A Descriptive Study of the Design, Development and Management Factors for a Multimedia Project Involving Multiple Stakeholders.

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CHAPTER I: Nature of the Project

One of the greatest pains to human nature is the pain of a new idea.

Walter Bagehot

Introduction

The concept of multimedia project management is relatively new in the field of education. There are many unknowns when embarking upon this type of development. When one considers that experts in the field of multimedia development, such as Golas (1994) and Greer (1992), suggest that development time for producing one hour of multimedia can range from 50 to 600 hours, there is no doubt that there will be ambiguity. However, it is the benefits of this type of development that attract educators, managers and designers.

Multimedia products provide a wide range of advantages for the learner. They allow for individualization, maximize interaction and provide motivation for content. Feedback and evaluation can be provided immediately. In addition, multimedia products provide the learner with more control over learning. All of these benefits are well suited to adult learners.

However, there are concerns associated to the development of multimedia products. These products often require expensive hardware, developers designing the product need more specialized skills and the development time is longer than for other types of products. The relative newness of computers in education and the use of the internet often means that the people who will be using the product are inexperienced with the media. It was with knowledge and understanding of only some of these aspects that the development of Academic Preparation for Science began. Through the development process, much was learned by the project team members.

History

Adult Basic Education (ABE) began in this province in 1963. From 1968 to 1995, students were required to take five credits in grade 11 and five credits in grade 12 to get an ABE 12 certificate. Because of difficulty in the recognition of this certificate by programs in technical institutions and universities, a need to revise the system was reviewed by the Department of Education. In July 1995, a new seven credit Adult 12 program was implemented. Students who had completed grade 10 could enter the Adult 12 program.

Instructors and students quickly discovered a significant gap left from the absence of grade 11. For example, subject areas that required significant bridging were the sciences. Biology, chemistry and physics students were encountering difficulties due to a lack of background information. Saskatchewan Post Secondary Education and Skills Training (SPSEST) conducted a number of focus groups with practitioners in the program and felt the need to try to bridge the gaps. As a result, a provincial government multimedia department committed money into bridging from ABE 10 to Adult 12.

The task for the project as set out by the sponsor is as follows:

> Create interactive, culturally sensitive learning materials with testing capability, primarily focussed on bridging between ABE 10 and Adult 12 in Math, Science and Literacy, for adult and special needs learners preparing to enter the provincial Adult 12 program; to be accessible in independent or group settings using various computer formats, such as on-line discussion and CD-ROM. Materials to be developed using existing resources where

available, in partnership with the Correspondence school, regional colleges, both universities, and Aboriginal institutions.

The scope of the project was eventually narrowed to the field of science and the partnering organizations are more limited than originally suggested.

The story for this study began in March of 1996, but did not begin for me until August of the same year. In early March 1996, the sponsor of the project contacted the principal of a Northern technical institute campus in Saskatchewan and asked him if his institute would take on a project to develop a multimedia product in partnership with other organizations. The principal, in consultation with other faculty members, agreed to take on the project. Before the project could begin, the principal felt the need to solidify a partnership agreement that was in the process of becoming a reality. It wasn't until the summer of 1996 that this partnership was formed.

In August 1996, I was asked to attend meetings with staff from the sponsoring agency and other personnel from my employing institute to discuss the breadth and scope of what was to become the product now known as *Academic Preparation for Science*. My role would be to write a proposal for the project to be submitted to the sponsor.

After the initial meeting with the sponsor, members from several organizations came together to form the steering committee for the project. This steering committee consists of seven adult educational institutions as follows: a Northern technical institute campus, a Southern technical institute campus, a Northern community college, three Aboriginal institutions and a Southern rural community college - all in Saskatchewan. Within a few weeks, I was hired as the project leader. This study will contain my observations and interpretations of the process as the project leader and will include the perceptions of others involved in the project.

This project has a rather unique flavour from three perspectives. First, under most circumstances, groups with common interests are drawn together and jointly present a proposal that reflects their common interest to funding agencies. They then work toward this common goal. In this situation, the sponsor provided money, asked for a partnership and then asked for a specific product. Because the steering committee wasn't initially tied by a common interest of their own counsel, the sense of partnership had different beginnings than most.

Second, the people involved in the production were not experts in the field of multimedia. Rather than having the "techies" as the driving force behind the operation, the people in the classrooms and those involved in the teaching process were the driving force. This served the purpose of emphasizing material based upon teaching and learning rather than allowing the technology to drive the process. The focus was on instructional design rather than multimedia production.

Finally, this project would be considered somewhat innovative in this province. Never before has a multimedia project of this scope and breadth been undertaken by the groups involved. In the process, it was discovered that many of the issues the project faced had not been faced before by others, such that this project has set some precedents and a framework for future developments.

The purpose of this study is to describe the design, development and management of the *Academic Preparation for Science* project.

About the Product

The product is called *Academic Preparation for Science* (APS). *Academic Preparation for Science* is a multimedia program intended to enhance possibilities of success for adult students in further educational and work related pursuits. The purpose for the product is to prepare students in science so that they may be successful in further academic secondary science training. This

program was designed to assist educators and students with processes related to integrating knowledge, skills and attitudes. The product is seen as a companion to existing Adult education programs as well as a bridging to further studies in science. It was designed to produce interactive learning materials on CD-ROM in combination with internet resources to meet the needs of a wide variety of adult learners in Saskatchewan.

Because the funding was made available from a government multimedia division, media selection was a major consideration. After an initial proposal was derived, a survey was sent to adult educational institutions throughout Saskatchewan requesting information regarding their media capabilities. Instructors and coordinators were asked about computer access, internet access and other media availability. From the results of this survey, it was determined that many institutions were not able to provide adequate internet access that would allow delivery solely through this form of media. Many institutions would be purchasing computers or had computers but many northern and remote regions felt that good access to the internet was still some time away. As a result, it was decided that the program would be offered on CDROM based on the hardware availability and because it can provide opportunities for interactivity in the learning process.

The program consists of seven modules. These seven modules are designed on a CDROM with the internet as a support. The four introductory modules include topics related to Science and Us, World of Work, Decision Making, and Learning Science. The other three modules focus on basics in biology, chemistry and physics. The content is written to reflect views and interests of adult students in Saskatchewan and to reflect the interactivity enabled by the use of media to deliver the information. There is a strong Aboriginal component in the four introductory modules. The content was determined through focus groups, the project steering committee and an industry survey.

An internet web site and manuals support the CDROM. The internet contains module overviews, module objectives, and a variety of support resources. Each module has video resources cited that are available through Media Group, print resources of value and internet hotlinks to sites with related information. The exams for each unit are on-line utilizing an on-line testing system that was also funded through the same sponsor in another multimedia initiative. The testing system provides immediate feedback for objective test questions but requires teacher marked responses for subjective questions. Email and a discussion room are also provided for instructors and students. The manuals contain the information from the web site and additional tutorial information on how to use the program.

As previously indicated, the reason this initiative was targeted by the sponsor came as a result of interviews conducted throughout the province in ABE and a decision by the province to target ABE for multimedia development. The original hope of the sponsor was to fund a senior mathematics program to be delivered on CDROM. However, a western agreement precluded them from targeting mathematics and the multimedia division had to look to other projects. At the time, they did not have any other significant projects to fund and the fiscal year was quickly coming to a close. A spokesperson from the division contacted the principal from the Northern technical institute by telephone and advised him that the money was available if he could find a suitable area within ABE to target. The decision had to be made immediately so as to get an agreement in writing prior to the close of the fiscal year. Thus, the *Academic Preparation for Science* project had a rather unusual start.

The focus of the program was to bridge the gaps created by the removal of the ABE 11 program. In addition, there was a need seen to develop curriculum that focussed on Aboriginal learners. Multimedia delivery of the content was seen as a possibility to bridge the gaps.

The *Academic Preparation for Science* program uses examples and information relative to science in Aboriginal lifestyles and cultural heritage. The product serves to provide a bridge by using real life situations and everyday experiences to create an interest in science. It then looks at specific topics in biology, chemistry and physics that are needed in preparation for senior science courses.

Target Audience

There are several groups who will benefit from this program. This project is aimed at adults who lack personal and academic preparation to effectively pursue available educational and career related activities. Students who have previously received a grade 12 but remain inadequately prepared will gain from studying the program. Also, students who have partial high school, ABE 10 or GED preparation will benefit from this program. Additionally, this program will serve adults who have been out of school for a period of time and now want to continue their education. It will serve to provide the sound basis required for further study in specialized science areas. Targeted learners will be those who enroll in adult programs in educational institutions across Saskatchewan. The emphasis of the program is on Aboriginal, rural, remote and Northern students, but not to the exclusion of Southern and urban populations.

People Working on the Project

Writers	6	Sound Engineer	1
Instructional Designers	3	Graphic Artists	2
AV Technicians	4	Project Leader	1
Internet	2	Reviewers	3
Document Editors	3	Focus Group #1	10
Authors	4	Focus Group #2	16
Steering Committee Members	9	Evaluation	2

Significance of the Evaluation

The purpose of this study is to describe the design, development and management of the Academic Preparation for Science project. This study will be of value to educational institutions in partnership who are involved in the design, development and management of a multimedia project, and indeed any project. It will answer the specific project question "How are large multimedia projects effectively managed"?

Definition of Terms

ABE - Adult Basic Education is an educational system for adults 18 years of age or older that has been delivered in Saskatchewan since 1963.

ABE 10 - an individualized upgrading program for adults wishing to complete their education. The program is aimed at adult students working at any level between grade 5 and grade 10.

Adult 12 - A seven credit grade 12 program for adults in the province of Saskatchewan. The 7 credits are 30 level credits as recognized by Saskatchewan Education.

Authoring system - An authoring system is a computer program which is designed for the development of computer based instruction. The software program used to design the Academic Preparation for Science project is Authorware.

CAI - Computer assisted instruction which involves the delivery of instruction and activities by computer.

CDROM - Compact Disc Read Only Memory is a format for storing large amounts of information. The format is capable of storing audio, video and graphic pieces of information.

GED - A General Equivalency Diploma awarded to students who complete a battery of examinations. It is an equivalency standing for grade 12 in Canada.

Internet - The world's largest computer network used for freely exchanging information. The internet can handle forms of information that vary from print to graphics.

Multimedia - A multimedia program is one that provides a variety of sources for instruction. These sources can range in variety on a compact disc such as audio, video and graphics. The content may also be varied such as games, tutorials and drill and practice. The mode of delivery may also range from compact disc to videos to the internet.

Subject Matter Expert - A subject matter expert (SME) is a person who knows the topic or content and knows how to prioritize material.

CHAPTER II: Review of the Literature

Thus times do shift, each thing his turn does hold; New things succeed, as former things grow old.

Robert Herrick

Man can learn nothing unless he proceeds from the known to the unknown.

Claude Bernard

Project Management

Introduction

People have been involved in projects since the beginning of time. However, the concept of project management and the details that are a part of project management are relatively new (Lock, 1994; Frame, 1987). There is an abundance of literature regarding management of industrial projects and construction projects, but newer information-age projects have very little supporting literature (Bergman & Moore,1990; Frame,1987). Consequently, project managers involved in software production and multimedia production can find themselves making mistakes and chalking these errors up to inexperience. Learning from others' mistakes and using the experience of others can help to prevent costly errors, provide insightful guidelines for planning and development and yield a more effective end product.

How does project management differ from the management of any other type of general management? What makes project management unique? How does the manager of a project effectively plan and supervise the design and development of a multimedia product? What role do team members play? How does a project team deal with the politics often associated to projects? These are just some of the questions to be addressed when discussing project management. Although the research base regarding multimedia projects and their management is minimal, more and more attention is being given to the topic and the base of knowledge is growing.

