The Social Construction of Genre in Multimedia Learning Environments

Final Report
18 April 1992
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1 Introduction and project abstract

The Davidson School in Marin County provided a special research site for examining the important issue of the creation of multimedia documents by students for learning. While holistic evaluation of written text compositions is becoming standard practice in learning environments, standards of evaluation for multimedia compositions have yet to develop in the context of their uses for communication and learning. For this reason, the situated study of how genres for multimedia documents are socially constructed during classroom activities by educator and student audiences is of paramount concern. Students bring evaluative standards with them from outside school and from their experiences with mass media, while teachers bring their own standards, some of which are not as yet functional for students. Through classroom discourse and work, students and teachers jointly construct evaluative standards for appraising the work processes and outcomes of multimedia document composition for learning.

In this project, we introduced the MultiMedia Works software environment to the classroom, and worked with teachers and students to find appropriate links to their current Foxfire-like curriculum. We then studied the multimedia composition process for small groups of students, from planning and research, to critique during presentation, in order to determine how terms and norms of multimedia document evaluation emerged for the students and teachers involved in the Davidson multimedia classroom. This orientation was of special interest because of the diversity of cultural backgrounds represented in the school, which meant that a broad variety of evaluative dimensions were brought in by the students. We sought to discover those innovative aspects of design and content of learning-oriented multimedia documents that came to be seen as critical and important by the classroom community.

2 Ethnographic description of the research setting

The "MacMagic" classroom in the Davidson School Annex in Marin County, California provided a special collaborative research site for examining the important issue of the creation of multimedia documents by students for learning. A devoted group of educators, including two teachers (Karla Kelly and Genevieve Colteaux), and a multimedia programmer and educator (Bill Garr from Lucasfilm) worked with a single, full seventh-grade classroom during a half-day period, promoting learning through cultural diversity and collaborative activities enhanced by technologies.

In this Foxfire approach, students shaped the curriculum through the unique experiences they brought with their different cultural backgrounds and perspectives to the learning setting. The classroom worked closely with LucasFilm (Karla and Bill) and used GTV and ABC Interactive multimedia databases for learning, among other resources. They also used Macintoshes for Hypercard-based black and white text, graphic, and sound compositions which were developed through research and peer/teacher critique. Prior to this project, they had been shooting and editing videotapes, but as a separate process from their work with computers. These activities provided a very fertile foundation for extending the capabilities available to students and teachers through integrated multimedia computing technologies in MultiMedia Works, in which students used computer-controlled live video, video snapshots, digitized voice, music and sounds, and other media in an integrated manner for expressing and developing the knowledge they gained from research and experience.

Three quite unusual circumstances defined central aspects of the research site. The first was that the educators had defined a three-hour period (8:00-10:25) for working with their class rather than the usual school schedule of a set of 45 minute periods. The second was that there was an unusually high density of computer and media equipment, and expertise available to students (two teachers, and two other professionals were available for help in technology-related components of classroom practice). The third was that the teachers had substantial institutional and professional support in thinking and acting innovatively about the teaching-learning processes that their educational activities comprised. They had roughly three periods during the day for preparation, and collaborated closely in both planning for and carrying out the educational activities of their classroom in team teaching (meeting for several periods together, several times a week, either from 10:30-12 or in the afternoon).

The MacMagic research site was made up of three rooms. In one, the 16 Macintosh computers on an Appletalk network, scanner, and laser printer were located. They were first used during the 1989-1990 school year with 8th graders; whereas during the 1990-1991 school year we studied, the class was all 7th graders. Half the class was in this room, doing computer related activities, while the other half of the classroom was in a second classroom, with desks and resources for paper and book-oriented educational activities. The two classroom groups switched places midway through each three-hour period, rotating in the use of the resources. A third room was devoted to video shooting and to the production of rough editing cuts of videotapes that students had shot. Students had video cameras and tape recorders available to borrow for use outside of the school.

The MultiMedia Works Macintosh station, and affiliated video recording and video display equipment purchased for the project, was located in the Macintosh classroom, along the front wall near the teachers' central desk. In this room, Bill Garr, from Lucasfilm, worked with students doing Hypercard writing, scanning, sound digitizing, and scripting. He was a regular presence at DMS for three to four days a week, and played integral support roles for the two teachers - Karla Kelly and Genevieve Colteaux.

The 30 students came from diverse cultural backgrounds and native language groups; many of them had Spanish as a first language. In the classroom, there was an overall commitment to making English a regular language for the students, while using the knowledge the students had as expressable in their native tongue. The gender composition of the classroom was approximately half boys and half girls. Students seemed to take a lively interest in the learning activities of the classroom, and were often around using the Macintoshes for their schoolwork before school (as early as 7:15 a.m.), during lunchtime, and after school (2:10-4:00 p.m.)

These unusual circumstances provided a strong foundation of educational goals, pedagogy, and attitudes about appropriate roles for technology in education that were compatible with much current learning research and theory, with the original design aims of the MultiMedia Works technology and activities, and with the orientation of ACOT's Experimental Learning Centers. The research we describe provides critical information about the integration of multimedia learning tools into classroom environments designed for active learning.

3 Research activities and methods

The primary method used in this report was that of participant ethnographic observation and interview, augmented by analysis of video records of certain interactions. Our concern was to understand the activities in the site of particular interest for us--uses of computing for multimedia research report development-- in the terms articulated by the student and teacher participants. During the first six months of 1991, we were in the site each week. In those sessions, we:

- Investigated and articulated the background context of pedagogy, existing work with computers, and student interactions during computer use. The results of this investigation are described in Section Four.

- Interviewed all of the students in the classroom to examine their on-going Hypercard writing projects. These open-ended explorations with students included why they had chosen

their topics and approach, explanations of the content of their compositions, and the purpose and form of non-text media and special effects that were used in their projects. We supplemented these interviews of individuals with videotaped observations of small groups involved in discussing ongoing activities with Hypercard compositions. The results of these interviews are discussed in Section Five.

• Introduced the teachers, and later, the students, to the capabilities of the MultiMedia Works technology. We engaged in numerous meetings and discussions in which the Davidson educators considered how they would integrate these tools within their ongoing design for their classroom work. Descriptions of these processes can be found in Section Six.

• Examined how the teachers worked to redefine their paper-based research project from previous years' lesson plans to incorporate the new opportunities of Hypercard and Multimedia Works for student research and presentation. This included the following activities:

a) We examined the processes by which the teachers introduced the goals of the research to the students. These processes are discussed in Section 7.1.

b) We examined the processes by which the students developed their research project documents, and how teachers contributed to and shaped this process. These student processes and outcomes can be found in 7.2.

• Studied how the students and teachers both contributed and developed evaluative norms during this process. The contribution, development and use of evaluative norms towards multimedia research presentations are presented in Section Eight.

4 Teachers' and students' experiences with and attitudes toward multimedia and computing before the introduction of MultiMedia Works

We began meeting with Genevieve, Karla and Bill in early January. The purpose of these meetings, and the research with the students that accompanied them, was to identify the existing practices of the classroom with respect to curriculum and learning goals, issues of learning with media, the use of media in research and presentation during learning activities, and their perceptions of the opportunities and problems that the technology of the classroom was contributing. We will describe these issues in turn.

4.1 *Pedagogy: The curriculum and learning goals*

While the teachers were concerned that their activities were accountable to the California State curriculum, they were very creative in their design of learning activities to support these objectives. Their approach was broadly interdisciplinary, rooted in writing across the curriculum, focused on collaborative learning activities, and treated cultural diversity among students as a major educational resource.

Their focus was on an interdisciplinary approach to social studies. In the 7th grade, this meant a focus on World History and Geography: Medieval and Early Modern Times. They used as one resource the Armento et al. book entitled Across the centuries (Houghton-Mifflin, 1991), which students had copies of for study, although it was "only actively used a few days every couple weeks" (1.18 field-notes). They organized the curriculum in terms of Maslow's pyramid for conceptualizing the growth of civilizations (see Appendix A). At the start of the school year, they began with themes related to survival skills and needs, and then worked up the pyramid as the year continued.

On Fridays, students participated in a Current Events activity called "What's in the news?," which consisted of finding a news article and describing it to the class. This both helped the students to "get brave about class presentations," and had them thinking about research topics that interested them. The activity had a regular structure for "reporting," and was aimed to have students learning news and contemporary history in terms of geographic place, which was depicted on a map when they do their reporting to the classroom. The activity was also designed to encourage the students to ask questions of one another, and engage in debate with both the presenter, and other students.

The teachers had a well-developed writing program that was influenced by the Bay Area Writing Project, and which they interwove across their curricular activities with students. Students worked in clusters of four, and provided responses in formal ways to one another's works when they produced written work in "read-around groups" (see Appendix B for categories of desired response for the response groups). As one example, the teachers described how they read some model stories utilizing "good observational skills," then went to take notes in a garden. Each student was responsible for selecting a plant, doing a sketch and observing it, then writing an observation story. Then read-around groups were formed on these papers, and students made changes to their text documents based on peer critique. Finally, the teachers produced a critique. Students were also responsible for keeping a

learning journal in which they were required to contribute 2-3 entries a week and upon which the teachers commented.

