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ABSTRACT

In 1984 the Learning Technology Center (LTC) at Texas A & M University negotiated agreements with three K-12 Texas public school districts to explore ways that computer technologies could be used to assist in managing instructional programs. The intent was to establish a field-based research environment in which information technologies for educators could be designed, developed, and tested. Since the agreements were negotiated before any design specifications existed, LTC could only share ideas concerning computers' assistance in alleviating paperwork associated with planning and evaluating instruction, empowering practitioners as decision makers, and tapping the power of leading edge technologies. In exchange for the center's provision of products and services resulting from the collaboration, the participating schools agreed to provide a setting in which a few key teachers and administrators could work with products as they were developed. The school sites also agreed to allow LTC personnel to conduct research on the development, implementation, and use of emergent products and services. The collaboration facilitated the development of a comprehensive instructional management system now being used at several schools. This paper discusses: (1) the activities characterizing the partners' relationship between 1984 and 1989; (2) project development programs; (3) collaboration results; and (4) recommendations for ensuring successful future collaborations. (Two references) (MLH)

Development of a Computer-Based Instructional Management System Through School - University Collaboration

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Abstract

In 1984, the Learning Technology Center (LTC) at Texas A&M University entered into agreements with three K-12 public school districts (alpha sites) in the state of Texas to explore ways in which computer technologies could be used to assist in the management of instructional programs. This is an area acknowledged in effective schools research as an integral function of school administration. The collaboration has resulted in the development of a comprehensive instructional management system (IMS) which is now being used in several school sites. In this paper the following items are discussed: (a) activities which have characterized the relationship between the LTC and the alpha sites between 1984 and 1989; (b) problems that were encountered as the project was being developed; (c) what was learned as a result of this type of collaboration, and (d) recommendations for others to consider which might help assure successful collaboration.

Key Words: School/University Collaboration, Instructional Management Systems, Prototyping, Practitioner/Researcher Development Model

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Introduction

In 1984, the Learning Technology Center at Texas A&M University entered into agreements with three K-12 Texas public school districts to explore ways in which computer technologies could be used to assist in the management of instructional programs. The intent of the agreements was to establish a field-based research environment in which information technologies for educators could be designed, developed, and tested. The agreements were negotiated before any design specifications existed. In the beginning, we were only able to share ideas of how computers might be able to alleviate much of the paper work associated with planning and evaluating instruction, help empower practitioners as decision makers, and tap the power of leading-edge technologies.

As part of the collaboration, the LTC agreed to provide (free of charge) any products and services that would evolve as part of the collaboration. The alpha sites agreed to provide a setting in which a few key teachers and administrators would be able to work with products as they were developed - providing continuous input, and making suggestions to LTC personnel for improvements in the software. In addition, the alpha sites agreed to allow LTC personnel to conduct research on the development, implementation, and use of the products and services that would be developed.

The collaboration has resulted in the development of a comprehensive instructional management system (IMS) which is now being used in several school sites. In this paper, the following items are discussed: (a) activities which have characterized the relationship between the LTC and the alpha sites between 1984 and 1989; (b) problems that were encountered as the project was being developed; (c) what was learned as a result of this type of collaboration, and (d) recommendations for others to consider which might help assure successful collaboration.

History of the Collaboration

In 1983, the Texas Engineering Experiment Station (TEES), an engineering research arm of the Texas A&M University System, funded the creation of a Learning Technology Center (LTC) at Texas A&M University. The LTC serves as an entity within which engineers and educators can collaboratively work to determine how new technologies can be useful in helping improve educational systems and solve problems in education. During the Center's first year, focus was on development of a research agenda. During this period, TEES hosted leading researchers in educational technology, and funded visits to various research sites across the nation to determine, as closely as possible, what other activities were occurring. These activities were undertaken to avoid reinventing or duplicating technology or applications that others were already developing.

From the research, we determined that there were large-scale efforts to develop micro-based applications for administrators (e.g., scheduling packages, inventory control, budgeting, and decision support systems) and for students (e.g., computer assisted instruction packages and integrated learning

systems), but that with the exception of a few grade book and graphic development packages, no efforts were underway to use the new microcomputer-based technology to empower teachers. In fact, in many of the developing applications, teachers were being bypassed.

