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The Use of Participatory Design in the Implementation of Internet-based Collaborative Learning Activities in K-12 Classrooms

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INTRODUCTION

Participatory design is a concept originating out of the Scandinavian nations (Schuler & Namioka, 1993) that has as its objective the inclusion of the user in the design and implementation of any new technology. It is a user driven design in that it "places the needs and abilities of the worker at center stage along with the other needs of the firm" (Emspak, 1993, p. 21). Participatory design grew out of the realization that traditional systems design was unable to effectively introduce new technologies in the workplace and factory floor. Or, as stated by Greenbaum when discussing the introduction of participatory design, "... over the last 30 years the pages of management and system journals have been peppered with articles bemoaning the fact that so many systems don't work or fail to do things that both managers and users expect them to" (1993, p.30).

The introduction of new technologies into classrooms has faced similar problems. Indeed, promises made decades ago about computer technology remain for the most part unfulfilled: one of the reasons being lack of teacher participation in its introduction (Plomp & Akker, 1988; Schultz & Higginbotham-Wheat, 1991). Moreover, although computer technology is present in schools, it is under-utilized. This has not had the effect,

however, of banishing technology from the classroom. With the growing interconnection between K-12 local area networks and university or regional wide area networks, exhortations for new uses of old technologies along with the introduction of new technologies in classrooms are likely to occur. Of these new technologies, use of local and wide area networks by students is currently one of the most popular.

Furthermore, traditional learning techniques are being scrutinized for effectiveness. In the last twenty years, the popularity of new learning techniques emphasizing critical thinking and collaboration has increased. Most of these new techniques fall under the rubric of cooperative learning methodologies.

There are three issues that merit discussion: the potential in participatory design as the means to introduce and implement new technologies while promoting the use of collaborative learning; the impact that collaborative learning methodologies may have in the use of these new technologies, or inversely, the role that new technologies may have in shaping or promoting collaborative learning; and the need to examine the process when introducing and implementing computer networking technologies in the classroom.

Four distinct, but inextricable developments are responsible for bringing these issues to the fore: Collaborative learning techniques, a greater sensitivity to the needs of the user, the advent of K-12 local or wide area networking, and the evolution of the Internet. Because each event has been examined in isolation, the process arising out of their interaction has often been ignored. While these developments may be complementary, the merging and introduction process the classroom remains unknown.

REASONS FOR THE USE OF PARTICIPATORY DESIGN

There are five reasons to investigate the use of participatory design when implementing new technologies in the classroom. First, the introduction of any new technology into classrooms is difficult, especially in light of previous statements made about them in the past. Again, a parallel can be made with industry where technologies are introduced without worker participation. Research on the use of participatory design in industry suggests that "... local participants increased their competence on new technology and became more willing to take initiatives around it" (Clement & Van den Besselaar, 1993, p. 34). Perhaps teacher and even student involvement may foster a better understanding of the needs of the user with an optimal integration of the technology with everyday tasks.

Second, since many new projects may depend on collaborative learning activities, the decision of the teacher to combine resulting classroom tasks with use of the Internet requires an approach that maximizes their participation and cooperation. Arguably, only then will they understand and, therefore, endorse the technology. Because participatory design relies on full cooperation between users and systems analysts, it offers a ready made theoretical blueprint for initiating the activity and process.

After all, a fundamental tenet of participatory design is the belief that user participation gives workers the power to influence matters that directly concern them in their work (Clement & Van den Besselaar, 1993, p. 36).

Third, a participatory design approach has the potential to create a setting where opportunities for the researcher to share in and understand the concerns and perspectives of the participants become possible. Participatory design methodology has an affinity with research methodologies that place emphasis on interaction between researcher and participants. This is similar to its use in industry where a the role of the system analyst-management consultant is transformed into a user-facilitator, the role of the educational

researcher is changed from that of an expert to that of an equal participant who happens to have expertise (Carmel, Whitaker & George, 1993, p. 46).