As an additional literacy activity, the students spent 20 minutes per class period in SSR (Silent Sustained Reading), which the teacher modelled, and in which they could read anything they liked. Read-aloud sessions sometimes took place during this period as a substitutive activity.

We found it very exciting that the educators were concerned to have students recognize the "built" rather than the authoritatively-given nature of not only writings, but also of films and videos. For example, Bill Garr, in order to "emphasize the parallels between film-making and writing," had the students read part of *To Kill a Mockingbird*, and then had them story-board a scene for how they would videotape that part of the book, and finally had the students observe how that part of the book was treated in the film version, and then critique it from the perspective of their story-borads. As part of this same parallelism, Bill did work with students on visual literacy, e.g., as involved in recognizing the structural relations of segments of film and video to one another.

The teachers were concerned with assessing learning, but in flexible ways. They had formal assessments each Friday of vocabulary learning. The students set learning goals with the teachers and reviewed progress with them regularly. The students wrote letters to their parents on the topics they were learning and what they thought they were getting out of the instruction. Quizzes and tests were given, but were more content-oriented in ways useful to instruction, rather than to global standardized tests. The teachers described the task of providing an overall grade as a hard one, but one to which all these forms of assessment contributed. They developed grades in a group process, whereby each teacher contributed observations and records to determine the grade a student would obtain. The classroom atmosphere was not fundamentally oriented to tests and scores, the teachers said, and one indication of that emphasis is that the students "do very little challenging of the grades they are given" (Genevieve, 18 January 1991).

The role of biography projects, or "bios" provided an ongoing project during the school year that was used to introduce Hypercard use (see Appendix B, Bio Stack assignment). At first the kids had a 6-card limit on their Hypercard stacks. Later the students were taught interviewing skills and allowed to expand this limit to more cards (8). Teachers began the year introducing the students to exemplary autobiographies in literatures such as Geronimo's

story and KonTiki. Regular critique was provided to students by their peers in terms such as those provided by the Bio Stack Evaluation sheet (see Appendix C).

4.2 *Educational goals and values*

Early in January, we discussed the teachers' educational goals and values to better understand how they select, design, and revise their instructional activities in the way that they do. They expressed a strong commitment to the following goals and values in these open-ended discussions:

- They encouraged students to work together cooperatively, and respect one another's points of view:

> We work very very hard on kids respecting one another. At this age, it is real important for them to get this concept, that everybody has their own worth. That you should treat a person equal to their worth. I am not saying that this is perfect or anything like that, because kids this age, what they do get into, I will not allow it in the classroom. It ruins everything. And it can turn into a battlefield. And we both work really hard at that. It is a real cornerstone. (Genevieve, 1 March 1991)
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> We touch base if we see a kid, and we pull them aside and talk to them, and do what we can to immediately make it so it does not happen. (Karla, 1 March 1991)

They saw this goal achieved in part through criticism in a context of positive evaluation, and in their work to state learning goals in terms of students' cooperation and co-learning.

- They encouraged cooperative learning by students. They mentioned several activities as contributors to achieving the goal. The first was the role of peer critique, through "writing response groups" in shaping students' products such as Hypercard stacks and writing; The second was the use of games that involve sharing information for common goals (small group "cooperative competition").

- They based many projects on connections to the local community, global issues, and parents outside of the school.

- They emphasized "higher level thinking," including "synthesizing, evaluating, organizing, and connecting information".

- They worked to promote students' self-esteem in part through encouraging respect from others of their diversity. They encouraged the belief that everyone could excel "in some media or other," and could have distinctive strengths based upon what they knew. The diversity of the roles available in video-making and Hypercard scripting supported this goal. They often encouraged students to take safe risks in their work.

• They valued the notion that in a classroom, everyone should be learning, including the teachers. They worked to diminish their roles as authorities, and instead emphasized working problems out together with students. They explicitly described to students their processes of arriving at answers to questions, rather than merely providing the answer to a question: "It's really process-oriented; how to learn, not facts per se" (Genevieve, 1 March 1991).

4.3 Initial work with computers

At the onset of the project in January 1991, we observed our educator team doing three primary things with computer tools: word processing, graphics programs, and Hypercard composition and scripting of stackware. More details are provided in the following section. The teachers believed that computer games and other applications beyond word processing and Hypercard might center student learning on goals outside those of learning and instruction, and thus did not support these uses of computers in the classroom setting.

5 Student perspectives and values for Hypercard multimedia composition projects before the introduction of MultiMedia Works

As part of the on-going research, we interviewed all of the students to examine their progress in developing their Hypercard writing projects. These open-ended explorations with students included why they had chosen their topics and approach, explanations of the content of their compositions, and the purpose and form of non-text media and special effects that were used in their projects. We supplemented these interviews of individuals with videotaped observations of small groups involved in discussing ongoing activities with Hypercard compositions. These findings were key to understanding how student values, expectations, and dispositions contributed to the social construction of genre that evolved in the use of MultiMedia Works for research document preparation.

We found a predominance of attention among students to the role of media and special effects in these projects. This pattern was particularly evident among the boys:

> I am going to try to figure out how to make a button that blinks, although I don't know how yet, I will figure it out. I am not sure if it is possible yet but I am just gonna fool around with it. I have done a lot of scripting, and have a lot of really neat stacks in here if you would like to see one. (John, 1 February 1991)
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> This is a fun thing to do since it is fun to fool around on Hypercard and see what you can do with a lot of buttons and things. I have buttons on the name of each of my relatives, and you just click on it so you can find out more... [discusses visual effects] if you want to do it nicely, and professionally, you don't want a rough cut. I learned my effects from Bill. First I saw them, like a dissolve, and I was wondering how they

did it and Bill showed me. It is real fun, I have learned a lot, I never knew that you could do this much in Hypercard (Brian, 1 February 1991).

I am making my biostack, and putting a bunch of stuff in it to make it look nice. Here is my first card, and I put a bunch of interesting stuff on it. Later on I will do sounds for these. This one will say Monty's biostack and it will have music in the background. and each time you click on a window it will give you a little summary. So when I click on this it is a summary of me that appears. Buttons are windows in the house and I am planning on doing some animation and stuff. For my animation I will make two boats coming to the same state where my parents were because my dad is from Ireland, and my mom came from Hawaii, so I am gonna have two boats coming together in the state with a heart. So how you make animation is like you draw like a line, go to next card, and move the line, and if you do it right it looks like it is moving. (he demonstrates creating an animation in real time). you can use as many cards as you want in an animation. (Monty, 1 February 1991)

In addition to the focus on the part of the students to the compelling special effects, we observed that the students found challenging the non-linearity of the movement from card to card that was available in the Hypercard stacks. Since buttons that they could design into their cards allowed movement from one card to a multiplicity of other cards, "structuring a story" or narrative was a much more complex process than in linear text. The medium was better suited to be browsed in a non-linear fashion than to stand alone as a story. This was evidenced by the running, explanatory dialog that the kids used to describe a stack as it was being used. The "document" experience for an audience was thus the computational artefact *plus* the oral commentary. We found that there was additional information in the spoken dialog to augment what was designed into the stacks. In summary, the students the kids saw the documents as a supporting medium for the story, rather than a stand-alone encapsulation of the story itself.

We observed a variety of social processes by which these values concerning media effects and storytelling came to be shared among students. Through these processes of sharing, the kids reinforced the story-telling-with-media-support model, because over and over again, they would show-and-tell their bio-stacks to one another as they progressed. These processes included:

- The solicitation of advice, including calling to peers for evaluation of what they had created, as well as to the teachers and aides.

- The prevalence of 'drop-in' advice. Students would "cruise" by and observe one another's work, and make comments and offer innovations.

- Students would explicitly solicit help from other students that were known to have expertise.

These findings were key to understanding how student values, expectations, and dispositions contributed to the social construction of genre that evolved in the use of MultiMedia Works for research document preparation. The interactive, studio-like structure of the classroom allowed the students to articulate their values and demonstrate their work processes to one another, and hence to create communally held work values of a sort not typically found in classrooms where work is done independently and graded privately.

6 Introduction of MultiMedia Works to teachers and students

We introduced the teachers, and later, the students, to the capabilities of the MultiMedia Works technology[1] through demonstrations and support with early experiments with composition. In meetings and discussions with the Davidson educators we were concerned to discover how they would wish to integrate these tools within their ongoing evolution of design for their classroom work in media-rich composing environments. Clearly, the context of work involving videotaping and editing, interviewing, and Hypercard authoring, offered a rich foundation for these extended functionalities. The substance of these planning meetings provided information fundamental to understanding the values, expectations, and other dispositions that they brought to the social construction of genre for multimedia documents during the period which followed.

From early on in the introduction of the tools and discussions of what students and teachers had done with them in our previous research, the Davidson educators began describing ways that they could foresee extending what they did in Hypercard with the new capabilities of the MultiMedia Works tools. The primary steps in the process of integration, which involved various changes in their conceptions of the relation between "media" and "content," are described below.

