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ABSTRACT

This paper reports on a study which examined critical mass for the use of information technologies (i.e., electronic mail and World Wide Web applications) in schools, colleges, and departments of education (SCDEs) by faculty, students, and faculty and students combined. The study also investigated critical mass for the existence of adequate infrastructure for information technologies. A sample survey design was used to collect data from professional teacher education institutions. The 1996 SCDE Technology Survey was mailed to 744 SCDE institutions. Responses were received from 465 institutions for a response rate of 63%. Achievement of critical mass was based on the number of institutions identified as SCDE faculty and student users combined, SCDE faculty users, SCDE student users, and SCDE institutions which provide adequate infrastructure for information technologies. Results confirm critical mass has been reached in SCDE use of information technologies and for the provision of adequate infrastructure for the use of information technologies. Recommendations and implications for other issues associated with technology integration are included. (Contains 23 references.) (Author/DLS)

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Pre-Service Teacher Preparation and Interactive Information Technologies Critical Mass

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Abstract

This study examined critical mass for the use of information technologies (electronic mail and Web applications) in Schools, Colleges, and Departments of Education (SCDEs) by faculty, students, and faculty and students combined. The study also investigated critical mass for the existence of adequate infrastructure for information technologies. A sample survey design was used to collect data from professional teacher education institutions. The 1996 SCDE Technology Survey was mailed to 744 SCDE institutions. Responses were received from 465 institutions for a response rate of 63%. Achievement of critical mass was based on the number of institutions identified as SCDE faculty and student users (combined), SCDE faculty users, SCDE student users, and SCDE institutions which provide adequate infrastructure for information technologies. Results confirm critical mass has been reached in SCDE use of information technologies and for the provision of adequate infrastructure for the use of information technologies. Recommendations and implications for other issues associated with technology integration are included.

Introduction

The purpose of this research study was to advance the knowledge base in the area of critical mass for the use of and infrastructure for information technologies (e-mail and Web applications) within pre-service teacher education institutions. While the results of this study are not particularly surprising to those who study diffusion and change related to technology, the documentation and dissemination of the results have strong implications for several areas associated with technology integration (e.g., accreditation guidelines, professional teacher standards, school reform, public perception of teacher preparation in and access to technology). This study was developed on the functional definition of critical mass given by Rogers (1995, p. 313): "the point at which enough individuals have adopted an innovation so that the innovation's further rate of adoption becomes self-sustaining." Unfortunately, little contemporary critical mass data exists to aid administrators and practitioners in planning for increased implementation and utilization.

Problem/Significance

During the summer of 1996, a research study of 465 Schools, Colleges, and Departments of Education (SCDEs) was conducted to determine whether critical mass for the use of e-mail and Web technologies had been reached by SCDE faculty, SCDE students, and SCDE institutions (combining data from both independent user groups). Markus (1990, 1987) describes interactive technologies as any which require reciprocal communication; where the spread of their use relies on the users' contributions of information. This study concentrated specifically on electronic mail and Web technologies (Bulletin Board Systems (BBS), computer conferencing, the Internet) as the interactive media. The lack of documentation regarding current use of information technologies and critical mass levels leaves educational institutions without important information necessary to weigh the advantages and disadvantages of continued investments in technologies infrastructure. The availability of information technologies and the documented increase in the number of users of information technologies across general populations indicates

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that core requirements are in place to achieve critical mass (Geoghegan, 1994; Green 1996b). This study investigated critical mass for information technologies specifically within SCDEs.

Literature Base

Critical mass is a conceptual construct of diffusion theory which has tremendous influence on the practical applications of systemic change models. Many researchers and change theorists (e.g., Rogers, 1983, 1995; Markus, 1990; Van de Ven & Rogers, 1988; Valente, 1993, 1995; Zaltman, Duncan, & Holbeck, 1973) have explored critical mass as an indicator and a predictor of successful adoption efforts within a wide variety of disciplines and settings.

There are increasing pressures on teacher preparation institutions to prepare new teachers to effectively use technology (Ely, 1996). The Office of Technology Assessment (OTA, 1995) continues to call for reforms which upgrade the quality of teacher preparation, with emphasis on increasing the implementation and integration of technology within classrooms. One result has been that colleges and universities are embracing information technologies to address the public pressure for reform in the way teachers deliver instruction (DeLoughry, 1996). While computers and information technologies are commonly used as research tools in higher education settings, Denk, Martin and Sarangarm (1993) have shown that computers and information technologies are not an integral part of classroom instruction.

The work of Kenneth Green (1997, 1996a, 1996b) and colleagues (Green & Gilbert, 1995; Green & Eastman, 1994) has documented critical mass levels for institutions of higher education and access to computer-based technologies. This study focused on documenting critical mass for access *and* use of interactive information technologies within pre-service teacher preparation institutions.

Limitations

The limitations of this study were the sample identification, survey instrument and distribution, and knowledge base of survey respondents. The sample was the membership of an intact national organization consisting of private and public four-year schools, colleges, and departments of education. Using this sample placed a limitation on generalizing to SCDEs which are not members of the intact organization. The potential for a low response return rate with a mailed survey jeopardizes representativeness and generality due to the selective nature of the non-respondents.