Fourth, participatory design is attuned to current trends in education where attention to the learner and teacher, as opposed to the expert, instructional methodology, or technology, is primary. Inclusion of student and teacher needs, through their active participation in the design and objectives of the project, arguably harmonizes the need to introduce new technologies with new research approaches. Or, as stated by Schultz and Higginbotham-Wheat, "There should be frequent feedback from teachers as implementation takes place. Teachers can identify problems before they become disasters" (1991, p. 212).

And last, use by children of local area networks logically linked to wide area networks or the Internet has been somewhat controversial; the media has focused on isolated cases where children accessed pornographic, violent, or dangerous information. Naturally, parents, school administrators, and teachers, who have little knowledge of the network, may feel concern. Their participation in the project will allow them to understand the safeguards placed on the project and secure their cooperation.

REASONS FOR THE PROMOTION OF K-12 NETWORKING

There are several reasons why educators and researchers are promoting use of networks and computer mediated communication as a medium for education in K-12-higher education classrooms. The unreserved justifications to integrate these new resources in the classroom are surprising given the newness of K-12 local and wide area networks. Although network facilities are commonplace in higher education environments, they remain rare in K-12 schools. Nevertheless, it is possible to discern a trend to design projects that incorporate the use of networks for teaching and learning with more traditional educational tasks.

K-12 Computer Networks and Collaborative Learning

One of most common justifications given for the establishment of educational networking projects is the belief that use of computer networks fosters collaborative learning. In other words, computer networks are ideal vehicles for collaborative learning tasks and activities (Bump, 1990; Davits, 1988; Din, 1991; Levin & Cohen, 1985; Owen, 1991; Owen, 1993; Resnick, 1992; Riel, 1989; Riel, 1990a; Riel, 1990b; Riel, 1992a; Robinson, 1993; Sloan & Koohang, 1991; Tinker, 1993). Moreover, because of the flexibility and potential of the networks, collaboration may be effected among students in the same classroom or among students dispersed among remote classrooms (Resnick, 1992), the former being the more common approach.

Indeed, initial results of projects emphasizing computer- network-based collaborative learning has led Bump to assert that "the most intense collaboration occurs when computers are electronically linked to each other to form networks" (1990, p. 49). Riel lends support to the above in her claim that the true potential of computer networks lies in their ability to create new forms of group interactions that are essentially of a collaborative nature (1990b, p. 449).

As connections to the Internet by K-12 schools become more commonplace, educators will have new opportunities to integrate collaborative learning techniques with new curricular activities, projects, and instructional methodologies. Sellers (1994), for example, in her guide to educational networking, emphasizes the shift from teacher-as-expert model to one of shared responsibility for learning arising from the use of computer- mediated communication. A similar viewpoint is made by Hunter who argues that with the advent

of the National Research and Education Network (NREN), educators will have a resource where they will be able to direct and establish network projects, software, and structures to support and foster collaborative learning (1992, p. 26).

It is interesting to speculate whether the above perspective could have had an indirect influence on the final text of American legislation calling for the establishment of research and education gigabyte networks. For instance, one of the primary purposes of the U.S. High-performance Computing Act of 1991 is to "invest in basic research and education, and promote the inclusion of high-performance computing into education institutions at all levels..." (United States, Congress, 1991, Sec. 3(H)). The said inclusion of high-speed computing, however, must integrate collaborative projects among members of the research and education community (United States, Office of Science and Technology Policy, Director, 1992, p. 1).

Again, collaboration is seen as being essential to the purpose and success of the project. Admittedly, collaboration among educators and researchers does not necessarily imply the structured learning methodology found in collaborative learning theories. Nevertheless, collaboration in the context used does suggest recognition that the Internet is a suitable medium to undertake collaborative tasks. This in turn intimates that it may be prudent to structure collaboration in such a manner so as to best exploit learning activities and the sharing of knowledge, especially in K-12 environments.