The substance of these planning meetings provided information fundamental to understanding the values, expectations, and other dispositions that they brought to the social construction of genre for multimedia documents during the period which followed.

In their introduction to the students of the topic of research reports, the students were told that they could do the report either individually in Hypercard, or as teams using MultiMedia Works. Some of the values and dispositions towards multimedia research reports are revealed in this introduction by Genevieve on March 22:

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[1] For more details regarding the technology, see Pea (1991), included as Appendix G.

> We are going to run an experiment and see if any of you would be interested in doing your report in a little bit of a different way. And its going to be using all of the skills that you already know, but it is going to be using them in a little more of a sophisticated way and with some unique differences to it. Its going to be in the form of what's called MultiMedia Works. We have one station, and that means that all of us are not going to have the opportunity to do it. We are going to have to see who is interested in that, and then see which groups, I think we can have two groups of people do their research paper on MultiMedia Works. What we want to do is show you what MultiMedia Works is and then if any of you are intrigued by it and interested in doing your report with it, you will let us know and we will talk about it. It means that you can work in teams, the reason for that is that it is going to require a little more time and if there is two of you, you can distribute their efforts and still get the thing done. (Karla, 22 March 1991).
>
> It does lend itself more to different kinds of subjects, for example, something probably more current, that you can go out and talk to people about. You are going to be doing alot more interviewing, and less, probably less library research. It's a different kind of research. It means you are going to have to film things and get more support....and editing, you are going to have to think of the fact that the material that ... if you get alot of material, you might not use it all, you might decide that some of it doesn't fit into what you decide to do. In MultiMedia Works, you may be filming alot, but you may need to edit that since you can't put it all on. So that is the same thing as taking your cards, and going through and choosing things (Genevieve, 22 March 1991).

One of the researchers (RP) then introduced the students to MultiMedia Works, noting that:

> You have been writing before on paper, and later with word processing, but now in Hypercard you are doing very different things. (Asks students for how Hypercard is different from word processing, and they note they are: "building stacks," "creating graphics," "visual effects," "sounds," "animation," "adding pictures".) What we have done with MultiMedia Works is to add some more things. Color pictures. Sounds. But also video, so you can play video and have it show up in the computer window. And so you can play a video, and also take a snapshot from it. (Karla, 22 March 1991)

We then showed a presentation created by some students from another Bay area school using MultiMedia Works. We showed and explained how color, background, text, buttons, and sound are all used by the students. We illustrated how to create a multimedia scene with the tools, including video and digitized video snapshots from the Davidson classroom. Karla explained how they will be able to use text, graphics, moving video, sound and other things on the screen all at once if they like, and how it is exciting that you can put moving video on the same screen as the other media. Karla explained to the students that they would be "designing a screen" for a presentation but could include text, video, graphics, and other media in those screens.

The students asked about whether you could make "a rocket go across the screen." Karla asked what kinds of topics would it lend itself to, what kinds of research could be well

represented in this way? What would could really come alive? The learners suggested "the Gulf War," since they could use footage from newsreels, and that it would be good for "showing, not only telling things." Another student said he would show a Mach 2 airplane with sound. Others suggested that they could get your own footage on "the drought," interviewing people and showing effects of it, and "tips on how to save water from your neighbors." Karla then suggested that those interested in using MultiMedia Works for their report should think about whether their topic would be well-served by the tools, and then sign up for discussions with the teachers on it.

In summary, the teachers articulated a number of values and dispositions about MultiMedia Works research in their introduction to the kids. These included perceptions that since the medium was largely video-supported, it would be best for events where current footage could be shot. They also indicated that these projects would take more time, and hence would be the only projects that would be done on a team basis. In addition, they say the kids as confronted with tasks of editing alot of information, which they didn't think of as a problem with the research methods for the Hypercard and word processed research projects. As the conversation between the students and the teachers progressed, it was clear that the kids were once again fascinated by special effects, and that the teachers put their requests into context by asking them how the special effects they proposed would fit into the research plan and the story the students would be telling.

7 How the "Research Project" was redefined with Hypercard-based and MultiMedia Works-based media

During the project we examined how the teachers worked to redefine their paper-based research project from previous years' lesson plans to incorporate the new opportunities of Hypercard and Multimedia Works for student research and presentation. This included examining the processes by which the teachers introduced the goals of the research to the students, as well as the processes by which the students developed their research project documents, and how teachers contributed to and shaped this process We were particularly interested in examining how the teachers redefined their paper-based research project of the past, to a time when students could also create Hypercard stacks and a MultiMedia Works document as a way of presenting their completed research.

After a number of meetings with the teachers, they came to believe that the best way to work with us on questions of mutual interest would be to devote the "research project" part of their Spring semester to the joint inquiries. In the past, both teachers had introduced

research skills to their students in the context of a largely text and paper-based research process (see Appendix E describing their Research Paper Guide, written by Genevieve, and handed out to students on March 22nd). Since the teachers worked in 1989-1990 with Hypercard stacks and writing with 8th graders, the need to do the standard 7th grade introduction to research skills and the formal research project with these new media emerged as a major and interesting technology integration issue. The teachers perceived MultiMedia Works to be primarily valuable as a value-added technology platform for carrying out a related program of technology integration. What follows is our account of the steps by which the teachers thinking evolved in relation to these questions.

7.1 *Phases in teachers' conceptions of how the "research report" will change for students when they use Hypercard or MultiMedia Works*

In January 1991, the students had their first exposure to research in a two to three-week small research project on the Aztecs, Mayans, and Incas. They used the Reader's Guide in the school library, and produced a small oral report from notecards and a poster, rather than a big written project. The major project activity for learning research skills would begin in late March.

In early March, the teachers decided that students would be asked to carry out their research project using one of three approaches. Some would do their research using the computer as a word processor for textual composition and presentation (a minor variant of the paper-based approach of the past), some would use Hypercard stacks to prepare and present their reports, and some would create MultiMedia Works documents for their research. Whereas individual students were responsible for the word processed and Hypercard stack versions of research reports, teachers decided to have small groups of 2-3 students work together to create collaborative MultiMedia Works documents.

In the past, students had always hand-written their research reports for these teachers. Their responsibilities had been to develop an 8-10 page report, and then an oral report to the classroom on that work. Research report guidelines and parameters helped direct the students' work within broad outlines (Appendix E). Generally, the phases of the process included:

- Choosing a general subject;
- Defining a specific topic;
- Conducting research with traditional (books, magazines) and new media (laserdisc, video of films and television, audio tapes, interviews conducted);

- Developing notecards of information to be used in report;
- Outlining and designing the report (and more research as needed, and revision of outline and design as needed);
- Writing a first draft of report;
- Revising and rewriting the report after a critique; and
- Presenting a final report.

The teachers realized that it would require some significant work to adapt this process for computer-based and Hypercard-based work. For example, word-processed documents were to be 7-10 pages, while Hypercard documents were to be roughly the same amount of text, but were also to include 4-6 images and 2 sounds. MultiMedia Works documents were as yet undecided in requirements, but the teachers thought that all media used should contribute to "quality and depth" of content (March 15, field-notes). Whereas individual students were to be responsible for the word processed and Hypercard stack versions of research reports, the teachers decided to have small groups of 2-3 students work together to create the MultiMedia Works document, because of their beliefs that the media search, design, and production needs would "make teams more appropriate" than individuals for the work. They believed that the teams would operate through the division of labor along lines of expertise and interest.

As of March 21, it was still uncertain what the length limits and parameters would be for either Hypercard stacks or MultiMedia Works documents, although the considerations below came to weigh centrally in the teachers' decisions. Furthermore, the teachers recognized students were going to need support for the video component of research for their MultiMedia Works report, including preparing questions, setting up appointments, conducting interviews, and reviewing, editing, rough cutting, and final cutting of the video, and the integration of the video into the MMW document. And they were concerned of a dominance of special multimedia effects to the exclusion of attention to content issues in the students' reports.

In February and then in early March, we had several important meetings with the teachers in which they reflected critically on what they observed with students' work on their Bio stacks. In our interviews with the teachers, we pursued this development in some depth since it appeared it would provide an important context for understanding similar tendencies that could emerge for MultiMedia Works compositions. The initial constraint at issue in students' work was a six-card Bio stack. But then Bill introduced them to special effects, animations, sounds, and in the teachers' words: "the kids went wild, and got scattered". The trends here

in students' aesthetics were clear to the teachers: "the more active the effects, the more they liked it," and "they had to build the code to do this, and were very taken with it".

> We are at a place where we have to take what the kids have already done and then stop, and go back to the basics, since they have begun to scatter themselves and get into other things. So we are trying to use almost traditional ways to get them back. (Karla, 1 February 1991)
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> One of the things is they were doing, I guess you could say they are doing a lot of playful things, like showing a lot of Macpaint, and scanning, and getting carried away with visuals, and they were not backing that up in any way. Instead of going in depth at all, it was just very, very superficial (Genevieve, 1 February 1991).