In 1984, the staff of the LTC began visiting with practitioners about how computer technology might be useful as an information management tool if that tool were designed to give teachers access to the plethora of information that they need when they plan and evaluate instruction. The idea was enthusiastically received, and the LTC began pursuing that agenda.

To enable us to develop the new technology in a way that would be immediately practical and useful by practicing teachers and administrators, we decided to not only conduct extensive needs assessment activities in the field, but to also develop the product in the field. These decisions required the development of a close collaboration between the LTC and practitioners in the environments within which, it was hoped, the technology would be used. We realized that in order to do a thorough and thoughtful job at designing, developing, and testing the new technology, long-term commitments would be required. We also felt that it was important to establish collaboratives with more than one district and that the districts be of different sizes because:

(a) technology, whenever it is successfully implemented in an organization, impacts and alters that organization, and size is one of the factors which affects the nature of the changes; and

(b) the processes involved in planning and evaluating curriculum and instruction vary in major ways from small to large districts.

By Spring of 1984, we had negotiated long-term research and development agreements with three K-12 school districts. (These districts were designated as alpha sites.) The smallest district had a student enrollment of less than 400. The enrollments of the other districts were around 3,000 and 12,000 respectively. As a part of the contracts, the LTC agreed to give the alpha sites whatever products and services might evolve from the collaboration. In exchange, the alpha sites agreed to provide staff and equipment that were necessary in order to test and evaluate the products and give feedback to the LTC to assist in design and development work. Additional features of the agreements were designed to facilitate on-site research for doctoral-level students at Texas A&M. Internship opportunities were included as an option.

Immediately after the agreements had been negotiated, staff of the LTC and students in the Educational Technology program at Texas A&M University visited each of the alpha sites and conducted a series of needs assessment activities. The purpose of the needs assessment was to determine, from the teachers' perspectives, the ways in which their jobs could be improved and what would be needed for them to feel more enthused about teaching. In other words, how can teaching be made more professionally rewarding? In the two smaller districts, a nominal group technique was used with small groups of teachers, in the larger district random interviews and a survey instrument were used.

We felt that it was important for the teachers' responses to be free of any artificial bias, so we tried to hide the fact that we were interested in determining how computers might be used to help improve education.[1] As an aside, it is important that the reader understand that the needs assessment activities were conducted about the same time that the Texas Legislature was passing HB 246 the intent

[1] Our purpose in this paper is to discuss the nature of the collaboration, not the results of the needs assessment nor the products which have evolved. If you are interested in obtaining additional information in either of those two areas, please write or call the authors.

of which was to require teachers to demonstrate linkages between their daily instruction and a set of state curriculum guidelines (the essential elements of instruction).

As a result of the data that were obtained from the needs assessment activities, a design was conceptualized which would involve the use of microcomputers to assist teachers and administrators as they plan, manage, and evaluate instruction. We wanted to design a system which could be used to increase teachers' ability to be accountable to the public and to the state regulatory bodies, but did not want the system to restrict creativity nor remove local control. We felt that it was possible, using new, powerful hardware/software systems to design support technologies which could be used to increase teachers' abilities to manage diversity and increase their decision-making skills while automatically maintaining sufficient audit trails which could be used for analysis of those decisions and the generation of the accountability reports.

During the Summer of 1984 we began evaluating various hardware platforms and the set of relational database management systems (RDBMS) which were just beginning to become available for micro-computers. In collaboration with graduate students in computer science, we acquired around twenty such systems for evaluation. The results of our evaluation are reported elsewhere (Chen and Burger, 1986).[2] We selected two RDBMSs, one which we felt would be good for the development of a prototype (prototype RDBMS), the other which would be good for the development of the final product (product RDBMS).

By late summer, 1984, we had begun developing a prototype, and a teacher began entering curriculum into the system. Despite the fact that the prototype was awkward to use and was not fully developed, a teacher in one of the alpha sites began using the IMS to build an electronic database of her curriculum and to align that curriculum to the newly released state guidelines for instruction. This teacher had never used a computer before. This experience gave us our first lessons in how to improve the prototype and what new features and capabilities would be needed. The prototype, at that time, was only a vehicle which could be used to 'capture' a school's curriculum, help align the local curriculum to state guidelines, and print curriculum documents.