The influence of collaborative learning is stated more directly in the National Information Infrastructure Act of 1993 (H.R. 1757), originally proposed by Rep. R. Boucher (D-VA). In the H.R. 1757, it is possible to find a call for educators and researchers to develop and evaluate educational software specifically designed for collaborative use over the Internet (1993, Sec. 307, (A),4). Still, although the intent to promote collaborative learning approaches remains implicit as opposed to explicit, the Bill does suggest that the Internet offers a virtual collaborative environment.

However, in the National Information Infrastructure: Agenda for Action, the Clinton administration's attempt to define its vision of the electronic superhighway, it is possible to find an explicit call for the express use of collaborative learning methodologies. A section in the report specifies "Students and teachers can use the NII to promote collaborative learning between students, teachers, and experts..." (United States, White House, 1993). It is possible to discern, therefore, an acknowledgment that a collaborative environment necessitates a well structured approach to ensure optimal use of its resources. And arguably, because of the nature of the network, collaborative learning techniques may be the approach that most optimally ensures maximum use of the potential in gigabyte networks.

It is interesting to note that calls for greater collaboration do not, as a rule, attempt to restrict communication among specific groups. On the contrary, current and future networking projects are being designed and implemented under the assumption that networks should foster greater communication among groups having different skills, professions, and status. The number of joint post-secondary and K-12 networking projects are indicative of this trend (Clement, 1992b, 1992c; Rude-Parkins & Hancock, 1990).

In Canada, a project similar to the NREN called the Canadian Network for the Advancement of Research, Industry, and Education (CANARIE) has been established (CANARIE Associates, 1992; Canadian Network for the advancement of Research, Industry, and Education Business Plan Working Group, 1992, p. 7; Silva & Cartwright, 1992). And not surprisingly, those responsible for the implementation of CANARIE have made collaborative research, development of new partnerships, and support for education, notably higher education, a key component of the project. In fact, the CANARIE Business Plan Working Group claims that the possible linkages among schools, research centres, and universities is one of the principal benefits of the forthcoming Canadian electronic highway (Canadian Network for the advancement of Research, Industry, and Education

Business Plan Working Group, 1992, p. 7). Even more, the Group asserts the said linkage is essential in guaranteeing the ability of users to cooperate in joint research while remaining physically remote from each other (1992, p. 7). And, increased collaboration is viewed as indispensable if Canada is to remain competitive in the modern international marketplace (CANARIE Associates, 1992).

K-12 Computer Networks and Situated Learning

Another reason for the enthusiasm found for educational networking projects is the belief that students using computer networks are able to contextualize and cognitively situate learning tasks (Lave & Wenger, 1989; Levin, Riel, Miyake, & Cohen, 1987; Mabrito, 1992; Riel, 1985; Tinker, 1993). In other words, social interaction and physical activity are viewed as being an integral part of the learning process. Or, the essence of learning is the result of sharing purposeful, patterned tasks (Roschelle, 1992).

In collaborative writing projects, for example, contextualization was possible because of the effect of having an immediate audience responding to the text (Din, 1991; Riel,

1985); writing was no longer a solitary activity devoid of the social interaction present in most non-classroom activities. Also, the effect of collaboratively writing for a remote audience contextualized the work; the effort had meaning and significance resulting in superior work and deeper learning (Cohen & Riel, 1989).

An additional benefit of telecommunication projects is that through use of networking protocols, students are able to form partnerships with experts in a domain. These partnerships can be so structured to resemble what Brown, Collins, and Duguid call cognitive apprenticeships (1989). The aim of the apprenticeship is to "embed learning in an activity and make deliberate use of the social and physical context..." so that the learning is "...more in line with the understanding of learning and cognition that is emerging from research" (1989, p. 32).