During this time, we interviewed all of the students and had them show us their Bio stacks in development. Examples manifesting the phenomena described by the teachers are included below:

> Derek's Bio stack had individual letters of his name coming up in red, and harpischord-like sounds appearing as an accompaniment to that animation! The parents and siblings cards with scanned graphics would come on for a timed period and then cut to the next card. A piano melody he wrote for the computer to play is ongoing. It was a highly complex stack, in terms of graphics, audio, timing in HC script. But he was not as far along in building up the content as were most of the other students, and there was no sense that the audience using the stack would need time to read the cards! (Karla, 1 February 1991).
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> Jim's Bio stack, using as many as half a dozen consecutive transition effects, including checkerboards, in moving from one card to another in his stack, providing a flashing and eye-shocking sequence with no connection to the content in his account of it. Jon's Bio stack included his own music compositions which accompany an animation of handwriting of his name appearing on the screen, which he achieved by writing script telling the computer to draw. (Bill, 1 February 1991).

The teachers described this tendency toward dramatic effects as an example of the "expand and contract cycle" in education, where when you expand, unproductive stuff happens, then you "reel them back in." They described kids as "carried away," their stacks as having "no depth" and looking "superficial." Bill felt that the students had done very little elaboration in content, and that the teachers should revise their critique form so better work would be done. Interestingly, they saw these tendencies as due primarily to competition, especially among the boys in the class. The girls were described as more content-oriented and more aimed at completing their assignments, whereas the boys would only go halfway into their bio story and then concentrate on special effects programming.

The teachers described how they felt torn about these "magnetic tendencies" of the media:

> Karla: And that is very common. That is what happens all the time. The trick is deciding how much of that is really good and has a use, and a lot of it really does.

They stumble into things, it broadens their base, they are motivated and that is good. But then you get to a point where you have to remind them that what's really important is the content. And that the visuals and the sound or anything else needs to simply add to the point of the card or the project.

Christina: Are the effects content or special effect motivated?

Karla: 99% of the time it is effect motivated.

Christina: Does it ever lead naturally to content again?

Karla: It does. last year Tan did a piece on displacement, and he was a displaced person from Vietnam who left during the war. His card had lots of content but then there were also explosions, where you felt an impact of the war, and pictures of the war. It was intentional to give you a feeling about what he was talking about (1 February 1991).

These discussions continued in later interviews. The themes covered include the struggle to get depth in content of their stacks, and the competition, especially among boy, in producing superficial visual, sound and animated effects.

Karla: It is a constant battle to get them to put content in. We give them the assignment and try to make it really clear what we want, which includes content, which we hope drives it. They interpret it in a variety of ways, and we give them some time to initially get enough stuff, and then have something to talk about. And it will usually stop, when something is due, like 6 cards on Friday, and you must print them out. And they must be in this form, and we get all kinds of stuff -- people unclear on the concept, up to absolutely accurate. We have spent time with them individually in the classroom, but it does not necessarily turn out that way by the time of the due date.... All kids take care of business to a certain point, like content to a certain middle range, then there is the little extra that they need to have it have substance or be more connected, and that is where we lose them when they get into other things. They feel "I have done what I need to, and now I will get onto something else." They want to support what they have done in other ways, with music, or visuals, which are valid points, but the distribution of time begins to get weird. If they have an hour, they distribute their time in ways that do not really address the content.

Genevieve: There is competition among some of them, who can make it jazzier.

Karla: Boys are much more competitive in special effects than the girls are. I think the girls are just more individual about it. They don't seem as aware of what the other person is doing, or as concerned about it, or as pulled in.

Genevieve: I think they are more content oriented, not everybody, not each girl. It seems they are more interested in the story that they are telling. Or what they want to tell about their families.

Karla: And they want completion. They want it to have more completion. Whereas the boys get half way through the story, and then they are off and running, but wait a minute, you didn't tell me what happened on this adventure, you got me to Disneyland, but then what, are we still there or what? (1 March 1991).

Along these lines of competitiveness, the teachers also described a phenomenon that they called "What's new today?"

> You know what I see it a lot in the mornings when they are in here. "What's new today ?" - what have you done what's the newest thing you have done - show it to us! And then they all look at that, and go OOH! And they are thinking of ways they can one-upsmanship the other. They are here before 7:30. The whole room is full. Lunchtime is same kind of thing. They come in to work on their projects. Mixed, boys and girls. (Genevieve, 1 March 1991).

Students would arrive at the classroom before 7:30 am and during the lunch period to see what effects had been created by peers, and how they had been integrated into their Bio stacks. A few of the boys, they noted, were at the center of this action: Jonathan K, Derek B, Brian de C, and Hewen. Derek and John had Macs at home, which they found meant kids paid less attention to dramatic effects they created, presumably since they had so much more time at home to create them. Jonathan had won an award at a mathematics and science animation fair. Victor's work on art was an attractor for students, but he was quite quiet about it. Brian had written his own music at home on his piano, written the notes on paper, and then made a Hypercard program that would play that music in his stack. The teachers described him as knowing a lot of "hot stuff," but that when others asked him for help, "he often does not want to explain it since he is very intent on goals, and intense about doing his own work." The teachers also note that Hewen had taken to "pit-stopping," cruising between work groups and offering critiques on Bio stacks rather than working on his own.

We inquired about the culture of code-sharing that would enable other students to mimic the effects that their peers achieved in their code. During January, the teachers saw this as very open - students cut and pasted in the Scrapbook, then collected it on a disk, and returned to their machine, or copied the code onto paper and retyped it in their stacks. A server began to be used in February and did not appear to change the shareability practices. The teachers never saw screen-blocking, or help-refusals, or any kind of barter economy around code-sharing. Karla suggested that perhaps this was because the students had such a large block of time, and were more like a family, that could settle into things and share. She noted: "Kids are very generous with each other and appreciative of one another's abilities." Another possibility is that since the effects were not the primary indicator of a grade, they were less likely to be held as proprietary by the kids.

But as the complexity of effects in students' biostacks evolved, and scripting became more complex, Bill noted more proprietariness came in as well:

"A lot of kids are very protective of biostacks. Especially scripting. They set up passwords, and it is really important to them." (3 May 1991)

The teachers summed up the difficulties of the media effects "scatter" problem by stressing how much management work it took them to avoid it taking over the classroom:

Karla: Once you are past that first phase, of giving the assignment, and you say, wait a minute, we really need THIS, then they will settle in and do it, and then they know the difference between something that is complete and not. It is just that it requires management. It requires us intervening at a certain point, and just saying "Wait! Here is what we need before you go onto this".

Genevieve: This has to do with teaching and showing them, and being with an adult, because they don't know, and coming from a different perspective and knowing that there needs to be more depth. Sometimes they just say "What's wrong?" What would I have to do here? They do not think that there is more (to do).

Karla: What is really difficult for me is when to really stop them and demand certain things and when to let it go. Because sometimes a kid will only provide content when they have been given the opportunity to do visuals or sound, and it's the thing that motivates them to then care about the content. So the kind of writing you do get is much better writing because they care about it, they are connected to it. And they are concerned that it has as much worth as the pictures they put in. So I find it's a real individual thing, that the better you get to know the kid, and the better you can feel out what works for them, the more you can decide if it is OK for them to go off on this little bit of an avenue for a few minutes, or to spend an extra day scanning pictures, because you know it is going to be the thing that gets them to do content like they probably have not done before. (1 March 1991)

In summary, the process of defining the research project structure for Hypercard and MultiMedia Works centered on a tension between the motivating and exciting new programming and special effects available in these media, and the educational desire of having the students learn to conduct and present research in a coherent and complete way. The teachers recognized the motivational nature of the new technologies, and were excited that students who were not engaged with text-based research became excited by the new media, but they felt the need to temper this enthusiasm with a concern for content. This tension was resolved both through informal classroom critiques of the work by the teachers, and by the teacher's structure of the research project requirements. The requirements for the Hypercard and Multi Media Works projects thus included written outlines and drafts that were reviewed before the "research story" could be translated into other media forms.

In Section 8, we describe how the teachers' perceptions of media and content evolved as students' MultiMedia Works research report projects developed over the final weeks of the Spring.

7.2 *Research reports: The students' perspective on the role of different media technologies for their construction and presentation*

We also examined the processes by which the students developed their research project documents, and how teachers contributed to and shaped this process. We will first review their reactions and questions in first being exposed to the MultiMedia Works technologies. Then we characterize the nature of students' proposals to use MMW for their research report work. Finally, we characterize how they worked with MMW for their research reports.

On March 22nd, after the teachers explained the requirements of the research project in the weeks to come, we have noted (Section 6) how we introduced the students to the MultiMedia Works technologies and capabilities. The topics students asked about as appropriate possibilities for their research report also carried over into the MultiMedia Works discussions. They included: sports, drugs, AIDS, earthquakes, origin of the Macintosh, Greek games, the '80s as an era, a planet, or a person like Billy the Kid. They were especially interested in knowing if they could use tape recorders, video, and cameras to get materials for their research.