Characteristics of Projects

What is a project? When is an activity considered to be a project? We use the term project often in everyday language. We may have a weekend project that involves painting the fence, building a tree house or putting a boat into a lake. Whether the project is an activity around the house, a pleasure activity or a job related activity, they all have common features. According to Frame (1987), projects are goal-oriented, involve a coordinated undertaking of interrelated activities, are of finite duration and are each, to a degree unique. Dinsmore (1990), supports this in his reference to a project as "a unique venture with a beginning and an end, conducted by people to meet established goals within parameters of cost, schedule and quality" (p. 17). He further suggests projects are temporary, unique and are systems the are made of "different pieces linked together in intricate ways" (Dinsmore,1990:29). Love (1989) supports this in his reference to a project as a "one-time job that affects operations and people...something with an end point and each project is unique" (p. 5-6). Knutson and Bitz (1991:1) suggest "that a project is a well organized development of an end product that has a discrete beginning, a discrete end, and a discrete deliverable". It is " a set of principles, methods, tools, and techniques for the effective management of objective-oriented work in the context of a specific and unique organizational environment" (Knutson and Bitz,1991:2).

Project management is different than general management in that projects are finite, more complex and very task-oriented. Project management requires more detail in planning and more control (Love 1989; Dinsmore 1990). However, the finite nature of a project precludes the need for long term planning and long term goals. In addition, in a project, lines of authority tend to cross boundaries and "assignments are intermingled in a web of authority and responsibility that is not always clear" (Dinsmore, 1990:37). General management involves people reporting to a person who is their immediate supervisor. In a project, the team members already have a different supervisor for their general day to day activities. Thus, the project manager carries more responsibility than authority with his/her team members. Love (1989) summarizes the difference between project management and general management as follows:

> When unique projects are added to routine operations, chaos can result. The planning and controlling that is suitable for repeated operations is simply not intensive enough or deep enough or sophisticated enough for managing projects that are different from each other. Thus, although project management is similar to general management, it is also different because it requires more management effort. (p.25-6).

Anderson, Grude, Haug & Turner (1987) support this view and further suggest that due to the uniqueness of projects, existing practices and customs cannot be relied upon and plans and budgets must be based on estimates, not necessarily past experiences. In a project, there is only one chance to get things right within specified time constraints. Because of the variety in resources, relationships must be created between people who do not normally work together (Anderson et al.,1987; Dinsmore 1990; Bergman & Moore 1990).

Multimedia projects.

Multimedia products are becoming more common place in education today. A multimedia program is one that provides a variety of sources for instruction. While there are an abundance of definitions for multimedia and multimedia instruction, it is difficult to find consensus. Schwier and Misanchuk (1993) provide a definition compatible to that of a project that centres on process rather than the hardware required to operate the program.

> Interactive multimedia instruction (IMI) is an instructional program which includes a variety of integrated sources in the instruction with a computer at the heart of the system. The program is intentionally designed in segments, and viewer responses to structured opportunities (e.g. menus, problems, simulated crises, questions, virtual environments) influence the sequence, size, content, and shape of the program. (p. 6).

The main advantage of a multimedia delivery system is its ability to provide interaction and student-centred learning activities. While multimedia projects have many similarities with other types of projects there are some important differences to consider. Frame (1987) contends,

> Because knowledge workers function heavily in the world of the intangible, the character of their projects is fundamentally different from what one finds in, say, the construction industry. For example, they operate in a fuzzy world where it is often difficult to define precisely what they are supposed to do and how they are going to do it. Consequently, many of the project management tools developed for working with tangibles are of marginal use to them. (p.13).

Multimedia projects "involve more resources, more factors, longer development times and larger budgets" (Bergman & Moore, 1990:5). Because multimedia is an expensive medium for delivery, its use must be warranted. Jones & Smith (1992) suggest three criteria to be examined when contemplating multimedia as a design option. "In order to justify the use of expensive

multimedia technology in a course, the instructional courseware must meet three criteria: it must satisfy a need not otherwise easily met, be closely related into curriculum, and enhance the quality of the learning experience" (Jones & Smith, 1992:41).

Multimedia and the interactivity that goes with it involves a unique combination of activities and a vast assortment of details that are not as common in other projects. Not only does the project require the management of applications such as scripts, storyboards, flowcharts, graphics and programming, but it also involves monitoring people, time and money (Bergman & Moore, 1990).

In most projects, team members and managers come from a common background. Multimedia projects will have people from an assortment of backgrounds such as content experts, instructional designers, graphic artists, audio visual technicians, authors and programmers. In addition, many multimedia projects presently have inexperienced personnel who have to learn to adapt their expertise to a multimedia format. (Bergman & Moore, 1990).

The Project manager

When involved in a project, it is essential to have one person who is in charge or responsible for taking the project from one point to another, preferably the beginning to the end. This person is the project manager or project leader. The role of the project manager "entails responsibility for planning, organizing, co-ordinating, staffing, leading, major decision making, motivating personnel, monitoring and controlling operations on the project" (Young, 1994:15). "Job descriptions for project managers spell out attributes, skills, and responsibilities that can only be described as monumental" (Dinsmore, 1990:40). Managing projects requires an involvement in a myriad of details and decisions regarding many real and potential problems.

> The project manager is supposed to make it all happen by drawing on a well of personal qualities and professional skills. V.E. Cole, former executive vice-president of Kaiser Engineers, has suggested that a construction industry project manager must be all of the following: superb planner, skilled administrator, brass-knuckled fighter, experienced constructor, master of communication, unshakable optimist, super salesperson and miser. A comparable list of characteristics also applies to project managers of high technology manufacturing projects and of "soft" ventures such as social or educational programs. (Dinsmore,1990:41)

In a multimedia project, added challenges arise from the vast differences in the backgrounds of those who work on the project and the commanding outcomes that result from the interactions. Miller (1990) explains this challenge:

> To realize this potentially powerful result, the art and science of each technology are placed in the hands of a project manager, who in turn must orchestrate the complete interactive experience for the final user. This represents a vast opportunity and a significant responsibility. It also poses a difficult problem, for as with your local Philharmonic, many can play the instruments but few can conduct the entire ensemble.
>
> To further compound the challenge, imagine that each musician not only plays a different instrument, but also speaks a different language. Such is the case with interactive video, where the assembled team includes instructional designers who speak of authoring, pedagogics, and remediation; graphic artists who talk of drop shadows, GUI's, and animated sprites; video producers who think in terms of wipes, fades, pictures, plots, scenes and storylines; and computer specialists who deal in bits and bytes, images and data, icons, picons, micons and programming languages all their own.

> Add a systems person who wants to integrate LDs and CD-ROMs with DVI and Windows via SCSI or RS-232 ports, and then telecommunicate the whole mess to a host; an accountant who wants to estimate the cost per instructional seat-minute or unit of customer interaction; and, of course, don't forget the subject matter expert who may know nothing about anything but hydraulic engineering.
>
> The management challenge is obvious. (Miller, 1990:xvii).

McDaniel & Liu (1996) suggest, "To manage multimedia projects successfully, one should not only have a general knowledge of instructional development (ID) project management, but also should have a good understanding of the current practices by multimedia companies" (p.3). However, project management is not necessarily something that a person will train for or be trained for. Often, in education, an organization will bid on a project and, if successful, have to quickly assemble a manager and a team to fulfill the obligation. Existing staff on-site that have some familiarity with a portion of the project may be selected to lead it. "Project management know-how is conveyed informally; managers learn to carry out projects by working on them" (Frame, 1987:70). Parda (1996) asserts, "Effectively managing projects and the dynamics of change is critical to success - the challenge for many organizations is that, while their people are functionally competent, they have had little, if any, experience managing projects" (p:6). As suggested by Greer (1992), "Most people who manage ID projects have had either formal or informal exposure to the field of instructional development....Many who manage ID projects do not consider themselves professional managers" (p.xvi). The obvious difficulty is to take an inexperienced project manager and enable him/her to produce a quality product within given timelines. Perhaps Mark Twain said it best when he stated, "A round man can not be expected to fit into a square hole right away. He must have time to modify his shape".

Role of the project manager.

The project manager holds the ultimate responsibility for the project. He/she manages the day to day operations and is intimately involved in the planning, development and implementation. Some of the key roles of the project manager are outlined in table 1.

Table 1: Key Roles of a Project Manager

Skills	**Abilities**
Leadership	Provide direction Delineate goals and objectives Unify team toward goals Delegate Sound decision making
Technical Expertise	Understand the technologies involved in the design and development Manage technology Communicate with technical team Assist in problem solving
Human Skills	Team building Motivating personnel Manage conflict Communicate with all levels of personnel Foster a team environment
Administrative Skills	Proposal writing and project planning Resources negotiations and secure commitments Establish operating procedures Maintain reporting and review systems Establish and manage project controls Manpower planning
Organizational Skills	Build multifunctional work teams Work effectively with senior management Understand organizational structures and interfaces Set up an effective project organization
Entrepreneurial Skills	Manage a project as a business Meet profit objectives Develop new business

Note: *Adapted from Human factors in project management.* Dinsmore, (1990:54-5).

There is no question that managing projects is difficult based upon their complex nature. Frame (1987), states that effective project managers must master two lessons. "One is how to identify and avoid some of the common pitfalls encountered in managing projects...The second lesson is how to organize and carry out the project for success - how to make things happen" (Frame, 1987:15). "The successful project manager delivers clearly visible results, not just at the end of the project, but all through its life. These results allow the people inside the project to see that they are making constant viable progress towards the project's final deliverables" (Woldring,1996:20).

According to Greer (1992:4), a project manager's role involves three main activities:

- planning - conceiving of the overall project and arranging for all project events to happen
- stimulating action - getting each individual event started at the scheduled time
- intervening - observing when things aren't going according to plan, then taking action to get things back on track

The most successful project managers tend to be democratic in their leadership style but will use

whatever style is needed depending on the circumstances facing them. (Anderson et al., 1987; Frame,1987). The democratic leader makes decisions based on discussions and consultations with the team members involved with the project.

Project Team Members

Multimedia projects require a team effort. "The development team is comprised of several specialists who perform the design, development, production, and authoring work. They create the application" (Bergman & Moore,1990:24). Depending upon the applications being integrated into the product, the project will require the expertise of subject matter experts,instructional designers, art directors, audio-visual technicians, graphic artists, authors, programmers and more. All team members play essential roles that require effort and commitment. "Many organizations with failed, partially completed, or over-budget projects underestimate the level of effort required to launch, manage and complete an initiative. Rigorous planning and team development, done immediately before the launch of a project, are critical to success" (Parda, 1996:p.6).

Team members need to be involved and buy-in to the entire concept. They must participate and play an integral role in the planning and decision making. Because team members for projects are often on-loan or participate only temporarily before going to another job, it is often difficult to instill the sense of team. "...team members are often borrowed and may only have the briefest exposure to the project effort. They work on a piece of the project, and when they are done, they move on..." (Frame, 1987:81). The use of staff meetings to discuss improvements or specific problems can increase the sense of cohesiveness for the team members.

Dinsmore (1990) warns that assembling a group of highly competent specialists does not always make the best team. "Optimizing project resources is easily done on paper, but only a well-primed team working together to achieve common goals can make it happen" (Dinsmore, 1990: 60). "A desirable project team structure is one that copes with staff turnover, and lack of direct control over resources, enhances effective communication among the project team members, and facilitates the integration of the many pieces of the project" (Frame, 1987:88). Not only do team members require expertise in specific areas, they require the ability to work as part of a team. "While it is important for team members to have substantial knowledge and experience in their specific functional areas, it is equally important that they have positive attitudes and skills related to being an effective team player" (Parda, 1996:p.6).

Politics of projects

"Nowhere is the influence of politics more apparent than in the winning of projects" (Warby, 1994:64). When one considers the number of people that are involved in projects, politics can not help but play a role. A project consists not only of a project manager and a project team, but includes several other essential members. First is the owner or sponsor of the project who supplies financial backing. "Most projects raise political issues of some sort and hence require political support: moral, regulatory, and sometimes even financial" (Morris, 1993:43). In educational endeavours the sponsor is invariably a government organization. "As the application develops, the sponsor's primary concern is the investment... However, the sponsor is ever present in the form of the original objectives that justified the project" (Bergman & Moore, 1990:22).

