, how such peer-to-peer networks could support the interplay of autonomy and coordination underlying current and emerging learning models will be discussed. Findings from a pilot study suggest that the information management and connectivity features of the machines make them ideal devices for such learning environments. The entertainment capabilities of the devices motivate students to learn how to use them. However, students found the machines and add-ons expensive, limited in capability, and difficult to use.

INTRODUCTION

Fueled by the widespread implementation of local area networks in the 1980s and the emergence of the World Wide Web in the 1990s, network computing has become an essential

piece of technology-assisted education. Indeed, universities and other educational institutions are even seen as key to "pushing innovations in software and networking into the mainstream" (Hamm, 2000). Web-based education is a viable and thriving model for knowledge delivery in this context. In this chapter, it is proposed that the notion of Web-based education be extended to incorporate peer-to-peer (P2P) networks. Specifically, it will present a model for Web-based education that incorporates P2P via the deployment of handheld computing. Aside from being portable, handheld devices have the capability to communicate with other devices, because most of them include an infrared port. The ports allow devices to communicate with each other without having to route messages through a centralized network, such as the campus backbone or a departmental LAN, thereby creating a P2P network (Gonsalves, 2001; Werbach, 2000; Werbach, 2002). A summary of the various components of P2P networks is provided in the Appendix.

The flexibility and user-driven features of P2P networks of handhelds make them suitable for the fluid, emergent learning environments envisioned by education futurists. Learning models based on coordinated autonomy (Davis, 2001), constructivist philosophy (Abbott & Ryan, 1999), distributed education (Hawkins, 2000), ubiquitous computing (Brown, Burg, & Dominick, 1998; Thompson, 2002), and community service learning (Papamarcos, 2002) suggest an undercurrent of balanced interplay between autonomy and coordination. P2P networks of handhelds hold the promise and a first glimpse of possible technology platforms that can enable and inspire this interplay. In this chapter, the first phase of a study to determine how P2P networks will mesh with Web-based education is reported. It reports on a pilot study that explored how students might use handhelds to support their activities. The study findings are used to develop propositions to guide future deployments of P2P networks to support Web-based education.

P2P networks are emerging as viable adjuncts, even alternative networks, to the more centralized World Wide Web. In P2P networks, users are able to share files with little to no involvement or control from centralized servers. Its most visible application to date is Napster's MP3 distribution network, with success that unfortunately led to its demise. While it is probably responsible for much of the fame and notoriety of the P2P model, Napster, ironically, did not provide a pure P2P network. Napster still required centralized servers to keep track of the locations of files on client machines. True P2P networks, such as those based on the Gnutella protocol (Limewire, BearShare), do not require such centralized directories to find files on computers connected to the P2P network (Fry, 2002). From its roots as an alternative and controversial distribution method for music distribution, the P2P concept has been used to support collaboration, decentralize delivery of large media files, allow complex calculations to be parceled out among clusters of inexpensive computers, and extend the reach of wireless broadband networks (Werbach, 2000, 2002).

A P2P network makes it possible to share information within the localized area of a classroom or a small group discussion, without involvement of the central campus backbone or a local area network. The P2P model allows individual instructors to quickly incorporate networked computing support into their classroom activities, because it reduces the cost and setup effort associated with the establishment of a connection to the campus' central network or department LAN. Although it is also possible to connect the P2P network to the campus backbone through a single machine with networking capability, such connections are expected to occur only once-a-day or even less frequently. Generally, participants in P2P networks do the majority of their sharing directly with peers in the network, rather than with or through servers accessible via the Internet or campus backbone.

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