In the MMW demonstration, we first explained the ways in which these tools extended what they could use as media in their research reports. The teachers explained to students that those who wish to work with MMW would need to learn some new skills, and that not everyone would be able to work on the project. Teachers' expectations were that two teams of either two or three students would become involved.

By March 29th, after three days of open-ended library search and exploration to find the right scope and materials for potential research projects, students had to decide if they would want to pursue a MMW research project. They talked with their teachers and filled out an "application form" to argue for why they thought their topic for research was particularly amenable to treatment with the MMW tools. We have included the applications students submitted as Appendix F.

Whereas individual students were to be responsible for the word processed and Hypercard stack versions of research reports, the teachers decided to have small groups of 2-3 students work together to create the MultiMedia Works document. Since we had only one MultiMedia Works Macintosh station, they decided to form two groups, and to make decisions of group membership by an application process where students would need to define their topic, main points, and say "Why you think MultiMedia Works would be the best way to present your project". Nine proposals were submitted (see Appendix F), and two teams were

formed, comprising five of the students who applied. One was a group we will refer to as the Boys, the second was a group we refer to as the Girls.

Each team had from the end of March to the beginning of June, or about 9 weeks, to complete their research work and report. The same schedule applied to the students using Hypercard or word-processing for their research reports. All students would be required to do the same research, irrespective of media. They would all create notes in logical order, write an outline, and provide a first draft of their papers on word processors. The goal was to be "content, and communicating what has been learned in their research" (Bill, 29 March 1991). They had to complete their research and outlining by early May, a rough draft of their papers by May 14, and after feedback from the teachers, a final version by May 31. Finally, the Hypercard students would prepare Hypercard versions of their reports (by May 24), and the MultiMedia Works students would create their MultiMedia Works documents (by May 31). The teachers recognized that this move from word processed drafts to Hypercard and MultiMedia Works multimedia documents would not be simple, that it would "need to accommodate to the form of the media, since they will be changing the pieces to present to someone else." For this reason, a Hypercard template program was created and taught to students by Bill. It facilitated the move from Macwrite-based outline documents into Hypercard stacks for research report presentation. A second reason was to prevent kids being mired in working on backgrounds, animations, and other effects, since they wanted very focused activity:

> Genevieve: Bill can tell you about the template he devised for Hypercard, and I think it is great. It is natural.
>
> Bill: It is a way to link your outline to your text, so that you make new cards by clicking on your outline headings. ...embedded in text are control characters, like a clapboard that creates an action, so that any script you write can be activated. There is another one for a sound, another for reference quotes. It supports outlining in Hypercard. This is the general template.
>
> Karla: We did not want kids bogged down in design, like which background to chose, and so on. They can spend all KINDS of time, you know, sorting things, moving it here, and there, and that is wonderful and has its place, but for this project we felt their activity had to be more focused.
>
> Bill: One thing we were talking about the other day is that we need to encourage kids to work on this differently than their biostacks, which are so free-form that pretty much anything can done. This will be a bit more stringent. (3 May 1991)

We now briefly present case studies of the two groups' work on their MultiMedia Works projects, overviewing how they conducted their research, used media and media tools, and what kind of final result culminated their efforts in using MMW. But first we must note the continuing effects of the teachers' concerns about *substance* needing to be manifest in

students' work, and writing to take priority in the process of even multimedia composing in Hypercard and MultiMedia Works:

> We have told them they must do the first phase in Macwrite. And that that is where they can think freely and not think about design, and spell checking and so on. And then what we are going to do is take it to Hypercard. They are going to turn their rough drafts in with Macwrite. We will comment on them. Then they will transfer the text into a Hypercard medium. We have created a template for them ...and later they can think about visuals and anything else they want. We don't want them to be reinventing something for the templates, but take content of what is already done, and what they think supports that -- sounds, or visuals, or animations -- and that content with it. That has been our approach. So the core of it is what they have to SAY about it.... I have not wanted to talk about visuals and things at this point, because I believe it creates a superficial approach to the topic....It will be better because they have done this initial thing first. If we started talking about visuals now, I believe they would be pulled out of this good groove they are in, because they are all into it, writing and using the notecards. And I want to keep them focused for awhile. Otherwise they get scattered (Karla, 3 May 1991).

Girls Group

Wakiah and Jennifer were the two members of the girls' group. They had written proposals to the teachers to use MultiMedia Works as a team to address AIDS. They wanted to explain what causes it, what effects it has, and the relevance of these issues for young teenagers. Another girl had proposed working with them, but the teachers were worried that since she had not carried out good work on her Biostack, that she would be "lost in the group". (She would instead do an individual report with Hypercard to allow for more personalized attention from the teachers.) Wakiah and Jennifer had ambitious research plans, to include video interviews with, and graphics of, AIDS victims to convey what the disease can do, and with scientists who study AIDS. As they noted in an interview during the first week of their project: "There is a lot of research on AIDS that could affect students now that they should know" (Wakiah, 29 March 1991).

Like the other student groups, they worked with the Readers Periodical Guide and identified articles in Newsweek and other magazines on AIDS. They took notes on cards for potential use in their research reports. They identified pictures of persons in advanced stages of medical problems with AIDS which they might want to use in their report. When we observed their work together in the library, they would sit down to plan their search strategy, go off to find the articles, and immediately share them with one another if they were excited about their usefulness for their collaborative project.

By the time they completed their background research on May 3, they had produced a videotaped interview with a Reverend who was an AIDS counselor in Marin County, as well as more than 30 notecards from sources such as magazine articles, pamphlets, a movie on AIDS including comments from the Surgeon General, and an AIDS videodisc. They planned to focus their report on the different ways one can "get AIDS." They also had pictures of a famous AIDS quilt and of people with AIDS.

Jennifer's outline was in on time, well-structured, and received an A. Wakiah's outline was handed in late, and so received a B-. Both outlines were titled "AIDS".

In their preparations for the MultiMedia Works document on their research project, they found they needed to do a lot of rewriting of their text draft for the computer-based screen displays of text in their report. Wakiah observed: "We had to rewrite our whole report over to fit with multimedia." They encountered lots of versioning issues as they created different MultiMedia Works drafts, and often were so excited selecting specific video clips from interviews with their classmates and an AIDS counselor that they forgot to label these drafts, and the videotapes that were used with them, in ways they could later distinguish.

We now describe the scenes constituting the Girls Group's MultiMedia Works research report which they presented to the class:

First scene: "In Search of a Killer" title screen.

Second scene: Wakiah reads a textual scene that describes AIDS.

Third scene: Wakiah reads a text description of a video clip about to be shown of an interview with a counselor who works with AIDS patients in Marin County. Wakiah describes the interview with him, and questions he was asked, in extemporaneous fashion, including questions not on the video clip. Then she shows the video clip.

Fourth scene: History of AIDS with another new interview video clip.

Fifth scene: Wakiah shows video clips of their classmates answering a true-false interview about how one can contract AIDS. The wrong answers, and delicate issues of sexual contact evoke much laughter.

Sixth scene: Card with picture of difficult decisions of youth involving sex and AIDS stressing safe behavior, including a HOTLINE number their friends can call.

Seventh scene: Depicts an "AIDS Facts" list, including information about counseling and prevention.

Eighth scene: More AIDS Facts are presented as a text list.

Ninth scene: Presents a bibliography of sources, including pamphlets, books, articles.

In their summary observations about the process of using MultiMedia Works for their research report work, they noted:

"I thought it was really fun because you use moving video on the computer and sound. It was different but fun." (Jennifer, 3 May 1991)

"It makes it easier to present our report using moving film, sound, and live video. I thought it was very interesting because we got to use new high-tech computers. We thought it would work good because we can show actual AIDS patients and it would give a better overall view of the killing disease" (Wakiah, 3 May 1991)

"I really like working with Wakiah, it was fun to work with her" (Jennifer, 3 May 1991)

"We had to do live interviews. My classmates made me more interested by seeming really interested with what I was doing." (Wakiah, 3 May 1991)

"I learned that computers can be used in more useful ways rather than in just video games" (Wakiah, 3 May 1991).

"It was good except for the difficulties, the bugs and everything" (Jennifer, 11 June 1991)

"I didn't like how you couldn't keep scrolling and adding text. You had to make a different text card for every scene" (Wakiah, 11 June 1991).

Boys Group

Shane, Paul, and Brian were the members of the boy's group. Their team worked on the role of aerodynamics in human flight, and different planes in the history of aviation that have exploited aerodynamic principles. They had initially submitted separate MultiMedia Works applications: Paul on aerodynamics and flight, Shane on the visuals and screaming of people during the sinking of the Titanic, and Brian on the origins of motion pictures. The teachers felt that the three of the might be able to integrate their interests into one project that made use both of the transportation and the film aspects of the individual's interest.