Projects that are run through a partnership will also have an advisory group or steering committee that represents each affiliated organization. "When the project spans political boundaries (joint ventures between companies or joint efforts between areas), the steering committee is a way to apply consensus decision making to upper-echelon project management" (Dinsmore,1993: 238). They oversee the operation and make managerial decisions regarding the

planning and implementation of the product. They may provide team members to work on the project and will give final approval to major content and delivery decisions that fall within the guidelines set out by the sponsor. However, the culture of the group may also affect the project, "A steering committee could get in the way of a particularly effective project manager..."(Dinsmore,1993: 238).

Internally, the organization that runs the project has several divisions and departments to deal with. 'Even small projects live under regulatory and economic conditions directly influenced by politicians; intraorganizationally, too, project managers must secure political support for their projects" (Morris, 1993:43). In order for a project to be successful, the organization must recognize its value and significance and provide support based on that value.

Lastly, the end user for the project is an important constituent. "Getting the support of the local community is particularly important...the local community may also be the potential consumer or purchaser for the project" (Morris, 1993:43). This local community may be an educational community who will use the product in their classrooms. "These users must be involved in the development process; they should shape the application. You need their multiple perspectives during analysis, their reality testing during the design, and their reactions during validation" (Bergman & Moore, 1990:23).

All of those who have some vested interest in the project will require input and progress reports. Dinsmore (1993) notes, "The project manager receives inevitable pressure from higher management. The client organization also exerts itself, as do members of the project team, support groups, third parties, and outside groups" (p.238-9). It is essential to recognize this political atmosphere and maintain positive group dynamics through communication and sound problem solving. "Communication is the critical factor that gives project stakeholders the ability to negotiate, plan, solve problems, keep one another informed, and reach consensus" (Pitagorsky, 1997:16).

Project Design and Development

Introduction

Once a multimedia educational project is undertaken it is essential to determine how the instructional strategies and design models are applied to the development process. It is also important to determine what interactive formats best meet learning outcomes and how media is selected. "Design moves you from what needs to be done to how it should be done. Design decisions determine the final 'look and feel' of the application" (Bergman & Moore, 1990:53).

Interactive multimedia has unique design activities associated to it. The designer is moving from a single medium to multiple media. He/she must employ active user involvement rather than passive presentations and move from the mind set of linear paths to multi-option sequences. (Bergman & Moore, 1990). Before embarking on a project or starting the design of instruction, it is imperative to begin the process using a sound design model.

Design Models

Contemporary views see instruction as "...a systematic process in which every component... is crucial to successful learning....The components of the system are the learners, the instructor, the instructional materials, and the learning environment" (Dick & Carey,1996:2-3). The essence of the systems approach is the importance and interrelationship of all components in the process.

The design model utilized for this project was based upon the model used by a Northern

technical institute in Saskatchewan. This design system stems from a combination of models. The design of the system, which is based on Blank (1982), Norton (1987), Pucel (1989) and Dick and Carey (1990), follows in table 2.

Table 2: Instructional Design System

Design Elements	Description
Needs assessment	Collect and analyze information about the need to establish an instructional program
Occupational analysis	Identify the general areas of responsibilities within an occupation
Task analysis	Analyze each task identified in the occupational analysis
Profile development	Identify the instructional units for the program and their sequence
Content structuring	Plan how the content will be taught by establishing objectives
Criterion-referenced test development	Develop tests to ensure they match instructional objectives
Methods/media selection	Select methods and media based on target population, to ensure variety and to encourage active participation
Development/selection of instructional material	Develop new materials, select external materials and other support materials
Formative evaluation	Collect information about the effectiveness of the materials
Revision of system elements	Revise materials and interrelated elements in the system
Program delivery	Implement instruction
Program review	Continual review to assess the success of the materials

Note: Adapted from *Overview of instructional design system,* Program Development Steering Committee (1994), SIAST Woodland Campus.

While this is a very elaborate design model, not all elements are performed for every program/project and the sequence for the elements is flexible. The current economic, social and political climates create difficulty in following the detailed process outlined by this model. In addition, it is not always necessary to complete each step in detail. For example, in multimedia applications for academics, there may be no occupational analysis and a modified task analysis. However, the systematic approach that places the learner and learning environment in the centre of the design along with the instructor and materials is emphasized.

The project also incorporated Greer's ID model. Greer (1992) suggests that a typical project management model consists of three phases. Each phase consist of several activities (see table 3).

Table 3: ID Project Management Model

Phase I: Project Planning
Step 1. Determine the project scope Step 2. Organize the project
Phase II: Instructional Development
Step 3. Gather information Step 4. Develop the blueprint Step 5. Create draft materials Step 6. Test draft materials Step 7. Produce master materials
Phase III: Follow Up
Step 8. Reproduce Step 9. Distribute Step 10. Evaluate

From *ID Project management: tools and techniques for instructional designers and developers*, Greer, (1992:5).

Often a combination of design models are considered. Regardless of the design models chosen, it is an essential process in the development of sound instructional materials.

Instructional Strategies/Events of Instruction

Many instructional design models have complementary characteristics. Whether it is the models of Gagne; Pucel; Dick and Carey; Tessmer, Jonassen & Caverly; Greer; or Bergman and Moore, they (and many others) suggest many complementary and similar design components. While the Events of Instruction as developed by Gagne are presented here as a sequencing of material, it is apparent that several theorists must be discussed. Gagne's nine step events of instruction, as presented in table 4, provide a template for organizing computer assisted instruction.

Table 4: Gagne's nine events of instruction

1. Gaining attention 2. Informing the learner of the objective 3. Stimulating recall of prerequisites 4. Presenting the stimulus material 5. Providing learner guidance 6. Eliciting the performance 7. Providing feedback 8. Assessing performance 9. Enhancing retention and transfer

Note: Adapted from *Planning and authoring computer-assisted lessons*. Gagne, Wager & Rojas (1981:19).

This template serves to guide both the sequence of learning and the use of media. Gagne's events, Tessmer, Jonassen and Caverly's learning components and Bergman and Moore's multimedia strategies not only discuss the required instructional steps but also focus on their role in regard to computer assisted instruction.

Gaining attention.

Dick and Carey suggest that the first factor one should consider when planning activities is the motivational level of the learner. They state:

> ...you could assume that no effort is required on your part to establish a high motivational level. Or you may wish to use special techniques such as an attractive colour scheme, a cartoon, a human interest story, or some other approach to gain the attention of the learners and "hook" them into your instruction. (Dick and Carey, 1990:163).

Gagne also endorses a need to capture the attention of the students from the onset and throughout the program. "The attention of students, in the sense of alertness for reception of stimuli is gained by introducing rapid stimulus change. (Gagne, 1985:246). Beyond this, a fundamental and frequently used method of gaining attention is to appeal to the learner's interest. (Gagne & Briggs, 1979:157). As Bergman and Moore (1990) suggest when referring to the user, "They don't have to stay; motivation strategies make them want to stay" (p.61).

Perhaps the most detailed accounts regarding motivation and attention have been proposed by Keller. "The ARCS Model defines four major conditions (Attention, Relevance, Confidence, and Satisfaction) that have to be met for people to become and remain motivated" (Keller, 1987:3). "The first condition, attention, is an element of motivation and is also a prerequisite for learning" (Keller, 1987:3). As Keller points out though, it is not only essential to gain attention but also to sustain it throughout the program.

Keller secondly emphasizes the importance of relevance. This is further supported by Jonassen, Campbell & Davidson (1994:32), "...learning is most effectively situated in the context of some meaningful, real-world task". Dick and Carey (1996) also contend that instruction must be related to the goals of the student.

The third motivational condition is confidence. "For learners to be highly motivated, they must be confident that they can master the objectives for the instruction" (Dick & Carey, 1996:184). "A challenge for teachers in generating or maintaining motivation is to foster the development of confidence despite the competitiveness and external control that often exist in schools" (Keller, 1987:5).

Keller's last condition is that of satisfaction which can be provided through feedback and reinforcement. Dick and Carey (1996) advise that intrinsic rewards are as valuable as extrinsic rewards. For example, "Self esteem can be greatly enhanced through meaningful learning experiences" (Dick & Carey, 1996:184).

There are many techniques available in multimedia instruction to accomplish a motivational strategy. Possible approaches include the use of role models, challenges and curiosity. (Bergman & Moore, 1990). Role models are particularly effective when demonstrating a behaviour that you would like to encourage in the user. Challenges entail a game or situation that places the learner in competition with the program and curiosity involves the presentation of information in such a way that it causes the student to want to pursue the topic further.

In addition, media techniques such as animations and shooting-on-location can capture the interest of students. It is important to note that "...it takes a great deal of knowledge about what will interest the learners and what will turn them off. The area of motivation is both broad and complex. What seems to be motivating to one person is not to another" (Dick and Carey, 1985:136).

Objectives and prerequisite learning.

The purpose for providing the student with the objectives of the lesson is to "establish a readiness on the part of the learner to learn" (Pucel, 1989:73). According to Tessmer, Jonassen and Caverly (1989:61), "The key to writing a successful lesson objective is to be as accurate as possible in the description. The objective should not be a statement of content...the objective should describe what the student will learn to do from the lesson". "For certain learners, it may be sufficient to state the objectives in the same form that you have them in your instructional design. For others, you may wish to reword the objectives so that the students will understand better what the instruction is about" (Dick and Carey, 1985:137). This is consistent with Gagne who states that the student should "...demonstrate the activity to which the concept, rule or procedure applies" (Gagne, 1985:247).

Present stimulus material and providing learning guidance.

"The role of presenting stimulus material is to provide the student with the information that is to be learned. Most studies in concept learning research indicate that young adult and adult learners learn concepts best when they are given both definitions and examples" (Tessmer, Jonassen & Caverly, 1989:65). Bergman and Moore (1990) state interactive strategies encourage participation and interaction. "Presentations may be interactive by using questions, answers, and activities to advance through the material" (Okey, 1991:203). This is further supported by Tessmer, Jonassen & Caverly (1989:63), "A concise and clear statement about the defining characteristics of a concept, coupled with a good example, is an important concept lesson component".

In multimedia applications there are a variety of interactive strategies that may be employed. Providing user control over the pace of instruction, allowing the learner menu options and accepting student responses and providing intelligent feedback can all encourage involvement. (Bergman & Moore, 1990).

Learning guidance provide learners with a model of what constitutes correct performance (Okey, 1991). Both Pucel (1989) and Gagne (1985) emphasize the necessity to provide information that is needed for the learner to meaningfully apply the behaviour. Meaningfulness can be enhanced by "using concrete examples of abstract terms and concepts and elaborating each idea by relating it to others already in memory" (Gagne, 1985:252).

Dick and Carey (1996) also discuss the need for "chunking" information. The material to be presented must be sequenced in a hierarchical fashion and should be sub-divided into manageable chunks. In a multimedia application, "The complexity of multimedia designs and the need for the user to stay in control demand a structuring strategy" (Bergman & Moore, 1990:62).

Elicit performance and feedback.

Dick and Carey (1985) equate student participation with practice and feedback. They emphasize the absolute importance of these two activities in the learning process.

> One of the most powerful components in the learning process is that of practice and feedback. You can enhance the learning process greatly by providing the student with activities that are directly relevant to the objectives. Students should be provided with the opportunity to practice what you want them to be able to do. Not only should they be able to practice, but they should be provided feedback or information about their performance. (Dick and Carey, 1985:138).