In networked environments, these apprenticeships are called teleapprenticeships (Levin, Riel, Miyake, & Cohen, 1987; Teles, 1993). The Writer in Electronic Residence project (Owen, 1993), where a professional writer works directly with the students through telecommunications, is illustrative of this approach. Teleapprenticeships, therefore, are mediated by access to peers and professionals in networked environments (Teles, 1993). This is why Clement claims that the value of wide area networks lies in their potential to support collaborative projects linking educators and students that provide "meaningful learning experiences connected to the curriculum" (1992a, p. 18).

In essence, computer networks create virtual classrooms and laboratories where spatial and geographic concerns become secondary (Harasim, 1993; Silva & Cartwright, 1993). Of importance here is that these virtual meeting places can offer the student and teacher the context necessary to imbue the information with meaning. Once learning is contextualized and situated, therefore, knowledge is meaningful and, as a result, can be processed at a deeper cognitive level giving rise to greater understanding.

Note, however, that the drive to implement collaborative network-based projects also stems from the recognition that this approach more closely resembles work procedures in modern industry (Hunter, 1992, p. 25). Mabrito argues along parallel lines in his contention that computer networks have the potential to simulate the workplace of the future (1992, p. 317). This point of view, called "new work" by Mabrito, (1992), is explicit in the Clinton administration's National Information Infrastructure project and in Canada's CANARIE.

K-12 Computer Networks and Cognitive Growth

Given the above, it is inexplicable that more research has not been conducted concerning the development of higher-order thinking skills through the use of collaborative computer network projects via the Internet. Research on collaboration in non- networked computer tasks, however, indicate greater cognitive processing and growth. Admittedly, while it may be difficult to generalize the results from these small studies to gigabyte networking environments, they may offer some indication for future studies allowing researchers to structure their experiments accordingly.

Nastasi and Clements (1992), in their study of social processes as mediators of treatment effects on higher-order thinking, concluded that certain computer tasks-- working with LOGO in small groups--may foster cognitive growth by promoting certain forms of social interactions, namely cognitively-based resolution of cognitive conflicts. Given the communicative potential of supernetworks, the possibility of inducing certain types of cognitive conflicts during specific tasks becomes very real.

Higher-level reasoning and problem solving by students in similar tasks were also found by Johnson, Johnson, and Stanne (1986). Hooper (1992) lends further support to the above with his claim that intra-group reflection during computer-based instruction enhances future collaboration. And collaboration promotes interaction that in turn engenders deeper cognitive processing.

Educators tracking the impact of computer networks have also justified such projects on the grounds that children have exhibited greater emotive and social growth as a result of their opportunity to collaborate via networks. In her study of a collaborative networking project funded by AT & T, Riel found that children displayed greater self-esteem (1990b; 1992a). In another project that linked two economically and racially different Detroit high schools, Ladestro (1991) claims that students experienced a breaking down of stereotypes and greater empathy for students of different backgrounds and socioeconomic groups.

Although these studies are mostly descriptive, they nevertheless support findings concerning self-esteem and empathy towards other groups reported by researchers concerned with the effects of collaborative learning techniques on social and emotional cognitive behavior. It is not unusual, therefore, to discover projects that have components that are designed specifically to foster prosocial development during collaborative learning tasks (Solomon, Watson, Schaps, Battistich, & Solomon, 1990).

The above outright optimism is somewhat tempered by research that examined mathematically-based groupwork with computers (Hoyles, Healy, & Pozzi, 1992). Although they agree that pupil- managed groups can effect positive outcomes during collaborative computer tasks, the authors warn that "groups must also be viewed as social systems, which, if they are to produce an agreed outcome, require a minimum level of mutual regard" (Hoyles,

Healy, & Pozzi, 1992, p. 256). That is, in groups where there are negative interpersonal relationships, the autonomous learning engendered by groupwork can encourage the "atomization of the group, a centration on computer products, a curtailment of negotiation and unhealthy competition" (p. 256). This finding requires further validation, especially since most collaborative learning approaches use heterogeneous or random groupings when selecting participants for classroom tasks (Davidson & Worsham, 1992b, p. xiii) where it becomes difficult to control the selection into groups of participants who have negative interpersonal relationships.