The boys had ambitious research plans. They wanted to include such media as diagrams and perhaps animations of airflow passing over airplane wings, the sound of jet engines to express their power for thrust, video of past planes as shown in films of the Wright Brothers, Top Gun, and various films by Lucasfilm, such as bombers in an Indiana Jones film, and planes depicted in Empire of the Sun. And Brian thought he might interview a pilot from the Gulf war. They had high expectations for what they could accomplish with Multimedia Works:

I find that Multimedia Works is a new way of explaining your term paper because you couldn't use any pictures before--there was just text, just outlines and text, but with Multimedia Works we are going to need text too but with sound and video we can really make a show not tell for the term paper. (Brian, 3 May 1991)

I think the principles of flight can be displayed good on the MultiMedia Works because you can have animation that can, like, show what lift is, by certain instances. Like when the plane takes off, and it gets carried by the wind (Paul, 3 May 1991).

When we observed their collaborative process in the library of the school, it had a different character than that of the girls. Paul would look through the index, and call out magazines for Brian to go find. Shane would often work somewhat independently looking through books, primarily, on principles of aerodynamics. While there was interaction, they were making relatively autonomous decisions regarding what information should be sought. In short, their work process could be described as three individuals collecting information, and then coming together to see what might be made of it in one presentation. When asked after the completion of their research work how their group progress was going so far, they noted:

> I don't think we work together as much as the other group. At the end we will be combining it all, and I think it will fit together pretty well. (Paul, 3 May 1991)
>
> We split apart for the research, and the typing things, but I think we'll be working more together for MultiMedia Works. We went on our own on the research. And where it will combine is MultiMedia Works. (Brian, 3 May 1991)

This individual approach to collaboration was confirmed in interviews with the teachers: "the guys are working more separately, so we are having them write together to coordinate their work more. Shane told Karla he was the technician! They have not shared their research enough with each other" (Genevieve, 17 May 1991).

When the boys' research work was complete on May 3, we discussed their project, and found they were planning to first explain the four component forces involved in aerodynamics: drag, lift, weight, and thrust, and then to display the principles of flight in action with video from feature films of different planes. Shane viewed himself as "working on technology, while they (Brian and Paul) are doing the information" (3 May 1991).

With the completion of the research phase, the boys handed in individual outlines. The three outlines reflected the converging interest on aspects of flight and film. Shane's outline ("An introduction to aerodynamics") was quite sketchy in detail and disorganized in content and received a B-. Brian's outline ("Aviation and movies") was highly elaborate and received an A. He explained how a plane flies, origins of planes, described the B2 bomber, characterized aerodynamics used for special airplane effects in Indiana Jones movies, and then reviewed the task involved in movie making and movie origins. Paul's outline ("Aerodynamics, and what makes an airplane fly") focused on the four forces mentioned above and vocabulary definitions for key technical concepts. While it was called "good outline!", since it was late, it received a B+.

In their preparations for the production of a MultiMedia Works document on their research project, the boys brought together very diverse outlines, as we have noted, and had not

worked on a common vision for their effort in the way that distinguished the Girls Group work. So they developed somewhat of a division of labor in their work process. Paul focused a lot on getting the text and graphics together for their aerodynamics explanation, Brian worked to identify specific video clips of planes from films, and Shane sought to serve as technical coordinator of the MultiMedia Works production, figuring out placement and design of media elements in the scenes of the document, and troubleshooting cabling and other technical issues involved in production. We now present the details of their MultiMedia Works document that the Boys Group put together, scene by scene, when they presented it to the class:

Title Scene: "Aerodynamics and Film" by Shane, Paul, and Brian, and Film by Brian.

Second Scene: A number of definitions are provided: "Welcome to our presentations on aerodynamics, we studied airplanes and how to get a plane airborne. Aerodynamics is the study of force on objects that move through the air." They then described the 4 basic component forces that enable flight: lift, weight, thrust, drag. The boys take turns reading, one force at a time. Their text defines each of the forces and how they make takeoff and continued flight possible.

Third scene: An introduction is made to a video clip of the P51 plane, from Lucasfilm's *Empire of the Sun*. Genie asks what the video has to do with what went before in their presentation, and Paul states the importance of the plane during the second world war, how Chuck Yeager said it was the best plane--none of which was information "in" the document.

Fourth scene: Shane describes the four forces again, and asserts that lift is the most important force. (Note: Significant redundancy with second scene here.)

Fifth scene: Brian introduces the video: "What you are about to see is video from Indiana Jones and the Last Crusade. This scene involves a Nazi war plane chase. The scene cannot be miniaturized since flame does not look realistic on small-scale. He then describes how the special effect was created by Industrial Light and Magic (ILM). (He narrates and points to the different cuts of the plane and the miniature plane in a tunnel from ILM as the video clip is running under MultiMedia Works.) Genie then asks why this clip was chosen. And Brian then explained how he was originally going to do his report on the history of film, and thought this would be "a perfect example of how aerodynamics and planes can tie in with movies". "They had to use good aerodynamics and special effects to make the scale model."

Sixth scene: Paul introduces the video scene (apologizing for the fuzzy video quality since it is recorded from television source signal) from the movie The Right Stuff. In this scene, Chuck Yeager breaks the sound barrier in the X1 plane after passing 0.98 mach and finally 1.0 mach, the speed of sound. (None of these remarks, which Paul provides as an ongoing narrative as the clip plays, are "in" the MultiMedia Works document.) Genie then asks again: How does this video tie into your report?

Seventh scene: Brian introduces a scanned color graphic of a "standard subsonic airfoil," and he reads text describing how lift is the upward force that must overcome drag. Drag is also defined. Paul explains how this wing would not have allowed

supersonic speed. (Note: again, this information is redundant with several previous scenes.)

Eighth scene: Paul presents a scanned color picture, with diagrammatic arrows, of a WWII biplane used in the movies earlier, and he explains again about forms of drag in this context and asks whether his audience understands it, and when they say they do now, he provides a comparable example of drag and lift for an automobile. A "drop" shape of wing is then described by Paul as verbal addendum.

Ninth scene: Shane introduces a MIG28 fight from Top Gun (mentioning nothing about why it is relevant to aerodynamics), and discusses bullets and missiles, and when each would be used. Paul narrates, pointing to enemy planes. Bill asks after it plays: "How does this relate to aerodynamics?" Paul says you can hear the thrust and see the drag! And he notes that aviation is big in fighting during wars.

Tenth and final scene: Brian explains how "We couldn't really do a bibliography because it is hard to do a bibliography with movies. And we couldn't find out all the information about movies, so we just wrote a brief paragraph of what we used."

In their summary observations about the process of using MultiMedia Works for their research report work, they noted:

"I have learned a lot of technical things about the computer. I learned how to make an airplane go faster without more thrust." (Paul)

"MultiMedia Works was the best way to present my topic because when you talk about aerodynamics--lift, drag, thrust, and weight--it can be displayed by color video and sound, not just pencil and paper" (Brian)

"It helps the listeners stay awake during the presentations. It was never boring to come to use, always something to do. And it was more fun to learn." (Paul)

"I thought it was cool because it's a new way to show things. I thought it was a good way to present my topic because it was new and bore-proof." (Shane)

"Aerodynamics is hard to explain by words. The film helped show without words. And the complicated words turned into easy to understand film and graphics" (Paul)

But not all was rosy:

"The computer was not always friendly to us. Some days bugs would come and attack the program. It would get locked up, and sound or video wouldn't work. With paper there are no bugs and viruses. It is not mechanical, you can just write down. But you can't express points of aviation like you can with this and video" (Brian)

7.3 Comparative analysis of the work of the Boys Group and Girls Group

It is important to emphasize the qualitative nature of our observations with these groups in this classroom, since it would be premature to make inferences about different tendencies in boys' and girls' groups toward collaborative style, preferred genre, or other observed

differences between the groups. But we may summarize the main differences we found in our work in the MacMagic classroom.

We saw two different styles of multimedia composition in the groups' works. The boys' group had a central tendency to begin by thinking about the video clips they desired, and to then consider augmenting and integrating those clips with text. Perhaps this was the case because they had worked independently on their outlines and research, such that their most obvious common ground was the video they planned to use, around which a shared story might be constructed. The girls' approach began with the outlined text script, then seeking to find the media that most strongly augmented the message of the text. This approach may have been facilitated by their close teamwork in the research and outlining phases of their project effort, in other words, the collaborative ownership of the outline narrative.

We also observed two different styles of multimedia genre. The boys' work represented a use of MultiMedia Works for purposes of *analysis* - explaining some concepts, in this case, aerodynamics, and then exemplifying these concepts in examples from feature films about planes. The girls' work instead used MultiMedia Works for purposes of a *documentary* style, with the aim of educating and changing beliefs and behavior of their classmates, so that they would pay more attention to AIDS and realize it could affect their lives.

8 An integrative analysis of teachers' and students' contributions to the genre of the multimedia research report

In this section, we present an overall analysis of how the students and teachers both contributed and developed evaluative norms during this process. What did the students bring to the multimedia research report as orientations and desires? What did the teachers bring to this new attempt at doing research reports with multimedia–how did new forms come to serve old functions? What were the final appraisals of the experience by the students and the teachers by the end of the semester? The project culminates in the perceptions of the students and of the teachers: what did they think about creating multimedia research reports? The assessment process is also ultimately asymmetric--the teachers need to present the students with assessments of their work, in substantive terms and as grades.