Tessmer, Jonassen and Caverly support this decision, "For right answers, the feedback can be a simple ‘that's right, ‘good job' or ‘right'!" (1989:70). The desirability of frequent reinforcement stems from the principle of behaviourism that maintains establishing stimulus of the appropriate response "...depends on two conditions: active practice of the correct response; and reinforcement of the response following its practice" (Salisbury, Richards & Klein, 1985:10) It also stems from Keller's satisfaction strategy of providing "...frequent reinforcement when a student is learning a new task" (1987:5). It is important to note that "eliciting the performance should not be thought of as a test even though the responses are like those used to test the acquisition of knowledge. The emphasis in this event is on learning, not testing" (Okey, 1991:201).

Assessment and enhancing retention and transfer.

"Performance assessment is concerned with exhibiting complete demonstration of the learning outcomes at the close of instruction" (Okey, 1991:202). Assessment refers to giving a test. "The functions served by such a test are (1) establishing that the newly learned capability has reasonable stability, and (2) providing additional practice that serves to consolidate what has been learned" (Gagne, 1985:255). Bergman and Moore (1990) state that assessment strategies should complement interaction techniques.

"If your application is planned for adult audiences, your design should take into account the research findings that have identified the approaches to learning that adults prefer" (Bergman & Moore, 1990:63). Possible options for adults could include their choice of a delivery medium, voluntary quizzes, credit for prior learning, and ways to control the presentation.

Media Selection

Media selection may occur at different points of the development process. The systems' models indicate that if a needs assessment identifies a need to develop instruction, media selection is an important part of the whole process to be considered in relation to the student, the learning environment, the content and instructor. "Media selection must be based on the learning context, the skills to be taught, the practicality of the situation, and what theory indicates would be appropriate" (Dick & Carey, 1996:179). Systems' models indicate that media should be chosen based on their ability to present instructional events. Reiser & Gagne (1982) indicate that "...the events of instruction constituting a lesson should be planned before selecting the media to be used during the lesson" (p.507). In a multimedia project the questions to be considered are numerous. Does the content lend itself to multimedia instruction? Is the learner and learning environment suitable for multimedia delivery? Is there time and money available to produce quality instruction using specific media?

"After information has been accumulated during needs assessment, the designer matches characteristics of the learning task with characteristics of instructional media. Once the lesson objectives have been categorized as developing some combination of physical skills, knowledge, concepts, or rules, the designer may begin to evaluate a medium's appropriateness"(Hannafin & Peck, 1988:84). For example, "Because CAI may accept and evaluate a variety of inputs from the student, it generally gains favour when the designer determines that student response serves an important function during learning" (Hannafin & Peck, 1988:85). However, Schwier and Misanchuk (1993) caution that it is important to choose media appropriately.

> "As with the selection of any single medium during instructional development, some interactive multimedia components and combinations are more appropriate for specific problems than others. Chosen appropriately, training via interactive multimedia can

> provide powerful instructional treatments. Chosen inappropriately, training via interactive multimedia can range from glossy and needlessly expensive white elephants to truly hideous interventions" (p.147-8).

It is also important to consider the target audience and the environment for delivery of the materials."The presence or absence of strong verbal and reading skills and the willingness and ability to learn independently will influence the designer's media-selection decision" (Hannafin & Peck, 1988:85). In addition, the range in learner abilities is of consideration."...the wider the range of abilities and aptitudes exhibited by the target audience, the greater the advantages of interactive multimedia over more conventional media" (Schwier & Misanchuk,1993:151).

Cates (1992) states, "While it is desirable for a product to offer enriching, divergent materials on a topic, it is imperative that the product offer what teachers and students need" (p.5). Not only does the learner play an essential role in media selection, but also the environment in which the instruction will be delivered. Centrally located sites can provide a variety of instructional mediums.

> But, if the audience is dispersed, located over a wide geographic area, then an individualized approach which has the potential for power, immediacy, durability, and flexibility of interactive multimedia becomes more attractive. Multimedia can provide a cost-effective means of distributing instruction, especially considering the savings realized from travel and lodging expenditures often associated with events centrally offered. (Schwier & Misanchuk, 1993:151).

The cost of multimedia instruction is another consideration. In discussing application strategies and resources, Bergman & Moore (1990) indicate, "Part of this decision hinges on presentation value, part hinges on resource constraints" (p.60). When considering cost effectiveness it is essential to look at costs over the long run as opposed to short term.

"Each medium has different advantages and drawbacks relating to production, presentation, and maintenance. New technologies provide new capabilities and cost considerations. Making wise tradeoff decisions is a demanding part of the design process" (Bergman & Moore, 1990:68). Using a variety of media in the presentation of materials can provide an optimal learning environment. "Interactive multimedia instruction, at its best, capitalizes on the advantages of several media and compensates for the weaknesses of individual media" (Schwier & Misanchuk, 1993:148).

Media and technology are often viewed as primary products. According to Shambaugh & Magliaro (1997), "In a general sense designers and end users should view technology as a means to engage learners through a process of solving human problems with tools that possess varying degrees of process or product characteristics" (p. 178).

Learning Outcomes

To ensure that principles of sound instructional learning are utilized in the development of instruction, it is necessary to determine the type of learning outcome that is expected. By reviewing the objective of the lesson, you can categorize the learning outcome. According to Gagne, Wager & Rojas (1981), the learning outcomes that are most likely targeted in computer assisted instruction include verbal information, concrete concepts, defined concepts, rules and problem solving.

Verbal information refers to outcomes that require a student to recall, state or list specific information. This is the easiest level of learning outcome. Concrete concepts require a student to

identify a property such as "square" or "black" which suggests some comprehension. For concrete concepts, the student must identify by a visual method as opposed to requiring a definition. *Defined concepts* are more abstract in nature and cannot be identified without an explanation or definition. Thus the identification is more complex. "Defined concepts are rules for classifying. When learners have acquired such a concept, they are able to follow the definition in actually classifying some object or relation" (Gagne, 1985:115). A *rule* relates concepts. A student is required to apply what he/she has learned by demonstrating a rule in applying it to new situations. "A rule is an inferred capability that enables the individual to respond to any instance of a class of stimulus situations with an appropriate instance of a class of performances" (Gagne,1985:119). *Problem solving* necessitates the student to apply previous knowledge to an unfamiliar situation. However, "Problem solving is not simply a matter of applying previously learned rules...it is also a process that yields new learning" (Gagne, 1985:178).

"In general, a learning objective may be classified by identifying the category in which it fits. In doing this, it is usually helpful to think, "How would the learning outcome of the objective be tested?" (Gagne, Wager & Rojas,1981:18). Once it can be determined how to best test the objective, it becomes more apparent how to categorize the learning outcome.

Design Options/ Interactive Formats

Educators constantly search for ways to improve learning and retention. More and more it is being recognized that instruction needs to be arranged to meet individual needs and the student themselves need to become more of an agent in their learning. Computers are one effective resource for interactive, non-linear learning. The use of computers in learning is one way to facilitate the focus on student centred learning and also affords interactivity in the learning process.

There are a variety of design options that may be utilized when developing instruction. The instructional strategy or design option is determined by the learning outcomes that are desired. Usually lessons employ a variety of instructional strategies due to the varied nature of the desired outcomes. The major types of instructional strategies used in lessons include drill and practice, games, simulations and tutorials (Alessi & Trollip, 1991; Hannafin & Peck, 1988). An effective multimedia program will employ a variety of these strategies.

Drill and practice is used to provide practice for a skill or concept that has been learned and is used for reinforcement purposes. Questions or problems are provided, the student makes a response, the response is judged and then feedback is provided. While drill and practice can be accomplished through various teaching methods, computer assisted drills and practice can provide more immediate feedback. "Drill and practice designs assume many of the same functions as traditional worksheets, but they avoid the problems of inadequate monitoring, unchecked error responses, and postponed feedback" (Hannafin & Peck, 1988:144).

Computer based instructional games can also be an effective teaching strategy. Instructional games have similar goals to drill and practice, but are usually regarded as providing higher motivational stimulation. "To be a game, the strategy must have a criterion for achievement or winning" (Tessmer, Jonassen & Caverly, 1989:86). Because games are designed to provide practice through motivation, it is imperative that they are well designed or they will quickly become tedious and boring for students. "If properly designed, computer games can use the learner's competitive nature to motivate and increase learning" (Kemp & Smellie, 1994:279).

Computer simulations emulate a real life setting, situation or task. They are used to provide instruction when the actual situation would be expensive, difficult or dangerous to reproduce.

"Good simulations provide a scenario or set of events, clear options for student participation, a range of plausible consequences for student responses to the scenarios, and guidance for the completion of the scenario" (Hannafin & Peck, 1988:150). "Such programs offer the opportunity to experience "real world" problems without the associated risks" (Kemp & Smellie, 1994:279).

"In tutorials, information is taught, verified, and reinforced through interaction with the computer" (Hannafin & Peck,1988:139). "The two key words in the tutorial method are individualization and interaction" (Leshin, Pollock & Reigeluth,1992:263). Where simulations, games and drill and practice are usually designed to reinforce what has been previously learned, tutorials are designed to teach skills and concepts. "As an instructional form, it is usually considered to be primary instruction, as opposed to supplementary instruction" (Gagne, Wager & Rojas, 1981:20). "Tutorials model the teaching strategies that a tutor might use to teach a student (Tessmer, Jonassen & Caverly, 1989:170). In computer assisted instruction (CAI), the tutor is the computer. CAI tutorial programs "...teach by carrying on a dialogue with the learner" (Pucel, 1989:116).

Bergman & Moore (1990) suggest other interactive formats which may also be employed. These include demonstration/example, metaphor, interviews and case study. Demonstrations act as models that show "real-world artifacts, situations, operations and procedures that serve as models or incentives for the viewer" (Bergman & Moore, 1990:59). These can be very effective for cultural demonstrations. A metaphor simply uses familiar and/or entertaining representations for complex topics. Interviews allow the user to engage in conversation with experts, while case studies place the user in a problem situation that builds on past experiences (Bergman & Moore, 1990).

The delivery of these design options can occur in prescriptive or democratic environments. In prescriptive environments, the learner has little control over the instruction. Democratic environments provide the user with more control over what they are learning and the order in which he/she will learn it. A democratic environment aligns more closely with the philosophy of multimedia and the interactivity associated to it.

Conclusion

Project design, development and management is tremendously complex. The project manager is in the centre of the process and in the forefront throughout the life of the project. He/she must fulfill many roles and respond to many situations and people. Sound decision making will be critical to the success of the project. However, decisions cannot be made by one person alone. The key to successful project management is the recognition of the crucial roles played by the team members and the need for involvement of team members in decision making and problem solving.

The design process starts with a need and turns that need into instructional materials that have been designed for the learner, the instructor and the environment. Throughout the creative process, media selection, learning outcomes and design options all play major roles in helping to shape the end product.

The development of a multimedia product involves many unique activities and employs a multiplicity of people that come from diverse backgrounds. The newness of multimedia and its development in education in Saskatchewan has added challenges. Managing the paperwork, processes, people and politics associated to multimedia projects is both challenging and exciting. But the challenges are not to be underestimated. In the year 1513 Machiavelli said, "It must be remembered that there is nothing more difficult to plan, more doubtful of success, nor more dangerous to manage than the creation of a new system".

CHAPTER III: Method and Design

For the things we have to learn before we can do them, we learn by doing them.

Aristotle

Introduction

The development of the *Academic Preparation for Science* project took place over an extended period time. Project team members worked on pieces of the project in various locations across the province of Saskatchewan. The objective for all participants was to develop a multimedia product that would meet the needs of a wide variety of Adult Basic Education students functioning at approximately a grade eight level. The focus was on Aboriginal content with a Saskatchewan framework.

In order to track the progress of the development, a daily log which recorded significant events and decisions was kept. The purpose of this section is to relate the progress and process for the project and describe the methodology utilized. The intent is to reflect upon events and demonstrate a clear understanding of how the development and management of the project unfolded.