During the next two and one half years, we continued to work with teachers and administrators in the alpha sites developing the prototype and exploring different implementation strategies. As the prototype was being developed, we began developing the 'real' IMS using the product RDBMS. The product RDBMS was much more difficult to use, but was much more powerful, flexible, and responsive than the prototype RDBMS. Computer Science students were hired to develop the IMS using the product RDBMS. Near the end of the two and one half years (early, 1987), we 're-engineered' the software that was being developed on the product RDBMS. The change (which involved a new database structure as well as a completely new user interface) was made in order to utilize the new capabilities that became available in a new release of the RDBMSs we were using and because we had hired new programming staff who had learned the capabilities of the product RDBMS and were using new approaches to software development.

During the Fall of 1988, we stopped developing the prototype, pulled it from the alpha sites, and converted the alpha sites to the final product. Even though the product was not as fully developed as was the prototype, its flexibility, reliability, and speed were superior. The practitioners were more

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[2] It is important for the reader to understand that our evaluations of the relational database management systems were done in the context of our design specifications, and were not done in order to provide a general statement about the relative worth of each one. Other publications do that well (e.g., trade journals such as Info-World, Byte, or PC Week). These publications and others were consulted as part of our own evaluation.

pleased with the new product than they were with the prototype. At that time, we recruited two beta sites which, we hoped, would help us understand some of the issues that would be involved with implementing the IMS in K-12 environments. We are hoping to continue working with these five schools (the three alpha sites and the two beta sites) over the next several years as we proceed with research activities and product development.

Research topics which we are interested in pursuing include: (a) how can the data that are generated through the use of the IMS be used to improve instruction and instructional programs; (b) what are the impacts that the use of the IMS has on teachers and administrators (in altering their skills, knowledge, or how their time is spent, etc.) as they work to improve instructional programs; (c) what are the best ways to implement this type of technology in schools; and (c) and what types of changes occur (or are possible) in schools when comprehensive IMSs are used.

By Spring of 1989, we felt we had a product that could be mailed to districts with no accompanying support person, and which could function reliably and be used easily, even by novice computer users. By the Fall of 1989, all of the alpha and beta sites had expanded their use of the IMS by implementing it on more workstations and making those workstations available to more teachers. Each of the districts continues to use the system to develop and modify their curricula, and several teachers are using the IMS regularly to develop their lesson plans.

As of this writing, the product continues to undergo revisions and improvements based on feedback from the field. We have released Module I which assists in the design, development, alignment, and maintenance of curriculum and in the design, development and monitoring of lesson plans. Several new districts have either purchased the IMS or have committed to purchase. In addition, we have established or are in the process of establishing collaborations with professors in about a half dozen universities who want to install the IMS and use it in their programs to train preservice and inservice practitioners and as a basis for service and research in their service areas.

Problems

As one might expect. everything has not gone smoothly over the past five years as a result of our commitment to developing a comprehensive product in a collaborative effort. Most of the problems that we encountered, however, are ones which, if anticipated, could be avoided or solved. In this paper, discussion is limited to the four predominant problems which probably are going to buffet any substantive collaborative efforts of this type. They are discussed in no particular order and are followed by a set of recommendations.

There was, in our work with the K-12 districts, a general tendency to promise more than what we were able to deliver. We found it difficult to maintain a balance between establishing and supporting enthusiasm for, and commitment to, our new (not yet developed) innovations, and mollifying those expectations so that they were in-line with reasonable development of the inventions. There were, in our case, several reasons why this was a problem. Among them were; inaccurate estimates for the time required to do software development, changes in organizational support for our research efforts, lack of continual communications, and incomplete testing of the software by both groups.

Inaccurate Estimates

New technologies are seldom developed 'on schedule' because with their development, new ground is being broken. Timelines for development are vague and difficult to estimate. This is true especially in prototyping environments, because in those development models, one does not know what

the product will look like until it is developed. One of the lessons that we learned in the first year of the collaboration was that our most optimistic estimates for development of software were less than one half of the time that was actually required.

In addition, both of the RDBMSs that were selected were constantly evolving and becoming more powerful. (For example, our prototyping RDBMS went through five major upgrades during the years in which we were using it.) New features enabled us to make significant design changes that resulted in dramatic improvements in the IMS. As a result of new capabilities of the product RDBMS software, we undertook a virtual redesign of the user interfaces.