The survey instrument was created by the research team. Two recognized experts in the field of change in schools examined the survey for face and content validity. The SCDE Technology Survey was sent to member institutions of the national organization as part of a larger survey and submission was completely voluntary.

The survey respondent's knowledge base was a potential limitation. The larger surveys were completed by an administrator within the member SCDE. One limitation is that the administrator may not have known enough about information technologies to respond accurately. A second is that the administrator may have completed the survey based upon their personal beliefs or perceptions of the SCDE's use of information technologies and not upon actual use of information technologies within the SCDE. Inter-woven in this limitation is that the administrator answered on behalf of SCDE students and faculty based on their knowledge, observation, and perceptions of information technologies use.

Methodology

A well-respected professional teacher education organization commissioned the design and analysis of a survey to gather data about technology use within SCDEs. The one page (front and back) survey was mailed (by the sponsoring organization) to 744 member institutions. These researchers received 465 (63%) useable responses from the United States, Guam, and Puerto Rico. Questionnaires were completed by an administrator in the SCDE. Of the 23 questionnaire items, 15 were used to compile the data for determining critical mass levels. Details of the coding are available if requested (Tharp, 1997). Description and analyses of the additional data collected are available in report form (Persichitte, Tharp, & Caffarella, 1997). The four research questions associated with critical mass were answered by calculating an observed critical mass value for combined SCDE faculty and student use of e-mail and Web technologies, for SCDE faculty use of e-mail and Web technologies, for SCDE student use of e-mail and Web technologies, and for the existence of required infrastructure for the use of e-mail and Web technologies.

Users and nonusers (faculty, student, combined faculty/student) and adequate/inadequate infrastructure were determined by combining data from five questionnaire items for each of the data groupings. If the combined value was greater than or equal to 60%, the institution was coded as a "user" and/or "adequate." The 60% cut-off was chosen to parallel Green's (1996a) research of technology use at two-year and four-year higher education

institutions. This coding provided the data for the observed critical mass levels. These observed critical mass values were compared to a pre-determined critical mass level of 16% to conclude whether critical mass had been reached. The decision to compare the observed critical mass value with a critical mass value of 16% was made based on reviewing previous statistical analyses of critical mass conducted by contemporary researchers (Markus, 1987; Valente, 1995; Rogers, 1995).

Results

Results confirm critical mass has been reached in SCDE use of information technologies and for the provision of adequate infrastructure for the use of information technologies. for all the research questions, the observed critical mass values greatly exceeded the statistical critical mass comparison level of 16%.

RQ1: Has critical mass for combined SCDE faculty and student use of e-mail and Web technologies been reached?

The observed critical mass value for this question was 87% (405/465). Critical mass has been reached for combined SCDE faculty and student use of e-mail and Web technologies.

RQ2: Has critical mass for SCDE faculty use of e-mail and Web technologies been reached?

The observed critical mass value for this question was 92% (429/465). Critical mass has been reached for SCDE faculty use of e-mail and Web technologies.

RQ3: Has critical mass for SCDE student use of e-mail and Web technologies been reached?

The observed critical mass value for this question was 90% (420/465). Critical mass has been reached for SCDE student use of e-mail and Web technologies.

RQ4: Has critical mass for the required infrastructure for the use of e-mail and Web technologies in SCDEs been reached?

The observed critical mass value for this question was 95% (444/465). Critical mass has been reached for the required infrastructure for the use of e-mail and Web technologies in SCDEs.

Conclusions

The results of this study document that critical mass has been reached in student use, faculty use, combined faculty and student use, and the provision of adequate infrastructure for e-mail and Web technologies across SCDEs. Results indicate that the SCDE adoption rate (92%) has surpassed the overall higher education adoption rate (59%) cited in Green's research (1996a, 1997). MacKnight (1995) argues that once SCDEs have reached critical mass for information technologies infrastructure, there is an opportunity to progress from being hardware access centers to becoming information centers. The issue which now faces SCDE administrators is no longer whether faculty and students will use the technology, but **how** they will use the technology in the classroom (Awbrey, 1996; Cummings, 1996).

Recommendations

For those SCDEs which have adequate infrastructure in place (or are approaching that goal): create an information technologies plan which focuses on classroom implementation and integration. This study confirms that the number of adopters of information technologies is high enough to ensure continued adoption of the technologies. Continued use, however, should be supported by a three-year life-cycle technology plan, as opposed to the standard five-year strategic planning model, to provide for the update and replacement of obsolete hardware, software, and networking. Another factor likely to influence continued use by existing adopters is the availability of faculty training for the use and integration of these information technologies which continue to change so rapidly. The importance of continual opportunities for faculty at all levels and in all disciplines to engage in updating their personal and pedagogical skills related to technology use cannot be over-emphasized. Finally, for institutions of higher education, continued utilization and implementation of information technologies by faculty may hinge on revised incentive plans which recognize and/or reward faculty for the significant knowledge, time, and initiative required to reach high levels of technology integration within instruction.

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