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Can WiFi Enable E-Learning in Developing Nations?

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ABSTRACT

This study presents a low-cost Wireless Fidelity (WiFi) model network that can be used to introduce economical IP-enabled communications infrastructure and uses the Equivalent Theory proposed by Simonson [20] to analyze underlying factors that may impact the successful implementation of E-Learning in developing nations. Managerial implications are summarized in a conceptual model which can be used by practitioners to assess the effectiveness E-Learning activities in developing nations

Keywords: WiFi, Wireless Fidelity, E-Learning, developing nations, Equivalent Theory

INTRODUCTION

Wireless Fidelity (WiFi), is a technology that enables Local Area Networks (LANs) to communicate wirelessly over radio wave frequencies of 2.4 GHz [13]. WiFi is based on a family of protocols known as the 802.11x, the most commonly used of which are 802.11b and 802.11.g, boasting speeds of up to11 and 54 Megabits per second, respectively. If supported by omni-directional antennas, WiFi infrastructures can reach unobstructed radius ranges of up to 300 feet [4]. Moreover, when used in combination with Wireless Access Points (WAPs), unidirectional antennas, and power amplifier options, ranges of up to 16 miles (25 kilometers) of point-to-point communications can be easily attained [18]. Recent research has achieved a range of 62 miles (100 km) [24], leading to product introductions [1] that enable the deployment of IP-enabled telecommunications networks costing a fraction of traditional wire-based solutions. WiFi networks can fill the communication needs of users at prices significantly lower than traditional telecom solutions [3] thereby making it an attractive option for developing nations who desire to deploy alternative telecommunications solutions to reach their constituencies. Moreover, the relatively low-power consumption of intermediate WAPs, and improvements in solar-powered batteries can be combined to develop networks that can be used to reach hitherto unreachable zones such as rural areas, islands, and the like.

Although, there are questions about the reliability of WiFi for WAN communications, the technology has matured significantly to the point in which large carriers, such as British Telecom, have started the deployment of “hotspots” to make WiFi available in hotels, airports, convention centers, and lately into rural areas [3]. The popularity of WiFi seems to be increasing exponentially; for example, T-Mobile has deployed over 2,000 hotspots in coffee shops, bookstores, and airports across the United States [4]. Datacomm Research [5] reports that WiFi LAN equipment sales are expected to triple, exceeding $16 billion by 2009.
The educational establishment has noticed the trend toward an unplugged environment. In the US alone hundreds of high-schools, colleges and universities have implemented WiFi [11] as an underlying technology to enable students access at anytime, from anywhere.

WiFi networks could be used to build the highways to carry distance education based on E-Learning content. E-Learning has been heralded as a revolutionary engine for the continued progress of advanced nations and as an important tool that could be exploited by developing nations to secure their entry into the global market [23, 2].

As a new array of internet protocol (IP) based interactive, multimedia-rich applications becomes mainstream in the World Wide Web [23], developing nations are afforded the opportunity to provide standardized education that can be used to develop incipient industries which hitherto required delivery of education through traditional training settings. Distance education can transform traditional education settings into cyber-classroom environments that virtually eliminate travel and costs related to it, specialized equipment, printed material and other traditional educational support [15].

Developed nations have seen a phenomenal growth of E-Learning. For example, in 2001, U.S. corporations invested over $1.1 billion in online training. Merrill Lynch predicted that this figure would increase to $11 billion by 2003 [2]. International Data Consultants forecasts that E-Learning will increase from $6.6 billion in 2003 to $23.7 billion by 2006 [8].

Several advances in technology have intersected, to facilitate the acceptance of E-Learning as an option in the education toolbox, including greater availability of high-speed telecommunication infrastructures coupled with escalating use of the Internet [13]. These advances, however, have been conspicuously unavailable to developing nations. Santoyo [17] argues that while developed nations boast telephone density above 50 percent, in some developing countries the penetration is one telephone per 350 people. The Internet World Stats [9] reports that as of February, 2005, the top 10 countries with the highest penetration Internet rate were: Sweden, Hong Kong, United States, Netherlands, Iceland, Australia, Canada, South Korea, Denmark and Switzerland with a combined population of 507.6 million people and an Internet penetration rate of 65.3 percent; whereas the rest of the world, with a population almost ten times greater, 6 billion people, possessed an Internet penetration rate eight times lower, or 8.2 percent.

Although there is a vast amount of literature linked to distance education most research is focused on comparing and contrasting the implementation and delivery of distance education through traditional academic settings [20, 21, 19, 12, 7, 6, 22] or advocate the advantages of using E-Leaning to train employees [14, 15]. There does not appear to be an integrative framework that includes technology, content, and people that to assess the impact that E-Learning may have on the student population of developing nations. WiFi has the potential to address to the technology component of the aforementioned equation, however, the other two elements, content and people, need to be assessed carefully to develop a holistic template that can be used as a guideline to the successful implementation of such an endeavor.

Purpose of the Research

Given the perceptible void in the literature, it is the purpose of this article to propose a WiFi-based network that can be used as a model to deploy low-cost IP telecommunication systems to guide academicians and practitioners wishing to implement standardized E-Learning in developing nations, A further objective of this study is to highlight social factors which have been identified in the literature as potential hurdles to the successful introduction of E-Learning in organizational settings.