Partnerships and Proposal Writing (August 96 - September 96)

The partnership and background to this project had different beginnings than most ventures. This enterprise was conceived when the provincial government multimedia department had funds they needed to commit to an educational project prior to the end of their fiscal year. Because they did not have a project on their proposal's table that they deemed suitable, they contacted a Northern educational institution and asked them if they would be prepared to form a partnership with other educational institutions and submit a proposal for a multimedia project. The condition to the funding was the submission of a suitable proposal. The provincial multimedia department would also have input into the scope of the project and the media used for delivery.

Thus, while proposal writing is a significant means by which organizations gain funding, this project had only to submit a reasonable proposal for funds that were essentially guaranteed. As project leader, it was my responsibility to respond to the needs of the sponsor and to the needs of the partnership and reflect those needs in the proposal. (The project leader position was advertised through all partnering agencies and I was hired for the position.)

In the proposal writing stage, all groups met to determine common ground and began discussing the focus of the project.The sponsor indicated a desire for educational institutions to enter major program development issues on a collaborative basis. It was seen to be in the best interest of education in the province to engage in the co-management of curriculum development. The partnership was seen as an avenue to increase the satisfaction of several groups who could potentially use the product.

The funding agency indicated the multimedia fund was looking to sponsor products that were innovative, accessible and involved partnership arrangements. They indicated a need to integrate new technologies in a fundamental way in all facets of education and training. The long term goal was to provide accessibility for more students to further training. They wanted a skills oriented approach driven by jobs as opposed to a content focus.

Because there were other small multimedia initiatives related to Adult Basic Education (ABE) being pursued by the sponsor, they indicated a desire to limit the scope of the project to science

material that would enable students to successfully enter Adult 12 science programming. While a formal needs assessment had not been undertaken by the sponsor, interviews held with ABE instructors across the province indicated that the elimination of the Adult 11 program had created significant gaps in the sciences. Students were experiencing difficulty bridging the gap in the sciences from grade 10 to grade 12. However, at no point was there any indication that the assessment indicated the need to use multimedia to bridge the gap. The sponsoring agency was accessing money from a multimedia fund, thus the delivery mechanism was pre-determined as using varied formats for delivery.

The partnering agencies were initially reticent to focus on science-related programming as many members of the project steering committee felt there was a strong need in basic English and mathematics. However, when it became apparent that the sponsor was interested in the science field, most members agreed that a skills-based program that developed an appreciation of science would have tremendous benefits for adult students in this province. It was deemed that material that came as a response to problems and issues related to everyday life situations rather than focussing on school subjects would serve to increase interest in science.

One issue for this project centred around its scope. Many of the partnering agencies had instructors who indicated the largest problem was getting students interested in science. These committee members felt that many students were intimidated by the sciences and believed they weren't "smart enough to do science". However, the sponsor was very specific that they wanted to bridge the gaps to grade 12 sciences and wanted very specific biology, chemistry and physics skills addressed. It was decided that a focus group of subject matter experts (SMEs) would meet and try to address both of these areas.

The sponsor required a proposal very quickly after the formation of the partnership. There was little time to get into details related to content, media and specific objectives. One major problem was that the funding agency required a budget. This was essentially impossible to deliver without specifics related to the program. Through discussions with subject matter experts, instructional designers, computer network technicians, and audio visual technicians a very sketchy budget was included. It was not a detailed budget and it lacked depth. However, the sponsor was concerned with having something on paper to present to others in the government and the accuracy of the budget seemed secondary at that point. Before focus groups could be arranged and target populations surveyed, the proposal was submitted. Therefore, it lacked depth and scope relating to many specifics of the project. The proposal is included as Appendix A.

Project Planning (September 96)

One of the first tasks that was undertaken was an assessment of technical equipment and availability of technologies. McDaniel & Liu (1996) indicate "...when the need is not an issue, that is, when there is a call for proposals (where presumably a need exists), a developer should conduct a needs assessment after the contract is awarded..." (p. 11-12). The need for content in science had been explored partially by the sponsor, but they did not have an understanding of what most institutions were capable of utilizing for delivery of the program.

In order to determine the technical capabilities of the target population, surveys were sent to all educational training organizations in Saskatchewan who dealt with ABE students. (See Appendix B). The questionnaire was aimed at discerning what technologies the populations were able to access. The results of the survey indicated that most trainers had access to computer hardware and software. Most institutions also had or planned to have computers that had CDROMs. The survey also showed that many of the more remote locations and rural locations had no access or extremely limited access to the internet. It was also apparent that some of the larger urban centres did not have ready access to computers that were wired to the internet in their classrooms

where the program would be delivered.

Thus, the main delivery medium was determined to be CDROM with support through manuals and a web site and discussion page on the internet. In addition, tests would be delivered utilizing an on-line testing system that had been developed through the sponsor. This testing system would give instructors the ability to tailor exams and make changes as they deemed necessary. Because some sites would not have access to the internet, the manuals would contain the tests in print form and would also contain much of the additional information that could be found on the web site.

Profile Development and Content Structuring (September 96 - October 96)

In order to ensure that the needs of all partnering agencies would be met, each agency was asked to identify a SME who could discuss the needs of their students. A focus group was called to meet and begin to determine program content and specific objectives.

One of the participating groups had done some preliminary work toward bridging some of the gaps for science students. They had developed a print based program that dealt with a variety of issues related to the sciences and to content related to learning science. This material was distributed to all partnering agencies so that the focus group members could review the material prior to the meeting. This material formed a basis for the meeting and determining content and objectives.

The first focus group meeting was two days in duration. At this initial meeting, major areas of study were recommended. The group indicated that they would recommend introductory modules that would serve to motivate students and garner interest in the sciences. The introductory modules would look at the following:

* Science in every day life - This segment would focus on aspects of biology, chemistry and physics as experienced in every day life in situations such as a farm, a mine, the forest, the kitchen, etc. It would also focus on science and Aboriginal lifestyles related to tradition in medicines, the teepee, hunting, fishing and trapping.

- Science and the world of work - This module would discuss the difference between applied and pure science and different occupations relating to each area. Testimonials of Aboriginal and non-Aboriginal people working in fields of science would be a part of the module.

- Decision making in science - This section would examine bias in materials and methods on how to make decisions. Issues such as uranium would be used to help students learn to make informed choices. Aboriginal people who had led tradition lifestyles and then worked in uranium mines would be interviewed to provide information regarding their change in lifestyle and the effects of the changes.

- Learning science - This segment would explore a scientific mystery that occurred in Northern Saskatchewan approximately three years ago when the ice came off Anglin lake and many of the fish were dead. This module would look at this phenomena and discuss what sort of things could have caused this occur. Through the discussion, the student would be exposed to several science topics including the scientific method.

The focus of the introductory modules would incorporate Aboriginal themes and Saskatchewan based material.

The group also discussed the bridging aspects that the sponsor had deemed necessary. It was felt

that the material in the introductory modules would not enable students to enter grade 12 programs. Further study would be necessary. Therefore, they further recommended three additional specific modules on biology, chemistry and physics. These modules would look at needed background material for the senior science courses.

These instructional goals developed by the focus group were conducive to the approach suggested by Dick & Carey (1996), "The definition of an instructional goal may be derived from a list of goals, from a needs assessment with regards to a particular curriculum, from practical experience with learning difficulties of students in the classroom, from the analysis of someone already doing the job..." (p.5). The recommendations of the focus group were then taken to the steering committee who felt that the group was moving in the correct direction.

When working on a project, one of the essential ingredients is to have constant checks and reviews in place so that there is always clear understanding for all parties involved in the project. While the SMEs and the steering committee were satisfied with the direction, it was also essential to verify the direction with the sponsor. Discussions with the sponsor were positive so the project began to take a more definite form.

A second meeting of the focus group occurred a very short time later. The members had gone back to their work sites and had begun to develop a plan on how the content would be delivered. At the follow up meeting, performance objectives were determined for the content. In addition, a questionnaire was developed to be sent to industry. (See Appendix C). This questionnaire was sent to industries involved in mining, forestry, agriculture and other possible employers of science students. The purpose of the questionnaire was to seek validation of the skills that had been identified and substantiate the objectives for the program. The feedback that was received supported the direction of the program.

Organizing the Project (October 96 - November 96)

Following the second focus group meeting, the project steering committee came together to review the tasks and objectives. At that point some of the members of the committee indicated that they were not comfortable with parts of what the focus group had identified. They had concerns relating to objectives and tasks associated to the last three units on biology, chemistry and physics. Because none of the committee members had science backgrounds, they had difficulty indicating how it should be changed. One view was that these sections would be too content oriented and it would be better to teach these topics using sections called mining or agriculture or forestry. Another member indicated he found topics such as mining and forestry to be a turn-off and would rather see a topic called biology or chemistry.

One problem seen in utilizing topics such as mining and agriculture centred around who would be hired as the subject matter experts and writers. Much discussion centred around this issue. Who knew these students best? Most members felt that instructors involved with the target population everyday understood their skills, preferences and attitudes best. They felt that most of the writers should be people who had extensive experience with the target population. Other members who preferred a more applied approach to the topics were concerned that those instructors would be too content oriented.

Through discussion and input from other committee members, the group came to an agreement at the end of the meeting. They decided that the topics of biology, chemistry and physics would remain but that they would be taught through an environmental theme using narratives, case studies and real problems to introduce topics. This would serve to keep the information from being too content centred. Thus, the program was able to move forward. This discussion proved to make the committee more cohesive and different groups began to work more closely together

toward our common goal.

Assembling the team

At this time, job descriptions and postings were developed for various positions. Subject matter experts, instructional designers, audio visual technicians, graphic artists and author positions were advertised across the province. Each partnering agency was invited to provide personnel for any of the positions. They would receive priority over outside applicants if they were qualified for the positions.

The response to the advertisements was inadequate and some positions required additional recruitment. From the applications received and people who were recruited, there were several people who lacked expertise with multimedia development. This had both positive and negative implications. The sponsor had indicated that the reason they were working with the partnering agencies was threefold: they wanted to encourage partnerships in curriculum initiatives; they wanted to increase multimedia expertise within these agencies; and they wanted to produce a product that was usable for a large target population. While some of the applicants lacked multimedia expertise and experience, the project would serve to help develop these abilities.

However, the lack of multimedia expertise also caused difficulty in the development of materials that utilized the medium to its fullest capabilities. As indicated by a steering committee member, "Most people lack the general knowledge and experience in developing complex multimedia instructional products. It is sometimes difficult to balance the exciting creative use of these technologies with the many practical constraints without a sound understanding of all the developmental factors".

Reviewing the project

In order to provide a more concrete view of the project, the project manager, a steering committee member with some multimedia background, and an author met to take the vision and capsulize it. (See Appendix D). This "cube" and the overview of the tasks and objectives were distributed to partnering agencies, the sponsor and subject matter experts. In addition, the more definitive tasks and objectives provided enough information for a more detailed budget submission to the sponsor. A revised budget with more specific allocations and a more in depth proposal was submitted to the sponsor.

A major issue for this project was the lack of science expertise of steering committee members and the sponsor. Both had tremendous influence over the direction and shape of the project but neither group had a clear understanding of the needed skills and content for the field of science. Consequently, when the sponsor received the revised budget and information on the tasks and objectives, their concerns were over the size of the project only. The sponsor felt that they were spending a large amount of money and should get a lot for that commitment. While this is a reasonable request, there was a lack of understanding about what was a good "bang for their buck".

The sponsor had supported other small projects in the past and had received a CDROM as a product. Because the smaller project had a budget that was approximately one-fifth of our budget, they wondered if they would be getting five CDROMs from this project! They also did not have a science expert in their department and had no real concept of the scope of the project. The steering committee also lacked this expertise. However, while the steering committee did not have a science expert, they did have people with some multimedia experience. The steering committee was concerned that the scope of the project was much too ambitious for the funding we had received.

This put me in a precarious position. I also felt that the depth and scope of the project was too vast. While the steering committee supported this view, the problem was that they wanted to focus on the first four modules only. The request from the sponsor was to bridge to Adult 12 sciences and these modules did not provide enough depth to afford that level for the student. Discussions were held with both groups. Despite the reservations of the steering committee, the sponsor indicated they would accept nothing less than the seven modules that had been identified.