Changing Organizational Support

In most collaboratives, the collaborating groups are very small subsets of large organizations. Incidents occur in the larger organization over which the collaborative groups have no control. Nevertheless, many of these incidences impact the collaboration. Unforeseen budget cutbacks, political struggles, changes in administrative staff, alterations in evaluation or assessment criteria are only a few examples of incidents which can occur independently of whether or not a collaborative arrangement exists within a subsystem of a large organization. Those events can and do affect each party - the one in whose organization the incident occurs and the one who is on the other side of the collaborative arrangement. For example, in Texas, the dramatic and rapid decline in oil prices during the first half of the 1980's affected everyone's budget. As a result, from 1985 on the LTC operated at roughly one half of the budget that we originally felt would be needed in order to sustain product development and support for the collaboration. Reduction in staff therefore, slowed the development of the IMS and made it difficult to develop product on schedule or test it as thoroughly as needed.

Research priorities at the upper levels of an organization's administration might also impact support for a given collaborative arrangement if those priorities are not consonant with the goals of the collaboration. For example, we found that our desires to conduct field-based, applied research and our feelings that those efforts would contribute to improvement of education was in conflict with the University's tenure and promotion policies which functionally recognized published articles in refereed journals as being the 'only' acceptable means whereby one could establish professional credibility. Though the policy has not impacted our research, it has impacted us as individuals. That is, we have chosen to proceed regardless of how that policy has affected our professional positions within the university structure.

Maintaining Communications

The third major problem was that maintaining sustained communications was difficult. Participants in both collaborating groups had obligations to the broader organization. Many of those obligations did not directly benefit the collaboration. Because of that, our collaborative efforts were always diluted with other commitments. When we did not maintain a high level of communications and support, the collaboration was perceived to get in the way of the regular daily activities of the practitioners. We would have liked to have engendered, in the participants at the alpha sites, a perception toward the collaborative activities within which collaborative activities were viewed as an integral part of their daily activities.

Realizing the importance of communications, we established an electronic mail (E-mail) link between the LTC and the alpha sites. E-mail was selected as a communication vehicle because of two main reasons. First, it takes one half hour to get to the nearest alpha site, and three hours to get to the furthest alpha site, so on-site visits needed to be carefully planned and coordinated with other

obligations. Second, because of other obligations, direct, synchronous communications were not always possible.

The E-mail system which was originally used was a mainframe-based system. This meant that we had no control over system maintenance nor over the procedures that users needed to learn in order to successfully interact with it. We provided on-site training for the alpha site personnel who would be using it. The interface was changed two or three times without warning, however, and the personnel in the alpha sites became discouraged, and their use of the system dropped to zero. To solve the problem, we purchased our own remote bulletin board system (RBBS), installed it on an old micro computer in the LTC and kept it operational 24 hours a day. We also acquired a software package that would let us remotely diagnose, operate, or monitor computers at the alpha and beta sites. Though not used extensively, these two packages have saved us a considerable amount of time and expense and have served to strengthen the communication ties between our collaborating groups.

In addition to facilitating electronic communications, an LTC staff member was assigned the task of working with the alpha sites. That person scheduled regular monthly trips to two of the three sites. (In the second year of the collaboration, the largest district hired an LTC staff member as an intern who served as a liaison to the project. The intern was to install new software, conduct training, facilitate data entry, and coordinate district planning for the project. Gradually, however, other demands placed on his time and talents by several other technology projects which were being implemented reduced his effectiveness as a project liaison.)

Unreliable Software

Even in a development mode, novice users expect products that work and work well. We found that, many times, in an effort to assure the practitioners that we were making progress and solving their problems, we released product too early. Not many things are more frustrating to a practitioner who is excited about the potential of a new tool and then finds that it is too difficult to use or does not work properly. Producing bug-free software is a very difficult task especially in a prototyping environment, without the support of rapid-prototyping environments (Hekmatpour, 1987), because it is the nature of the project to evolve based on user input and based on field observations. Quite frequently, we found, changes that were made to accommodate suggestions or to fix a problem, affected other, previously working, components of the software. It was almost impossible for us, due to resource limitations, to thoroughly test each version prior to release and maintain a reasonable software development schedule.