From the project outset, we have already noted that the "media effects" (kids) versus "content" dimension (teachers) was a salient contrast and an issue for the teachers. The students found graphics and sound very compelling in Hypercard, and devoted extra hours before school and at other times to do, as Bill put it, "the most difficult things possible."

Moving video images for MultiMedia Works promised to have an even greater appeal. So this media effects tendency on the part of the students was a burning concern. It had first appeared in the interview work we did with them with respect to the students' Hypercard based work early in 1990-1991 before they embarked on the students' research project in the Spring of 1991. Early in March the teachers felt they might be able to avoid excessive attention to media effects in the MultiMedia Works compositions:

> Genevieve: I am suggesting teamwork as a good way to go about the MultiMedia Works report. They would have to do research. prepare questions. setup appointment, do the interview, review the tape, edit, rough-cut, and then final. And then integrate it into the system. So, someone might be doing the setting up of appointments, doing questions and so forth, the other two on the team could be out interviewing. And then switch that back and forth.
>
> Bill: We wanted to make sure there would be a fair amount of content in this, so what we came up with without trying to restrict the kids too much was present the different media that MultiMedia Works is capable of delivering, and say "Pick one" and use it as your backbone.
>
> Genevieve: What we have to watch for in Hypercard is that they do not get too involved in the superficial things, the glitzy things, the pictures, the sound, that the content has to really govern it. So in that case we just had to take a different approach.

The teachers later contributed to setting specific constraints on multimedia reports so that the students would focus on content over form. These constraints included insisting that the students provide a rationale for their use of media beside text, and the provision of the template card for outlining in Hypercard, which diverted the students from fixating on creating visuals and special effects. Genevieve would regularly ask the students working on MultiMedia Works to explain why they were using the video they were, to make it focus on their specific topic clearly.

After the MultiMedia Works projects by students were completed, we had wide-ranging discussions with the teachers on their evaluation of the overall use of multimedia computing for research report work, including MultiMedia Works and Hypercard. We will primarily focus on the MultiMedia Works student projects for our purposes, although it is important to note that there was some disappointment with the Hypercard stack reports, since "there was too much transposing of 5 pages of text into a Hypercard version" (Bill, 11 June 1991).

Overall, the teachers had serious concerns about the poor integration of different students' contributions, and the lack of cohesion in their final MultiMedia Works reports. In the end, both groups received a B for their works. There was a perceived tendency for both groups to be

too distracted by the technology and the effects from the content. These problems were viewed as especially apparent in the Boys Group:

> There was redundant text across scenes. Brian also developed some inaccuracies about scaling issues in the portrayal of accurate dynamics of special effects work of the Indiana Jones plane scene. He may have missed some cuts in the movie and got a bug in his thinking that what was real was a model. They knew more than they showed. They made lots of verbal elaborations to their document in their presentation, maybe because the three in the group had debates around what should be in the document. That made it harder to grade (Bill, 11 June 1991).
>
> The boys were really concerned with effects--producing stuff that us fun to LOOK AT. Their video clips did not have much to do with aerodynamics (Bill, 11 June 1991).

The Girls Group work was more highly regarded by the teachers:

> They had a better conception of their audience than the boys, and they were comfortable with getting their own source materials [through interviews] (Bill, 11 June 1991).
>
> There was a real performance sense to the document and class discussion. They were giving a talk and using the document as a resource for their discussions (Bill, 11 June 1991).

But:

> The girls were rambly and had some misinformation

Even so, in terms of overall reactions to the use of multimedia for research reports in the classroom, there was a lot that the teachers valued, albeit with all the difficulties that were experienced in structuring the classroom experience of supporting students' work to create multimedia research reports for learning that would be dominated by content and not overwhelmed by a concern with dramatic effects:

> The students enjoyed seeing themselves as a source in MultiMedia Works, there was an air of authenticity unlike text, where they would feel they would be marked down (Bill, 14 June 1991).

> Instead of isolation, it fosters communication. Kids have something to look at that they can talk about, it provides a common denominator. So then they can discuss things that they may not have originally (Genie, 14 June 1991).
>
> The technology gives the kids a real open forum to request from each other. They are encouraged to help one another, and get support from each other. Kind of a trust system. They are looking at each others' stuff all the time, and they love the feedback (Karla, 14 June 1991)

We now turn to examining the implications of both positive and negative reactions, by students and teachers, to the classroom uses of multimedia for research reports.

9 Summary of results

We review the main results of the project in terms of two broad categories. The first category consists of the successes we observed, and their implications for media-rich composing environments for learning and teaching. The second is an analysis of the problems we observed occurring in the uses of such technologies for learning and teaching and the ways in which the teachers came to solve them, or at least made efforts to reduce the severity of the problems that arose. While it cannot be assumed that either these successes or problems will universally appear in classrooms using media-rich composing technologies, they appear to define a potentially general set of solutions, findings, and problems from which others may learn.

9.1 Successes observed and implications

We documented a number of successes in the uses of media-rich composing environments in the Davidson classroom study. By "successes," we mean those outcomes of the uses of such tools in the learning-teaching situation that the teachers and students came to spontaneously mention, or refer to in open-ended interviews we conducted about their ongoing integration of these technologies into their classroom work practices, based on our own participation in classroom practice. These successes included:

• *Students came to consider a diverse range of sources of information as relevant to their inquiries in their research projects.* In addition to texts and reference books, the standard fare of research reports, the students came to regard such media as recorded interviews, video clips from film and television, the use of diagrams and graphics, as fundamental to conveying the results of their research to an audience. Many of these resources were more current and more directly relevant to the project at hand than could be found in texts. A

prominent example was the girl groups' interviews with an AIDS counselor and interview of their classmates' perceptions of how AIDS is transmitted.

• *Students learned to use each other as resources and critics.* Media-rich composing environments encouraged collaborative project-based learning -- even when projects were "individual" assignments, as in the case of the Hypercard research reports. Several features contributed to this development. The first feature was the diversity of expertise needed for the completion of such projects –including scripting, graphics design, sound digitizing, text writing, library research sourcing and synthesizing. This required students to seek out others for learning of skills and sharing of innovations. The second feature was the advice that was commonly needed, sought out, and shared among classroom peers and teachers, as well as community members, family members, and librarians. Interviews were collected for reports (e.g., the AIDS project), and advice was sought out on various aspects of research projects, as varied as the content-appropriacy of sounds used, to the effectiveness of video clips used to make a point, to the clarity of expression of text used to convey a synthesis of literature that had been read (e.g., on aerodynamics in one project). The third feature was the public nature of the computer display screens, which graphically revealed "works in progress" for projects -- the images (and sounds!) of projects-in-development thus became public artifacts. Built up over time, the display nature of documents encouraged many discussions among peers, and contributions which led to revisions and improvements. While it was clear that the teachers' pedagogy was a major contributor to what we observed here, the display nature of the technology also had properties which were well-suited to the project orientation which the teachers developed for student learning.

• *The diversity of media allowed for extensive project participation, and peer-valued contributions by students not strong in written text skills.* The teachers saw this as particularly valuable for the multi-cultural setting of their community, which included a great diversity of native language groups. The various media available gave students the opportunity for different points of entry into the project. They might choose graphics or video as the primary message, and augment that with text, or vice-versa. Most importantly, those students without strong text skills could jump in and participate from the start. For example:

> Genevieve: She (Sondra) started blossoming when she started with the biostacks, with the scanning, got all excited about her family by scanning pictures. Then she got interested in putting them together with writing. And that was her first writing really.
>
> Bill: She got really good feedback from her biostack (3 May 1991).

• *Changes occurred in teachers' and students' judgements about what makes a "good report" when expressed as a multimedia document.* This finding is at the heart of the theme of our project -- on the social construction of genre in media-rich composing environments. A repeated theme, discussed earlier, which attracted much teacher and student attention, was the ongoing "struggle" between different norms. Teachers and students had very different native criteria for good multimedia documents. For the kids, the audiovisual look and feel of a document was more important than for the teacher. For this reason, students invested significant effort in finding media, and sizing and editing graphic, audio, and video media. The teachers professed to be centrally interested in content. For each group, these criteria came to change, to accommodate the norms of the other group, in a modified form. Even though the uses of video in the final MultiMedia Works reports from students were not all well-motivated from the teachers' perspectives, the teachers came to realize that well-chosen sounds and visuals *could* add significant content and emphasis to a report. And students came to realize that they had in many cases been selecting content-superfluous media for flash effects. And late in the year, peer critique of media choice came to appropriate the teacher norms in their call for content-relevance of media.

9.2 *Specific findings for MultiMedia Works use*

• *Students saw imaginative uses of media for projects.* The student groups who "applied" to their teachers to use MultiMedia Works for their research projects were imaginative in seeing applications for the media in their research efforts. Their ability to propose reasons why the additional media would add value were central issues for the teachers in selecting the teams, as we have discussed in Section 7.2. The two successful applicant groups of students were creative in terms of producing (planning, executing and integrating) new resources, like interviews with peers, and using found sources, including motion picture film clips of airplanes in flight.