K-12 Computer Networks and Isolation of Teachers

The isolation of educators from fellow teachers and other researchers is an additional reason for the current level of support for networking projects. Gigabyte networks are seen as the tools capable of allowing educators to communicate, share, and access valuable knowledge. Those responsible the implementation of the Texas Education Network (TENET), for example, have argued that one of the major benefits of the network is the potential for greater collaboration between K-12 educators and post-secondary educators and researchers (Consortium for School Networking, 1992; Stout, 1992, p. A-130). In their survey of the use of networks in technologically privileged schools, Honey and Henriquez reported that educators listed less isolation as one of the benefits ensuing out telecommunication usage (1993, P. 16). Or, simply stated, greater opportunities for professional support and growth become possible; more equitable access to and dissemination of resources for staff development can be guaranteed.

Riel (1990b), in her study of the AT & T Learning Network, Electronic Learning Circles, argued along parallel lines. For instance, teacher participants showed a greater willingness to admit their ignorance on a particular subject and use the network to request information. Also, electronically linked teachers appeared more amenable to sharing and cooperating in the design of new instructional techniques and classroom organization. In this manner, support for educational restructuring is made available. Finally, like students, teachers demonstrated greater self-esteem as a result of their participation in the project.

K-12 Computer Networks and Academia

A further reason put forward in support of K-12 networking projects is that postsecondary institutions, which often provide networking support and access, will benefit from possible collaborations. The perception by postsecondary researchers that K-12 networking is "an enabling resource for research, scholarship, and (at least in local settings) education" (Clement, 1991, p. 15) is frequently found in academe.

Another benefit to postsecondary institutions is the realization that higher education, and a knowledgeable workforce, depend on well trained incoming students (Clement, 1991; Allum, 1991). Furthermore, increased participation in K-12 networking with postsecondary institutions may influence legislators to support national educational goals, which benefit all levels of education. The last benefit to postsecondary institutions lies in the possibility of strengthening their image and relationship to the community and private industry (Allum, 1991). This may be an invaluable resource at a time of increased efforts at fundraising activities by university administrators.

K-12 Computer Networks and Resource Sharing

More practical reasons are also forwarded as justification for increased investments in K-12 networks. In times of budgetary constraints, it is unrealistic to assume that schools are able to acquire all materials necessary to meet the demands of the curricula, or, more importantly, to meet the demands arising from new curricula. With computer networks, the possibility exists for greater resource sharing. Local and administrative databases, textual information, and school materials can be loaded on a central or remote server, and so eliminate costly duplication of materials. In addition, intellectual resources held by a school district can be disseminated and shared easily with other districts and intellectual resources found in research centers and universities become more easily accessible.

A more functional reason why teachers support collaborative learning networking projects rests in the cost of hardware and software. At present, most school districts do not have the means to offer individual students their

own workstation. Most computer classroom activities, because of costs, demand that students share equipment. Collaborative learning environments are seen as a feasible approach that can maximize learning when students must, by necessity, work in groups.

Finally, with computer networks, educators and students have access to a vast warehouse of information. Databases, domain experts, full text reports, electronic books and journals, graphic images and sound, and software are some of the resources that are accessible and retrievable. With the advent of universal resource locators such as Gopher, World Wide Web (WWW), Cello, and Mosaic, novice users and children can locate and retrieve electronic resources. Indeed, given the exponential growth of the Internet, exclusion from these resources may hinder educators from offering their students the best possible learning environment.

Growth of the Internet

The Internet, a world wide interconnected computer network of networks, is growing at a phenomenal rate (Hart, Reed, & Bar, 1992; Krol 1992; Lynch & Rose, 1993). Some estimates put its growth at 14% a month, its user base at 25 million users, and the number of computer hosts at 1,500,000. Indeed, almost every major research center and library in the world has an Internet connection giving the student a gateway to distributed resources and information.