While I felt that we could deliver all seven modules, I also believed that the level of interactivity and the capability of the medium would be compromised. Some steering committee members suggested that we do the first four modules and then indicate to the sponsor that the rest of the task was not possible. I could not in good conscience do this. Ultimately, the committee agreed to move forward with seven modules on the agenda.

In order to get the maximum out of this project, the steering committee decided to solicit other funding for the project. A federal government agency was taking proposals for testing multimedia products that were innovative. The steering committee advocated seeking funding for the testing of the project components through this mechanism. A proposal was submitted to the federal program and the proposal was approved for funding.

Kickoff meeting

A kickoff meeting was held with all team members. This meeting was the first formal meeting of all personnel involved in the development of the product. Greer (1992) states the purpose of such a meeting: "to clarify materials to be created; to clarify roles and responsibilities; to create a feeling of more common purpose among team members; to get each team member's commitment to perform his or her tasks according to specific dates; to make certain that all team members have what they need to 'hit the ground running' when the meeting is over" (p.82).

Developing the Blueprint or "Big Picture" (November 96- December 96)

The kickoff meeting extended for two days. While the meeting helped to clarify roles and begin the project process, the meeting also provided an opportunity to review objectives and begin to develop strategies. This meeting also helped to establish a mentorship between those with multimedia experience and those without the experience. The gathering served to establish different ways to develop interactivity into material. Subject matter experts and instructional designers viewed professional CDROMs that had various forms of interactivity. Authors and internet specialists discussed methods of interactivity with which they were familiar.

Media was also reviewed by this group. The need for placing some print materials in manuals rather than on the CDROM was advocated. In addition, it was deemed that very little, if any, video would be incorporated onto the CDROM. It was decided that the money involved to make a video, the time it takes to produce good video and the space it takes on a CDROM were a hinderance to its use. It was felt that if there was a specific segment that required video, we would review whether it was crucial.

It was also determined that a web site that would include links to related sites would be set up. This web page would be referred to in the CDROM so students with internet access could obtain further material related to topics they were studying. Videos of specific value to the program would be housed by Media Group so all institutions could access them at a minimal cost. The project manager would make necessary arrangements with Saskatchewan Media to purchase the right to house the videos as needed.

A sub committee of writers, instructional designers, authors and the project manager was formed to look at the "big picture". This group discussed the feel and look for the project. They discussed navigation paths, menus, pacing and presentation, and outcomes or objectives. The content for pull down menus was discussed including the file menu, glossaries and resources and bibliographies. The group made recommendations for outcomes and objectives regarding what material would be embedded and presented indirectly and what would be provided directly.

After this meeting, the project leader reviewed the whole project with steering committee members and provided the project team members with an outline of what comprised the parts of each module. If you look at the original proposal (Appendix A), you will note the time frames initially set out for the development of the product. The time frames indicated that the entire project would be completed by March 1997 - a seven month time frame! This time frame had been set by the sponsor prior to the beginning of the project. The steering committee discussed the lack of reality this picture presented. It was decided that the sponsor would be contacted and informed that the development would not be able to completed in the time frame given the depth and scope of the project.

In order to support this decision, the project manager contacted other educational organizations involved in multimedia development. One initiative in Alberta involved developing one-fifth of their chemistry 11 program. This initiative took three and one-half years and used double the budget allotted to our project. Other Saskatchewan initiatives that were funded by the same sponsor were also behind schedule based on time lines they had been given. In an attempt to shorten time frames several other developments were studied to see if they had common themes or could provide some support. One of these projects was developing science curriculum on the internet for grade eight and grade nine level children in the regular school system. While this product appeared to be useful as a resource, it did not meet the needs of the adult audience that our project intended.

In discussion with the sponsor, an extension of time was deemed to be suitable. They had several projects in a similar position and agreed that more time would be required. The sponsor was also advised that the project would seek additional funding from a federal source to supplement their budget. This money would be used to provide an in-depth assessment and evaluation of the project materials and process for delivery. The project manager began developing the proposal which was later approved by the federal government.

Creating Tests and Draft Materials (December 96 - March 97)

There were six subject matter experts and two instructional designers who worked on the development of materials. Four of the writers and both instructional designers had extensive experience with the target population. Tests to match module objectives were developed by the instructional designers and the project manager who also had ID experience. SMEs reviewed the tests and made suggested revisions as needed. The content development for the CDROM began in early December 1996. Much of the scientific content was developed simultaneously by different writers to enable time frames to be met. Each worked on a different module.

The writers and the project manager found that there were no materials available that were already produced for the target audience with an Aboriginal and Saskatchewan focus. Thus, most of the budget went to human resources. This received some criticism from the sponsor who felt that we should be able to take materials that were already produced and just "dump" them onto a CDROM. It was at this point in the project that the sponsor suggested that the money was not for curriculum development! This detail had not been mentioned before and came as a surprise to all people intimately involved with the development. It was explained to the sponsor that anything that was developed had been developed for print and you could not simply "dump" materials

produced for print onto a CDROM. In addition, there were no materials geared for our target audience with local and Aboriginal focusses available. Although the sponsor would have preferred the use of existing materials, they conceded to let the development continue as outlined.

One person was responsible for the writing and development of Aboriginal content for the project. This person worked with material she received from other writers and integrated an Aboriginal perspective with the "scientific" perspective in the first four modules. In retrospect, it would have been more beneficial for the Aboriginal writer to work with each writer and develop materials simultaneously. However, due to geographic separation and tight timelines, the Aboriginal writer worked with the other writers' materials and integrated her material with help from discussions via the internet, email and through brief meetings. The instructional designers also helped with the process of integrating materials.

Some of the materials that were submitted from writers who did not have extensive experience with the target audience were written at an exceptionally high level. A readability showed that some material was at a university reading level. In addition, the material was written like an essay with no interactivity. As indicated by one of the instructional designers "Some of the content experts did not, in fact, understand the particular needs of the medium". This created some controversy, but through meetings and creating a more cohesive mentorship for these writers, a better product was developed.

The draft materials were sent to all steering committee members for feedback regarding needed revisions. Three SMEs not involved with the development were hired to review the accuracy of the draft materials. Materials that were reviewed were returned to the writers and revisions were made as requested. The sponsor was invited to review the draft materials but they did not provide a person to conduct the review. The sponsor was more concerned with the size and applicability to the audience as opposed to specific content.

Produce Master Materials ***(January 97 - March 98)***

Once the final written draft was compiled, the instructional designers began to work on the materials to make them ready to be placed on the CDROM.

Storyboard materials (January - June 97)

Two instructional designers were responsible for creating storyboards for the materials. The storyboards showed a screen by screen display of what would appear on the CDROM. They separated images, narration and text. The storyboard also contained notes to explain each screen for the authors. The designers created a two page storyboard that would be used throughout. However, after working through the first two modules, they went back and revised the storyboard form for future modules. They found it to be too cumbersome and revamped it so that it was only one page in length. (See Appendix E).

One major problem the instructional designers encountered involved the two separate writers for each for the introductory modules. One writer developed scientific material and another developed Aboriginal material. The instructional designers began to work on the storyboard as soon as they got the scientific portion. They felt they could integrate the Aboriginal portion into the storyboard with ease when it arrived. They found that this was a more difficult task than first anticipated. Both designers later indicated the need for a complete module with all written portions before beginning to work on the section.

Another issue was the lack of experience in the production of multimedia materials. One

designer indicated "Much to my chagrin, I found my expectation of development time unrealistic. It took at least three times as long to develop a portion of the program in an interactive, multimedia format as it would have taken to produce print-based independent study material". The same designer expressed that "content experts should work more closely with developers to brainstorm ideas and develop more meaningful interactions".

Screen design

The screens were developed using theory and outlines as discussed in Hannafin and Peck (1988) and Bergman & Moore (1990). Because the program assumes that the material is new for the student, the method of instruction, or lesson strategy, for *Academic Preparation for Science* is the tutorial. "In CAI, tutorials are generally used to present new information to learners - particular skills, information or concepts" (Hannafin & Peck,1988:139). In the APS program, the student is provided with information and examples. Students are provided with information about science topics and their relation to every day applications. For example, they are given examples of people working in science fields and examples of the kinds of things they do. They are then given practice with feedback that explains why they are incorrect and, in some cases, why they are correct. Each module ends with a summary of the unit and review questions for practice. The exams require them to recall information and to apply what they have learned to new situations.

Students are given interactive formats as suggested by Bergman & Moore (1990). Demonstrations, metaphors, interviews and case studies are utilized. For example, students experience a case study of an incident at a Northern lake and discover some of the scientific reasons behind the occurrence. While these situations would be better developed in a democratic environment, the limitations of the writers and the time allotted for development resulted in a more prescriptive environment in many situations.

The screens were designed such that navigation tools are always on the left hand side of the screen. The pull down menu with options to quit, glossary information, objectives, etc. are available on all screens. The available options were consistent throughout the program. Lesson orientation information is centred at the top, directions are provided at the bottom and options for going to the previous screen, previous section, next screen, etc. are on the left side. The borders used are consistent to a module. Pacing conventions and response formats are also consistent throughout the program.

Screen interactivities varied. Students may be requested to move objects to an appropriate box to categorize the object. They may type in a response or they may identify the correct response by clicking on it. Students engage in putting the pieces of a puzzle together to form a concept and move objects to demonstrate their understanding of a concept. Appendix F provides samples of screens and interactivity exercises.

Image gathering/narration (February 97- November 97)

The audio visual technicians were responsible for gathering images. The images varied from clip art to photos they had to produce. Some images that were difficult to obtain were purchased. The number of images required and the approximate length of time spent gathering images and recording and digitizing narration for each module was tremendous:

- Module 1 - Science and Us - 260 images - 30 days
- Module 2 - World of Work - 100 images - 20 days

- Module 3 - Decision Making - 167 images - 25 days
- Module 4 - Learning Science - 137 images - 15 days
- Module 5 - Biology - 130 images - 20 days
- Module 6 - Physics - 163 images - 17 days
- Module 7 - Chemistry - 368 images - 30 days

There was a lengthy discussion about the use of both clip art and photos on the CDROM. Some people felt that there should only be one type used throughout. Others felt that mixing the two was not a problem. In the end, a mixture of clip art and photos was used.

The technicians were also responsible for obtaining professional readers for the narrations and recording the narration. They then took the narrations and digitized the sound so it could be placed onto the CDROM.

One major problem encountered by the technicians was a poor system for managing all the photos and narration. They had not worked on a project of this magnitude before and did not have a good system to manage the files. Part way through the project they developed a database. While the database helped alleviate some problems it was not sufficient for the authors' needs. They did not have a numbering system that allowed the authors to easily find pictures. For example, they did not use a three digit numbering system. They came to realize that picture number 1 should be picture 001 so the computer could easily search for missing photos. After meeting with the authors, the technicians were able to revise some practices. The major recommendations for difficulties encountered follow:

- a need for an accurate up to date database of all elements
- consistent numbering of all elements
- a need to ensure that files and formats were correct for graphics and audio
- a need to submit the material for a complete module on one CD rather than in pieces

Authoring (March 97 - March 98)

The authors and graphic artists began work in March 1997. The artist began by developing backgrounds, a screen saver and introductory pages. (See Appendix G). These pages were reviewed by the steering committee and designers. The artist also chose the Palatino font to represent the look and feel of the product.

The authors began by setting up navigation routes, tracking, glossaries and menus. They discussed the need for continuity of the development amongst them and the need for frequent meetings to keep one another informed. This was one area that I, as project manager, had no initial expertise. Thus, many of the decisions were left up to the authors who were experienced in the design and development of multimedia materials.