Later, in the project cycle, we were able to produce a product which, though not complete, reliably and easily accomplished most of what the practitioners wanted. When we had achieved that level, we were able to 'freeze' product releases until they had passed through at least two levels of review and testing in the LTC. Nevertheless, products seldom work in the field the same way that they work in the development laboratory. To help us simulate field conditions in the LTC, we enlisted student volunteers (who were up to that point unfamiliar with the software) to work with the system and evaluate the documentation. Their insights as novice users were invaluable in helping us to establish quality and deliver products which worked under field conditions.

Recommendations

The most pervasive and difficult problem we encountered as we worked collaboratively with K-12 practitioners to design and develop the IMS was maintaining the expectations of the practitioners such that they were both committed to the long-term objectives of the project and yet were willing to put up with problems as those long-term objectives were being pursued. We found that our enthusiasm

about the project and our interest in maintaining commitment in the alpha sites tended to raise the expectations of the K-12 participants to a point that exceeded our ability to perform reliably. Confidence in the work of the collaborative is a function of communication and quality control mechanisms. In order to be able to make accurate projections and avoid embarrassment, it is very important to keep in close contact with other organizations which can influence the success of the collaborative. For example, when the collaboration involves software development that depends on projects, software development houses vendors and build collaborative activities to keep up to date with software changes and new expected capabilities.

We found that it was important to do more than just facilitate communications. The best progress was realized when we were able to provide regular in-depth support of those who were in the alpha sites, and when we were able to periodically encourage them to maintain continued involvement. When they realized that we depended on them for feedback, and that their recommendations were crucial for the development of the project, they responded positively. When support and persuasion were not consistent, feedback from the field slowed.

We learned that collaborative efforts that are developed within larger organizations need to explicitly contemplate the stated goals and missions of the larger organization. Unless the nature of the collaboration is clearly stated and programmatically supported, collaboratives are very vulnerable and subject to the vagaries of cultural and economic pressures, organizational politics, and the caprice or reorganization of upper-level administrative staff. We do not intend to say that collaboratives, as components of very large organizations, are either inadvisable or impossible to sustain. Rather, those who are participating in the collaborative must make concerted efforts to understand which variations in the larger organizations can and might impact the nature of the collaborative, and plan for those contingencies. If substantial support is not obtained at the highest levels of both organizations within which the collaboration is to occur, then when the initial excitement shared by the participants fades, and the fruits of one's labors are not immediately apparent (or are taking longer than originally estimated), there is a danger that the collaborative efforts diminish and it gradually fades into nonexistence.

Do not be afraid to hold each other accountable but do so within the context of a professional and non accusatory atmosphere. Collaborators are companions, not competitors. Establish formal mechanisms within which free and open communication between collaborative bodies can occur and proactively encourage on-going communication between participants by identifying and removing barriers which prevent or discourage it. Encourage explicit discussion of expectations, perceptions, and performance. Be sensitive to the demands placed on each other by the respective institutions. As much as can be possible it is important to consider the duties which compete for time and resources of the participants and make accommodations for them during the planning and negotiations process. The plans for the collaborative should include procedures which can systematically be used to evaluate the products and processes associated with the collaborative.

Summary

In this paper, we have taken a backward glance at our experiences as a result of collaborating with K-12 districts in the design, development, and testing of an instructional management system. In spite of the problems that are presented here, the collaborative has been extremely productive for all who have been involved. Each of the alpha sites have extended their commitments to the project and will be implementing the IMS at building levels in multi-user environments during Fall, 1989. Given that considerable time has passed between the initial agreements and a truly functional product, we consider the fact that the technology is being incorporated into the fabric of the K-12 settings as a measure of success. The collaborative efforts will extend into the future as we continue development of the IMS and conduct research on its implementation and use.

As organizations become more dependent on other groups for information and resources, collaborative arrangements will, we feel, become more and more important. Organizations which collaborate with other, dissimilar groups have a greater chance to become more responsive to a changing environment than those which do not. In addition to examining literature which features studies of collaborations, those who are considering collaborative efforts might find results from research projects which have studied the dynamics of complex organizations useful and applicable. Having had the fortune of working with three K-12 districts over the past five years, we have learned a great deal. As with most activities, there is not a set of procedures which, if followed, will guarantee problem-free collaboration between organizations. If members keep a continued focus on the purposes for which the initial collaboration was pursued, then disturbances can be identified and removed or tolerated while they are being pursued.

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