Also indicative of the Internet's phenomenal growth is the increasing heterogeneity of its user population. Whereas but a few years ago the Internet was used exclusively by the research, government, and academic communities, today its user population includes school children, business persons, and the public (Hunter, 1992). For example, it is estimated that over 600,000 school children in the United States used the Internet to supplement their curricular activities during the 1991-1992 school year (Itzkan, 1992, p. 1).

It is the newness of the Internet that makes its growth appear astonishing. McGill University gained connectivity sometime in late 1988. Its general student population had full access only in 1991. The literature on the Internet also follows this pattern. Prior to 1989, articles on the Internet were mostly technical and of interest to a limited audience. Today, a cursory search for monographs and periodicals will retrieve a wealth of information directed at a far less technically oriented audience.

Using the Internet, students are able to access remote computers and search databases and online catalogues, transfer binary or text files, and exchange information with peers or experts. New software commonly called resource discovery tools (RDTs) or universal resource locators (URLs) allow students to access hypermedia information databases, the Library of Congress Vatican Exhibit and the University of California, Berkeley, Virtual Paleontology Museum being cases in point.

ISSUES OF CONCERN

There are two simultaneous unfolding parallel events that should be of concern to educators: The constant growth of the Internet and the increasing awareness by teachers of the potential for learning, especially in collaborative teams, through the use of gigabyte networks. Consequently, hundreds of Internet based projects have been established (Batson, 1988; Eisenberg & Ely, 1993; Julyan, 1989; Kurshan, 1990; Murray, 1993; Quebec-Alberta Telecomputing Project, 1993; Riel 1985; Sackman, 1993; Solomon, 1992; Tinker, 1993). Moreover, most of the research details the processes in the classroom after teachers and students are linked to a LAN or the Internet. That is, with the exception of the work by Willis (1991), there is a lack of research

concerned with the process of implementing a technology as dynamic and as evolving as the Internet into the classroom.

By "process" we mean the method of introducing Internet based instructional activities to parents, teachers and students through a well structured set of actions and changes, and those steps which are necessary to successfully integrate this technology into classrooms so as to guarantee its most optimal use. This definition does not include planning for hardware and software, problems concerning telephone lines and gateways to the Internet, and logical links between networks. Rather, the definition of process emphasizes the methodology and design utilized to introduce and merge gigabyte telecommunications with regular K-12 classroom curricular activities, in particular, activities that employ collaborative learning tasks, whether locally or virtually.

Indeed, the disinterest shown by researchers toward the above problem becomes inexplicable given that some estimates place the number of U.S. children with some form of local, regional, or Internet network activities at 5,000,000 (Harasim, 1993, p. 21). Naturally, this figure includes local area networks not logically connected to the Internet. Nevertheless, given the growing drive to interconnect K-12 administrative and educational with state or regional networks, the need for studies on the process of introducing Internet access to classroom is arguably necessary and potentially significant.

In our discussion of the above, we noted several assumptions. First and foremost is the assumption that the Internet is a potential collaborative education medium that enhances and promotes collaborative learning. That is to say, the Internet not only promotes collaborative learning, but is inherently collaborative. Resource sharing, communication, dissemination of information, and exchange of ideas are some of the services available via the Internet that may be forwarded in support of the above assumption. So powerful is the belief in the inherent collaborative potential of the Internet, that policy makers have consistently justified investment in national networks on the basis that it will foster greater collaboration among different sectors of society, namely industry, education and academia (CANARIE Associates, 1992; United States, Office of Science and Technology Policy, Director, 1992; United States, Congress, 1991).

Second, we believe that participatory design has applications outside of industrial settings, namely the K-12 sector. Participatory design, because of its cooperative approach to decision making, also offers researchers and educators the means to meet demands made by users of new technologies. Since successful implementation of new technologies may depend on user acceptance, a cooperative approach to planning is arguably worth attention, study, and research.