One discussion centred around the extensive use of narration in the program. Some team members felt that material should appear in print or narrated but not both. Others felt that extensive use of narration was beneficial given the target audience. One writer indicated, " The type of students we have tend to benefit from a variety of presentations - written and verbal. As many are poor readers, the use of narration aids in understanding concepts".

An second difficulty related to the fact that one author who was integrally involved in the project at the onset, changed jobs and did not play a part in any of the development. Thus, decisions made earlier in the project were not necessarily compatible with that of the authors who did become a part of the project development. While this was a minor event, it did have an effect on the development process.

In addition, this project found it extremely difficult to secure people who were competent in the development of multimedia using a tool such as authorware. As a result, part time authors were initially the only available resource for the development. These part time authors were located in a different city than the project manager and the people involved with the image gathering and digitization of audio. This separation proved to create barriers in communication and difficulty in putting the product together. After a good portion of the development had taken place, a full time author was able to work with the project. This allowed for better consistency and communication among the personnel.

A very crucial difficulty encountered in the development was the crossing from Macintosh to Windows. The first CDROM burned for IBM computers that used Windows 3.1 or Windows 95 had several problems. Many background screens and pictures were missing in the IBM version. It was discovered that any files that had been saved as PICT files did not cross over. Only those graphics saved as JPEGs or Bitmaps crossed between the two platforms. Arrows and buttons were another challenge. When the authors tried to paste them into the IBM version, they found that authorware did not always know what to do with them in the conversion. Therefore, they had to be converted to JPEGs also. The immediate solution for the problems was to ensure that the IBM computers had Quicktime for Windows installed and the PICTs would then show up. But, because we could not assume that this would be the case for all users, the necessary conversions had to made.

Internet Web Site, Discussion Page and On-line testing (January - October 97)

The internet web site at http://www.siast.sk.ca/~science contains information for each module. Module overviews, objectives, print and video resources, additional related resources and internet links are a part of the web pages for each unit. The site provides an "at a glance" view to the CDROM as well as providing additional links to related topics. These links provide information and activities for the students. In addition, the student can become familiar with this additional technology. The web site is designed so that students will recognize it as being a part of the same program as the CDROM. Navigation buttons are similar and background screens for each module are consistent with those on the CDROM.

The discussion page provides an opportunity for students to interact. Because the product will be used in a variety of institutions and a variety of locations across the province, those with internet access will be able to communicate with one another. The discussion page provides a forum for interaction amongst teachers and students at many locations.

An on-line testing system developed through the same sponsor is available for student tests. The system allows for both open and closed test questions. All multiple choice, matching, fill in the blank and true/false questions will be computer marked and receive immediate feedback. Open ended test questions will need to be printed and given to the instructor, emailed or faxed to a marker. The system is user friendly such that instructors can quickly add or modify questions as desired.

Manuals (January - October 97)

Both student and instructor manuals support the CDROM. Because some sites do not have

internet access, all material on the web site is available in the instructor manual. A print version of the tests are also available in the instructor manual. The manuals also contain print articles and reference materials. See Appendix H.

Test Materials and Revisions (January 98- December 98)

As the CDROM began to take shape, the authors regularly provided updated views of the product. The CDROM was reviewed by the steering committee on several occasions. In addition, the project manager engaged in detailed reviews throughout the development. The instructional designers also reviewed the product to ensure that the look, feel and images were aligned with their original submissions.

Once the introductory modules were completed, the CDROM, manuals and web site were sent to pilot sites for instructor and student review. The instructors and students used evaluation and assessment tools designed by two evaluators. These evaluation tools were reviewed by the steering committee and the instructors to be involved in the review and revised as needed prior to being implemented. (See Appendix I)

Formative evaluation results

The product is presently being piloted in four sites across the province. The initial phase of the pilot involves only the first four modules as the final three modules are still being authored. The first four modules are being tested in the North and South of the province and also in an urban and rural setting.

To date, we have received feedback from three of the pilot sites. In all cases both students and instructors are very excited about the product and its potential. Several of the pilot instructors have had little experience working with computers and multimedia. They are quite pleased with the contents of the CDROM and the ease with which they can operate it. While there are some technical problems, most of these problems can be fixed with relative ease. One example relates to pictures that did not cross over in the Windows conversion. Those pictures have since been captured as JPEGs and now appear on both Windows and MacIntosh versions.

A second difficulty for some students and instructors relates to the content focus. This product was designed with an Aboriginal focus. For some students in Southern Saskatchewan who are unfamiliar with Aboriginal lifestyles, some of the content seems inapplicable. They have found some examples dealing with forests and mining to be more directed to Northern concerns. The instructor has dealt with this problem by supplementing the CDROM with print material that focusses on issues more familiar to her students such as potash mining.

Two evaluators have visited the pilot sites. They have observed that the instructors do not seem comfortable using the pull down menus and do not use them to augment teaching. They also noticed that some of the "glitches" that were mechanical in nature were of far less concern to the students than they were to the instructors and the evaluators themselves.

Student comments about the program have been very favourable to date. One student indicated that the CDROM "made learning fun". One example cited was a puzzle in the first module of the CDROM. A student commented that he liked it and that he "learned a lot better this way". Both students and instructors have commented that the material identifies very specific information to be learned. "It tells you exactly what you need to know". Another student indicated that the product was exciting and gave her incentive to continue, "My instructor asked me if I wanted to quit, but I wanted to go on. I wouldn't do that if I had books in front of me".

While the pilot phase is successfully identifying errors and areas of consideration, the required changes noted thus far are minor. The satisfaction level of the students is high and the product is being well received by all sites. One student summed up his satisfaction in the comment, "We should have something like this for all our subjects".

Final Product and Follow Up

The project will continue to be evaluated by instructors and students. When the final three modules are completed, they will be sent to the pilot sites for review. As all the feedback and recommendations are collected and analyzed, necessary revisions will be made by writers, designers, technicians and authors. These revisions will be made based on feasibility given the time lines and budget. Once all changes have been made, a final evaluation of the products developed in the project will be conducted in the fall of 1998. Further recommendations and comments will be reviewed in the final report for the project. This report will be made available to the partnering institutions and the sponsor. An additional report detailing the results from the review of the product and process of delivery will be available on the *Academic Preparation for Science* web site.

The product will be made available across Saskatchewan in early 1999. The intention is to produce approximately 150 copies of the manuals and CDROM to be distributed free of charge to adult educational institutions who work with the intended target populations. Additional copies will be readily available by ordering them through the book bureau. The book bureau will charge the cost to reproduce additional copies.

Conclusion

The objective of the project was to develop interactive, culturally sensitive learning materials with testing capabilities. The focus was to be on science for Adult Basic Education students. The requirement was to bridge gaps for students who would require senior science courses at an Adult 12 level and to also increase student interest in sciences.

The project manager was involved in several facets of the development. She was engaged as a subject matter expert for part of the physics module. She was involved in the instructional design in terms of writing test questions, setting up the storyboard and developing instructional strategies. In addition, the project manager wrote large portions of the instructor and student manuals and worked in developing the contents of the web site. This involvement allowed for direct experience and an understanding of many of the difficulties that team members experienced.

The daily log which tracked the progress of the development proved to be invaluable. Significant events and decisions that were made were recorded. The progress and process for the project were the focus of the daily log. Through discussions and interviews with participants, we were able to document many facets of the development and management of the project. Though there were many pitfalls and difficulties, there were also many successes.

CHAPTER IV: Analysis and Observations

Indeed, what is there that does not appear marvelous when it comes to our knowledge for the first time? How many things, too, are looked upon as quite impossible until they have been actually effected?

Pliny the Elder (Gaius Plinius Secundus)

Introduction

The project development saw many highlights and experienced many pitfalls. The team members and steering committee members often had to deal with issues that came up unexpectedly. Some of the issues were related to the inexperience of many of the team members. Other issues were related to the expectations of the sponsor and the partnership. While the project had many successes, there were also many difficulties that only experience can teach us. These experiences were reflected upon by all those involved in varying capacities.

The Development Process

The development of *Academic Preparation for Science* provided a learning opportunity for many people. It also provided an opportunity to have a better understanding of some of the issues associated to this type of development. The following information provides a reflection upon the process and identifies some of the significant development events and issues.

Common vision

The design of the product centred around the perceived and real needs of the students. The sponsor had requested a product that would provide bridging for adult students from grade 10 to grade 12. However, the steering committee members felt that there was more required in order to first get students to become interested in and appreciate the sciences. The two groups were on different wavelengths in regard to the development. This may have been tempered by the direction given to the steering committee by the sponsor. The steering committee were not producing a product of their vision utilizing sponsor support. Rather, they were creating a product that was the sponsor's vision.

A need for a common vision is essential. "The challenge is creating and communicating a project vision with enough impact to displace other topics your audience is thinking about" (Smith, 1996:60). As suggested by one steering committee member, "At the beginning of the process, the trust level was low and everyone seemed to be focussing on their own needs and not listening (or hearing) each other". The lack of common vision created much tension initially which took effort to displace. At every corner, when there was a problem encountered people generally pulled together to solve the issue. However, there were times when the perspective that suggested this "wasn't really our initiative anyway" existed.

Team member geographic locations

One major difficulty with the team was that they were spread across the province. The development group consisted of people from Waskesiu, Prince Albert, Saskatoon and Regina. Even those who were in the same city were in different locations and had little day to day contact. Managing and coordinating the group became virtually impossible and at times, people and their needs were overlooked. As suggested by Smith (1996), "Most authorities on project management agree that there is a large risk associated with geographically separate teams

working on the same project" (p.60).

While team members would often indicate that they were keeping in contact, were sharing common views and had an understanding of what each other were doing, there were several occasions where it became apparent that their views were incongruous. When difficulties arose between groups, there would inevitably be the criticism that they did not meet often enough. It became apparent it is essential that groups keep in close contact so they can physically compare notes and study what they have done and will require in the future. While meetings are often viewed negatively, frequent meetings are a must for the development of large products involving large numbers of people.

The need for expertise

The sponsor provided the educational institutions with the funding to afford them the opportunity to produce the product and gain knowledge in this type of development. Rather than purchasing the product from an expert company, they afforded the value of the learning process to the project team. The project was an excellent learning opportunity for all involved: from the steering committee partners to the writers, designers, technicians and authors.

However, inexperience can bring added difficulties to a project. Parda (1996) states, "It is important for team members to have substantial knowledge and experience in their specific functional areas" (p.6). Golas (1994) supports this view when she suggests that an inexperienced project team can increase the hours spent on the project by a factor of 100:1. The *Academic Preparation for Science* project had very few experts. Consequently, team members had to learn from the experience gained while working on this project instead of being able to rely on past experiences.

Building a prototype

The product was developed under tight time constraints and a great deal of simultaneous development occurred. In discussion with other development teams in other provinces, many of these developers agreed upon the need for developing and testing a prototype when undertaking a large project. It would have been more beneficial, given the lack of background of the sponsor, partners and team members, to begin with one module. This module could have been taken to completion through all facets of the process.

Each team member would have been able to develop their portion and send it to the next member. Difficulties in the process could have been identified in this smaller scale product. In addition, the product could have been tested by instructors and students and the feedback could have provided further information for the development team. This process would then have served as the prototype for the development of the rest of the product. Through investing a small portion of the funding and giving sufficient time to allow the process to unfold, many mistakes would have been avoided and valuable lessons learned. The sponsor would have received a more refined product. The team members would have been able to learn from their mistakes in this small scale enterprise and refine their processes for the rest of the development. The instructors and students would have benefitted from a better quality program that was tested and refined to suit their needs.

Timelines

The time lines for the project were exceptionally unrealistic. The sponsor did not have a clear understanding of the time and effort that multimedia development requires. It is evident that designing instructional programs takes time. Too often, initiatives that are provincially sponsored

are driven by fiscal year ends and the need to spend money within that time frame. Murphy (1994), advises that too often a "shotgun" approach to development is taken. "Senior management must understand the time required to design and develop quality training programs and must support this resource investment" (p.9). In this case, the sponsor needed this same understanding.