Introduction and Explanation of the Research Problem

This study is concerned with (a) the presentation of a basic model that can be used as the template to put into service a low-cost WiFi network, (b) the determination of factors that may hinder the successful delivery of standardized E-Learning as a mean to educate people in developing nations and (c) the development of a model to guide practitioners tasked with implementing such distance education programs.

In this study the understanding of equivalent learning factors is prescribed as an antecedent for the successful implementation of standardized nationwide E-Learning programs within the context of the Equivalent Theory of Distance Education posited by Simonson [20].

Research Questions

In the quest to deploy distance education through low-cost telecommunication infrastructures, the preceding discussion leads to the following two questions: (a) Could WiFi positively impact the delivery of effective E-Learning content to people in developing nations? and (b) Do equivalent learning experiences of distant students impact E-Learning effectiveness, as proposed by Simonson [20]?

Scope of this Research

Although there are many elements, such as financial resources, political issues, and a wide range of technology availability that should be considered in the decision to introduce standardized E-Learning, for practical reasons this study will focus on the introduction of one basic WiFi model. It will focus on the Equivalent Theory of Distance Education introduced by Simonson [20] which posits that "Learners, distant and local, should be provided equivalent learning experiences in order for them to achieve similar learning outcomes" [p.47].

Definition of Distance Education

Gunawardena (Gunawardena study as cited in [16]) and Keegan [10] posit that distance education is a distinct field of education, parallel to and a complement of conventional education, where students are separated by time and/or space and can be linked through the use of external means such as the postal service, radio, and the like [20]. Keegan [10] identifies six underlying dimensions connected to e-Learning: (a) separation between teacher and student; (b) influence of an educational organization; (c) use of media to connect teacher and student; (d) two-way exchange of education; (e) students perceived as individuals, not as groups; and (f) education as a form of industrialization.

Equivalent Theory

Simonson [20] argues that previous theories linked to distance education, such as the theories of Autonomy and Independence, Industrialization of Teaching, and Interaction and Communication proposed by Keegan [10, 16, 20] were introduced before 'virtual education' was common. Simonson [20] points out that it is a mistake to ask all students, regardless of their geographical location, to participate equally in the education process, in effect providing identical instructional

situations to all learners, regardless of their time zones, schedules, or geographical differences; to address these issues Simonson [20] put forward his Equivalent Theory explaining that "for distance education to be successful its appropriate application should be based on the belief that the more equivalent the learning experiences of distant students are to the local students the more equivalent the outcome of the learning experiences will be" [20, p.46].

Simonson's [20] Equivalent Theory is appropriate for this study because it was created to explain distance education in settings that were not commonly available when previous theories were introduced. Simonson takes into account the formal, institutionally based education that takes places using interactive telecommunication systems. Moreover, Simonson [20] recognizes that local and distant students may be exposed to fundamentally different learning environments. Therefore, it is the responsibility of the distance educator to design learning events that provide experiences of equal values to learners [20]. Although the original intent of the theory was to explain behaviors of students in the United States, its underlying premises can be extended to the international surroundings and multi-culture environments commonly found in developing nations.

Research Model

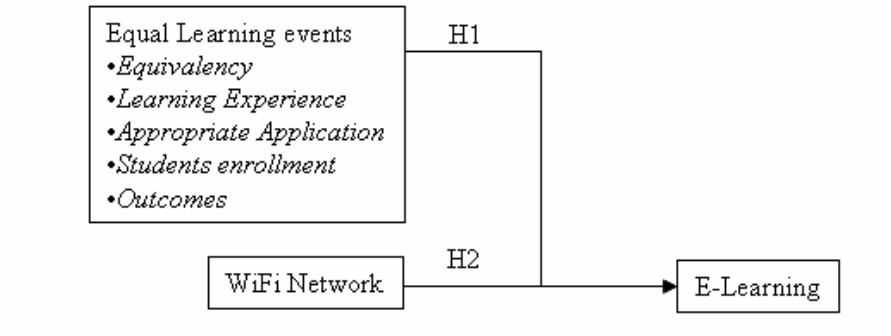

Figure 1. Relationship between Equal Learning Events, WiFi and E-Learning

The basic box diagram used to guide this study is shown in Figure 1. As can be seen there are three variables: Learning Events (independent variable), WiFi Network (independent variable), and E-Learning Effectiveness (dependent variable).