The third assumption is the belief in the efficacy of collaborative learning techniques. The present work assumes that research on collaborative learning has established a solid enough foundation (Davidson & Worsham, 1992a; Sharan, 1990; Slavin et al., 1985; Slavin, 1980, 1983, 1990) making it possible to argue for new technologies that enhance and promote the approach as opposed to demonstrating its validity.

Fourth, it is assumed that collaboration among different age and education levels is desirable. Again, we forward the assumption that carefully structured collaborative learning projects that foster cooperation among university, high school, and elementary age students is an effective learning approach.

The last assumption is the belief that the Internet will be an integral part of classroom activities in the very near future. Investments in K-12 logical networks will continue to increase giving teachers and students greater access to information and expertise. It is also assumed that this phenomenon is a positive trend and should be advanced and encouraged, especially since, given present trends, the advent of K-12 networks appears inevitable.

LIMITATIONS WITH THE PARTICIPATORY METHOD

Most of the research on participatory design is recent and has been undertaken by practitioners of this approach. As a result, there is a serious lack of studies on its weaknesses and flaws. Furthermore, most research is restricted to industrial settings, so it is not known if participatory design has widespread applicability. Finally, North American and European, especially Scandinavian, approaches appear to be splitting into somewhat similar but separate schools, making claims about the success of the method more problematic.

In addition, participatory design closely resembles the methodology employed in qualitative research. The qualitative research tradition can be described as naturalistic, ethnographic, or humanistic. A participatory approach is likewise part of this tradition (Kirk & Miller, 1986, p. 9). Moreover, similar to participatory design, qualitative research emphasizes the need to conduct research in natural settings so as to ensure a thorough understanding of the needs and perspectives of the participants. This intertwining of approaches resembles what Whyte calls participatory action research where "research and action are closely linked" (1991, p. 8). Not surprisingly, most well known participatory design projects have adopted an action research approach (Clement & Van den Besselaar, 1993, p. 29). As a result, participatory design has faced similar criticism leveled against qualitative and humanistic research.

Another criticism made against participatory design is imprecise definition of the concept of participation. For example, Elden and Levin, in their discussion of participatory action research stress that "... the degree and nature of participation in all phases of participatory action research is a critical factor" (1991, p. 133). Indeed, they assert that not all participation is necessarily empowering, especially within a non-democratic organization. They argue that participation must be full participation for it to be truly empowering. However, they also state that empowering participation does not mean that every person in an organization is a full participant. Rather, participation is dependent on representation by union members, managers, and top management.

Finally, attempts to define the users of the system has likewise posed problems under a participatory method. Carmel, Whitaker, and George accept the idea that "an unambiguous definition of user is impossible" (1993, p. 40) and claim that the main difference between the many different participatory methodologies is the degree to which users are able to participate in the project. A single definition, therefore, is impossible. As a result, different participatory approaches, dependent on specific settings and conditions, offer many varying definitions.

CONCLUSION

As gigabyte K-12 networks continue to grow, educators will be faced with increasing demands for integration of Internet resources and services with traditional classroom activities. With the advent of the NREN and CANARIE, it is safe to assume that demands will increase significantly in the near future. Indeed, the current number of school children linked to local area networks and the Internet presages the direction of the above trend.

Given the above, it is almost inexplicable that researchers appear disinterested in the process of introducing and establishing Internet based K-12 projects. Granted, there is research supporting the use of network activities in the classroom. Nevertheless, there is a serious need for research concerned with the process of introducing, training, and establishing such projects. This need should not be underestimated given that teachers frequently object to their lack of participation concerning the introduction of new technologies.

In conclusion, the collaborative nature of the Internet calls for a participatory approach where users of the system have a say in the design and implementation of new procedures and technology. In this manner, many of the pitfalls, obstacles, and misunderstandings normally found when introducing new technologies may be avoided. Indeed, participatory design may offer the means to fully exploit the potential in new technologies and networking.

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