Even with extended time lines, deadlines were ever present. One writer indicated, "It seemed like there were deadlines looming always. I learned you just have to let go of some things. I think now I would have focussed more time on setting up a whole unit in general first". An instructional designer also indicated time lines were a constant concern and "the only way to keep to deadlines was to put extra time and effort into my work".

Sponsor follow up and support

At the beginning of the project, the sponsor attended meetings with the partnering agencies to discuss their vision and expectations. After these initial meetings, the sponsor essentially removed themselves from the project. They were invited on several occasions to look at draft materials, to verify direction and to provide input into the process. The sponsor did not choose to attend any of these meetings.

The purpose of the feedback meeting is discussed by Greer (1992), "Besides obtaining feedback, another goal of the feedback meeting is to obtain your sponsor's approval of the draft materials in the form of a signed statement; that is you need to get his or her 'sign-off'" (p.128). This sign-off assures that the sponsor has approved the materials. In this project, the sponsor did not have a science expert who could verify the material and did not send anyone to study the draft materials. The steering committee chose to move on without the formal approval process. Another option may have been to force this sign-off by telling the sponsor there would be no further development until they approved the materials and direction of the project.

Interactivity

When some of the written scripts reached the designers, there was very little interactivity built into the materials. While the designers did their best to build in these interactive components they were also often up against time.

Many of the difficulties the authors experienced came from the inexperience of many members of the development team. The writers and designers had not integrated enough interactivity. However, given time frames and budget, it was not a feasible expectation either. As indicated by one designer, "There was a point at which I had to choose between spending time developing an interaction and completing the project". He further indicated, "My wish would have been to have somewhat less content, and more meaningful discovery and interaction". As suggested by Cates (1992), "Products need to be designed in ways that help learners recognize hypermedia/multimedia as different than television programs. Learners must do more than simply watch" (p. 7). While this product was not designed such that learners only watch, it could have been much more interactive.

The authors had to take what they were given and do the best they could with the material or return materials for revisions. Of interest, when one studies the reaction of the steering committee, the sponsor, the instructors and students that were the audience for the product, it is evident that the product was very well received. This may relate to the complete lack of applicable material that was available prior to this.

During the course of the project, I took an authoring class and became more familiar with the

authoring process and the inherent difficulties that can be encountered. After taking the class, I became even more cognisant of the vastness of the project. The scope of the venture and the associated budget could not begin to align with the interactivity that the medium could and should afford.

Size

The size of the project was too large in relation to the budget in order to meet the needs of the medium. The four introductory modules lend themselves to the medium well and could have been further developed and improved if they had comprised the entire product. Because we developed seven modules, there was less money and time available to expand upon their potential. As one designer indicated, "In hindsight, the scope of the project was too large. It covered three subject areas and included introductory modules that could well have been stand alone products".

Innovation

The product is an innovation for the target audience. Other than print materials, there are few available products that deal with science material which consider the needs of these types of adult learners. In addition, the introductory modules focus on science from a perspective that is not available to students in any form. Never before have ABE students had access to a skills based program that looks at science issues from an every day life perspective.

The development of the product in partnership was also a new venture for all parties involved. The project expanded the base of knowledge in multimedia development and provides a good experience for future partnership and curriculum development arrangements. Many valuable lessons were learned and could be applied in the future.

Conclusion

The successes in the project were extremely rewarding for all those involved in its development. The difficulties that were encountered were not insurmountable. Many of the difficulties that were encountered have proven to be valuable learning experiences for future multimedia development initiatives. Through the dedication of determined team members, the products developed in the project were completed as requested. While the time frame had to be extended, the sponsor was aware that the initial time frames had not been reasonable. The project came in on budget and was an innovation for Adult Basic Education instructors and students.

CHAPTER V: Summary and Review

Progress, therefore, is not an accident, but a necessity... It is a part of nature.

Herbert Spencer

Introduction

The development of a product that will suit the needs of several partners and their clients is a complex task. Not only are the sponsor's needs of the utmost importance but so are the requirements for the partnership. Perhaps, most important of all are the needs of the students and their instructors. These needs must be reflected in a well developed proposal and must be reflected throughout the project planning process.

The organization of a project varies from assembling team members to all the functions required for creating the materials. The process is very detailed and takes commitment from all those involved with the project. There will be many hurdles and many details that require attention. The creation of a new product requires a great deal of teamwork and dedication from all project team members. The *Academic Preparation for Science* project was no exception. It involved a complex design and development process and involved a tremendous amount of teamwork and cooperation.

Summary

Gilbreath (1986) suggests, "Because project work is unique as to size, scope, and setting, our expectations must also be unique. We cannot simply expect what happened last time to happen again and measure project experience against it. These rules do not apply" (p.34). However, we can learn from similarities in projects given similar conditions. Experience can also help to determine the planning and organizing of future endeavours.

When managing a multimedia project of this magnitude, it is essential to be well organized and to follow closely the step by step requirements of project management and development. A summary of the organization of a multimedia project follows:

Table 5: Project Management Summary

Partnerships	- development of a partnership and consolidation of a vision
Proposal	- reflect partnership vision in a well developed proposal
Sponsor	- secure a sponsor that is dedicated to the project vision
Project planning	- assessment of needed technologies - determine types of delivery media to be used
Profile development and content structuring	- identify SMEs - conduct focus groups for content - conduct focus group for objectives
Organizing the Project	- review and affirmation of content and objectives by sponsor and partners - revisions as needed - create an overview for the project
Assembling the team	- job descriptions and hiring
Reviewing the project	- determine an overall project vision
Kick-off meeting	- assemble all team members to clarify the vision, the product, roles and responsibilities - develop mentoring relationships among members
Develop a blueprint	- review media - discuss project materials - print, CDROM, web site etc. - determine feel and look for overall products - review with partners and sponsor
Create tests and draft materials	- develop tests to match objectives and outcomes - develop detailed content
Produce master materials	- storyboard materials - develop screens, backgrounds, frame protocols, etc - gather images, narrations and digitize - authoring - web site development, discussion page and on-line testing - develop instructor and student manuals
Test materials and revisions	- review by SMEs, designers and project manager
Formative evaluation	- send to pilot sites
Final product and follow up	- revisions from pilot sites - final evaluation - dissemination

While every project differs, similar conditions may exist that can provide guidelines for other projects. For that reason, a review of the budget breakdown for major roles played in *Academic Preparation for Science* is included as follows:

Table 6: Budget Breakdown

Team Member	**Percent of Budget**
project manager	20
writers	16
instructional designers	18
image gatherers/narration	10
authors	23
web site, manuals	04

Note: The project manager did much of the development of the content for the web site and manuals and this time is reflected under the project manager. The manager was also involved with some development of content and instructional design.

Recommendations

When beginning the development of a multimedia project, mentoring relationships should be set up among members so that they can come to know one another. In addition, those with expertise should be teamed with those who lack background so that they can learn from previous experiences. Workshops should be held to teach team members some of the difficulties they may encounter and some of the turning points they can expect. These workshops should be held early in the development so most people can benefit from the experience.

In large scale projects, a prototype should be developed first. In this way, all members of the team can play their role and learn what problems others may encounter from their method of development. Project managers, steering committee members and sponsors should hold frank discussions about time lines and reasonable expectations. Is there a preference for quantity over quality? If so, a discussion of the appropriate media for delivery should be held. If quality is foremost, a reasonable size for the project must be determined.

While workshops and mentoring can be extremely helpful, it is important to find others who have been a part of this type of development and learn from their experiences. These types of contacts can come from books, people and on-line web sites and list serves. Presently, there are several sources of project management on the internet. The web site addresses follow:

Project Management Forum - http://www.-synapse.net/~loday/PMForum
Project Management Institute - http://www.pmi.org

List serves include:

1. Subject: subscribe pmnet to: majordo-mo@uts.edu.au
2. projet-mgp@uquebec.ca

Simply typing "project management" into a search engine on the internet provides tremendous results.

The budget will be determined by the size and scope of the project and the medium used for delivery. These factors will determine the time needed to complete the project. When making an estimation it is essential to consider all of these factors before making a commitment. Print based materials are much cheaper to produce and do not provide a basis for determining cost when using multimedia. Factors such as level of interactivity, number and type of images, and the types of media used will affect the bottom line.

Before embarking upon a venture, it is essential to have a well though out plan that reflects the common vision of those who will be producing the product. Throughout development regular meetings among all groups are imperative. For example, not only is it essential that image gatherers have a sound file management system but they must have contact with the authors to examine and explain their system. In this way, the communication will alleviate any future problems of non compatibility between systems.

If there are several people involved in one area such as authoring or image gathering, it is essential to have a coordinator who is in charge of that section of the project. This will alleviate any difficulties in determining what has been done, what needs to be done and what can be transferred or reused in other sections.

Each member of the team should have a clear understanding of his or her role. The following provides an overview of areas that may require attention.

Content experts

Content experts must be provided with training so as to understand the needs of the medium. This will avoid problems related to material that may be written in textbook style. The content developer should be made aware of the concept of interactivity and understand a genuine interactive learning environment.

They must provide the instructional designer with complete and accurate information. They should be conscious of the need for order and provide prerequisite knowledge first.

In addition, the content expert must research the content and develop good examples. These examples should include graphics to help make information clear.

Instructional designers

The instructional designer must have an understanding that development for written material and multimedia material differs in that multimedia development will require more effort, more creativity and more time. Second, they need to separate documentation by creating shot lists, narration, storyboards and graphics.

They also need to ensure that content experts provide them with a complete module or unit prior to development. This will alleviate problems related to adding in material or revising material to match with existing work.

Instructional designers must provide accurate shot lists and narration to audio visual technicians. The shot lists should be numbered related to the screen they are on and must be complete.

Last, they must provide a complete and accurate storyboard to authors.

Audio visual technicians

Audio visual technicians must provide authors with a complete and accurate list of graphics and narration for each storyboard. They also need to ensure that the labels for the graphics are correct and are numbered such that they can easily be found by the computer. The numbering of the images should be consistent with the numbers on the storyboards.

They must maintain an accurate and complete database of all graphics. This would include separating all resources for a module and submitting them on one CDROM with a database for that unit. They must also submit audio files in AIFF format. This project utilized audio at 22 khz.

Technicians must maintain uniformity for the graphics. This project required full size images saved as 400 x 400 pixels; thumbnails as 100 x 100 pixels; and buttons as 50 x 50 pixels. Images were made consistent by creating a three pixel border around images unless it had an odd shape like a teepee. All images should be saved as JPEGs.

The technicians, and instructional designers must both meet with the authors to work through the storyboard and review the images.

Conclusion

This project involved teamwork and commitment on the part of many people. For many of the people involved with the development, this was an extraordinary learning experience. The Academic Preparation for Science project was a tremendous undertaking. From forming a partnership to the assembly of the team through to the final creation of the product, much effort

was expended by many groups and individuals. The partnership became more cohesive and groups became more supportive of one another with each barrier that was overcome.

The successes in the development were directly related to teamwork and the reviews and checks that took place along the way. As people came to know each other, their trust grew. The sponsor, the partners, the institutions, the instructors and most of all the students were a part of an innovation in ABE. The benefits were many and the regrets were few. The final product consisting of a CDROM, support manuals, web site, discussion page and on-line testing reflects the use of multimedia in education. Upon completion of the final product, many students and instructors will benefit from the commitment of dedicated project team members.

The literature supports a well organized and systematic approach to project management and the development of a product. But there are still many unknowns as every project has differences. If one wanted to capture the nature of a project, the key term would be unique. While one can capitalize upon past experiences, each project takes on a new form and has its own individuality. The development and management for a project causes us to reach from the known into the unknown. While it may seem easier for educators to shy away from project management and the development of new products, one needs to look into the future. As Barker (1989) expressed in a videotape dealing with innovations and progress, "Those who say it cannot be done must get out of the way of those who are already doing it!".

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