Hypotheses

The interrelationship of the proposed model is expressed in the following hypothesis:

H_1: Equal Learning events is related to E-Learning Effectiveness

H_2: Availability of WiFi Network is related to E-Learning Effectiveness

Proposed WiFi Network

As Figure 2 shows WiFi networks may be set up in two modes: "infrastructure" and "ad-hoc" mode. In an "infrastructure" configuration the devices within a WiFi system communicate with each other through an access point. An "ad-hoc" configuration, on the other hand, is targeted toward wireless-equipped devices communicating directly with each other; therefore "ad-hoc" WiFi arrangements do not require access points [18]

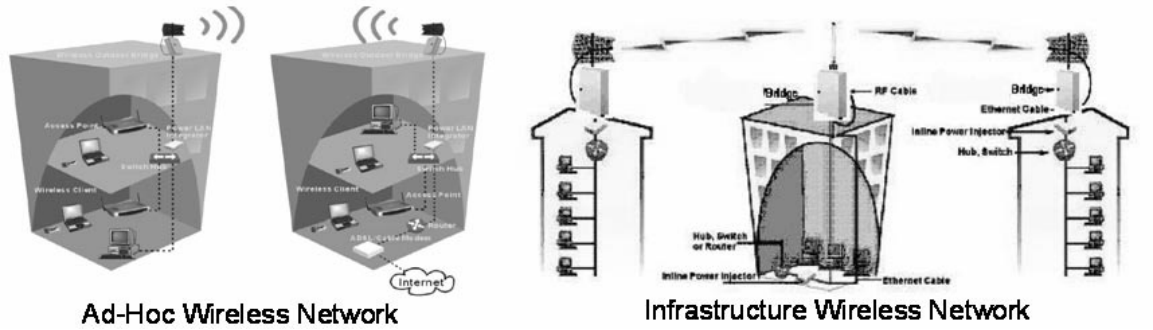

Figure 2. Ad-Hoc and Infrastructure Mode Wireless Networks

The proposed design is set in infrastructure mode so as to share data or peripherals, such as a printer, with a wired network. Infrastructure mode centers on the use of wireless access points (WAPs), which serve as the main point of communications in a wireless network. WAPs transmit data to PCs and other equipment containing wireless network cards, which can roam within a certain radial range away from the WAPs.

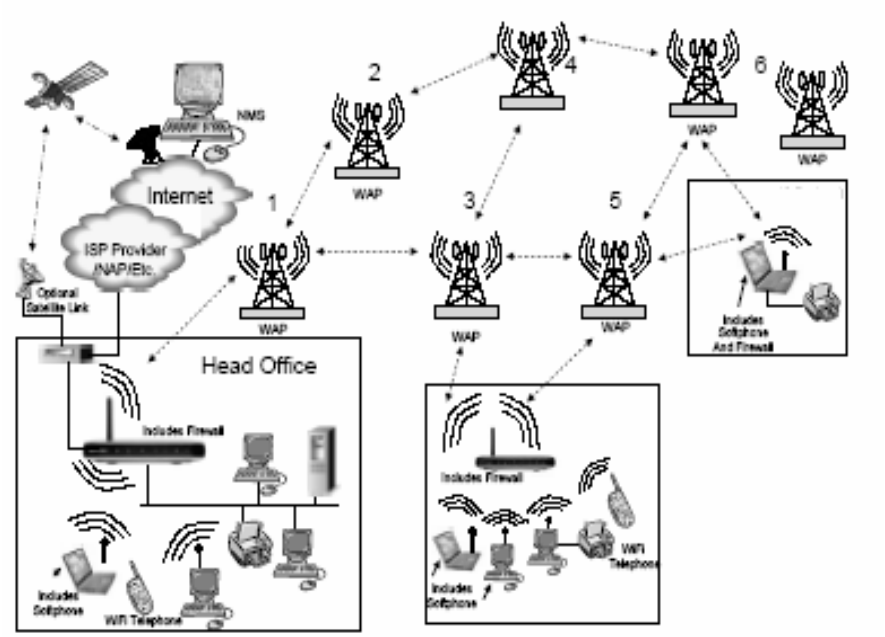

Figure 3. Proposed WiFi Network Topology

Figure 3 shows the proposed telecommunication network. It displays the following functional blocks:

WAPs. WAPs consist of antennas, which could be omni-directional or unidirectional. Omni-directional antennas are used to cover an extended region and are normally used as users' access points for the final stage. Depending on regulatory restrictions the transmission can vary from

100-milliwatt to 5 watts of power. Unidirectional antennas are used to cover links from one point to another. As a reference a point-to-point connection at 5 Watts can cover up 100 Kilometers.

Security. Security can be offered via two mechanisms: Radius and VPN. The Radius server provides authentication mechanism by validating and authenticating MAC addresses and passwords. The VPN is a connection that allows private data to be sent securely over a shared or public network, such as the Internet. One of the driving forces behind VPNs is the Internet and its global presence.

RESULTS AND FINDINGS

Implication of the Findings

In spite of its shortcomings, this study could suggest that the proposed hypotheses involving the Equivalency Theory and the implementation of a WiFi network could accelerate the acceptance and effectiveness of E-Learning. If so, the study may have some merits paving the way for further research.

CONCLUSION

This study presented a conceptual model that could be conducted to assess reasons that may impede the successful implementation of E-Learning programs in developing nations using alternate low-cost WiFi infrastructures, such as the one afforded by WiFi networks, from the perspective of its impact on the student population. The study uses the Equivalent Theory, proposed by Simonson [20] as its underlying foundation. The result of the research will be the acceptance or rejection of the proposed hypotheses. If confirmed, then this study may have some merit and further research will be recommended.

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