• *Multimedia reports as oral performance props.* Project reports in MultiMedia Works were treated as "performances," to use the teachers' phrase. Their presentations were supported by the contents of the MultiMedia Works reports, and they did not design the reports to stand alone. The reports became "conversational props" for group discussions of their project findings, and teachers observed that students made substantial oral and peer-conversational embellishments of the reports as they presented them to the class. In an important sense then, the locus of meaning for students' documents changed -- from a stand-alone word-processed document, to a Hypercard interactive experience, to a MultiMedia Works document

as a major but not the sole source of meaning for the report, since it became a performance prop.

• For MultiMedia Works, we saw *two distinctive genres of use* for the two project groups using the program during the year. One was analysis, and the other was documentary. One group engaged in an analysis of concepts in aerodynamics, whereas another group developed more of a documentary reporting style, in a project on AIDS and its potential impact on youth.

• *Two different styles of multimedia composition* were observed in the two groups using MMW. One group working on aerodynamics and the history of planes in films, started out with video clips they wished to use, and augmented them with text. A second group started with outlining their text script, and then augmenting their writing with media felt to be appropriate augmentations to the text. This relates to the notion of a spine and ribs in film making, where a media type is selected to convey the primary message, and additional media are layered to augment and highlight that message.

9.3 *Problems observed and teachers' solutions*

We also noted some central cases where problems arose. These were *core* problems -- emerging dilemmas, or issues, which the teachers came to note repeatedly in ongoing discussions with each other and with the researchers, and which led to efforts to solve or reduce the problems. Each of the problems we observed, and the creative efforts by teachers to solve them, constitute important evidence for the likely difficulties in the future of integrating media-rich composing environments into the classroom. As we note in the concluding section of the report, solutions to several of these problems may be contributed in part by technological aides.

• *The capture effect of multimedia production on students.* Multimedia technologies for students' work had magnetic appeal, with both an up and a down side which teachers found difficult to reconcile, although they felt that they came to a workable balance. As noted earlier, the teachers were well-aware that the diverse roles available for students in planning and producing multimedia project reports enticed more students to participate in an integral way in learning activities. But the teachers also found it difficult to distract many students from their initial fascinations with producing dramatic effects that captured the attention and the respect of their classroom peers. Students seemed to the teachers overly concerned with producing fun media effects for their student audience, without concern for the *substantive*

contribution of these media to the overall goals of their story or project. Teachers made these observations both for reports created with Hypercard and with MultiMedia Works.

The way teachers resolved this problem, apparently with some but not total success, was by requiring the students to provide a *rationale* for their choice and use of the media: "What are you telling us with this example?" They developed a critique session on the meaningful purpose that was needed in order for sounds or visuals to be present in compositions. They also later in the year required the students to submit a textual outline to focus on their story or project content, throughout the project, so that over-attention to non-textual media could be held in check. On the other hand, teachers came to see that images and sound could add depth, not only surface gloss, to a presentation. This was a discovery for them. The students became more critical, too, and started asking other students questions about why they were using the specific media they had chosen. There was a thriving dialectic on the evolving standards for a "good" multimedia document that permeated the talk and evaluations of both teachers and students.

• *Shifting time use by students in multimedia research led to problems in assessment of learning.* Teachers considered it difficult to assess students who might have worked hard to develop a skill that the teachers did not value highly, or were not sure how to evaluate, such as graphics programming (in Hypercard) or video clip editing and sequencing (in MultiMedia Works). Students often devoted significant time to developing such skills because of their perceptions of the importance assigned to them by their peers. Their peers were a significant and authentic audience, and thus provided a motivating context for skill development. Media research, media capture (digitizing), and media production (editing, refinement) were time-consuming processes for students, and often did not allow students time to display the full knowledge they had derived from their research to their teacher or peers. One accommodation the teachers made reflected a recognition of the extra effort required for media research, production, and integration in multimedia compositions. Because students in groups working with MultiMedia Works had to do more work due to the extra media involved, the teachers did not require them to do a five page textual report, which was required for students preparing their project reports with Hypercard.

In part, teachers found grading to be difficult because students' work practices were hard to observe. Project work generally was difficult to compare because firm grading standards do not exist, and process was difficult to observe during project development. As Karla noted: "you are always surprised by what you get even though you feel you have been part of the process" (1 March 1991). And many types of expertise are needed, only a few of which are

now recognized as valuable in traditional educational assessment (e.g., writing of text, but not selecting and integrating content-appropriate video for a research report). As we have noted, students made verbal elaborations of their documents when presenting them, demonstrating more understanding than was found in the final documents, which made the document itself hard to grade. If there were differences in the group about what should be in the document, they often did not resolve them within the document, but during its oral presentation.

• *Early overspecialization appeal for tasks in multimedia composition.* Students often tended to want to specialize on one aspect of the project work for their team, such as video clip editing, to the exclusion of other tasks found less appealing but important for learning content, such as writing text based on library research. Teachers sought to monitor such tendencies, and urged each student to contribute to multiple parts of the project tasks. We can imagine that better collaborative work tools for student teams could be developed for helping teachers guide and monitor student contributions to different component tasks of a multimedia research and composing project. "Offline" it was hard for teachers to keep track of what students were actually doing.

• *Emotional interference to planning and development of multimedia composing.* A number of the students got so excited about the media content -- fast-action film clips, live interviews with scientific experts that they had conducted, clips from favorite films, or music that they had composed and digitized -- that they found it difficult (sometimes impossible) to pay sufficient attention to the necessary details of planning and developing their multimedia document. For example, video file management and audio file management requires careful logging and naming procedures, or else one can easily end up with the wrong version of a multiply-edited clip in one's final report. This happened repeatedly to the MultiMedia Works teams.

• *Difficulty in maintaining a cohesive story across media and screens.* Teachers observed that students using multiple media for their MultiMedia Works compositions had somewhat less than cohesive "flow" across media and across the screens comprising a multimedia document. The sources of this lack of cohesion were found difficult to describe, but there was a feeling of disjointedness. Even though MultiMedia Works supports the screen-integration of diverse media, and reasonably uniform procedures for adding diverse media to compositions, this by no means ensures that the media selected will have a thematic or narrative cohesion. Such coherency was the task of the author(s). Since multimedia composing allows for the expression of genre with no well-developed normative standards as

yet, it was perhaps not surprising that the experience was not in place for teachers and students to produce good, cohesive flows within a document. With more experience with media-rich composing environments, we imagine teachers would develop norms and standards, and critique processes similar to the writing process approach which they have adapted with success to Hypercard reports.

• *Inadequate incorporation of peer and teacher critique in revision of multimedia documents.* As noted, a culture of peer constructive critique was developed and maintained by the teachers. This took place both informally, when all students were working on their projects at the Macintoshes and students would "cruise" to other student stations and make remarks, and more formally, when drafts of documents were presented to the class. However, teachers noted that for students' multimedia projects, while both the students' peers and teachers provided good formative critique of documents in development, reactions to these critiques were not adequately reflected in the revisions that students later made to their documents. Part of the difficulty was the lack of annotation facilities for peer commentary in the documents themselves. This could be resolved with electronic "post-it" notes attached to parts of multimedia compositions, or other kinds of electronic, context-relevant capture of comments that would later help guide revision. The teachers found a partial low-tech solution when they came up with forms that the student audience filled out and submitted to their presenting peers, and their suggestions that students rotate around the room to each others' computers to provide constructive feedback to compositions in development that could be changed in real-time.

• *Group collaboration was not well supported in the technology.* Students worked in teams on their MultiMedia Works compositions, but the technology does not currently support synchronous collaboration. Teachers resolved this issue by guiding student groups, so that they would pursue some tasks offline, and tasks online. For diversity of experience, they sought to rotate those tasks across students over the project duration. But collaboration *in* the technology would have been easier to track and manage. In both the MultiMedia Works groups, students underestimated the complexities of integrating the contributions of the different students' research efforts, notes, and other media into one cohesive document.

• *New demands on teacher expertise when multimedia composing is commonplace.* Teachers often could not provide the necessary technology support in many areas that students quickly started to desire, such as advanced Hypercard programming, video and audio file management, and integration of computing and video technologies in MultiMedia Works. While they had technical support from their Lucasfilm colleague Bill Garr, many teachers will not

have a comparable resource. Also, there are many directions for students to pursue when engaged in multimedia research, and as Genevieve noted: "this is one of the things too that shows you about the individualization of the computers which has been a real eyeopener. And that makes it hard for teachers to manage since they just get all over the place." (1 March 1991).

• *Difficulties become apparent in finding multimedia source materials for student research.* While the Reader's Guide to Periodical Literature was well-known as a useful resource for student research by the teachers, they have little experience in seeking out video, film, voice, sound, and other source materials to support students' research inquiries in the ways that the Reader's Guide does for print media. The students sensed this unknown as well, for example:

> I am trying to find film of the Wright brothers. My original subject was movies, and so I can use some clips from Top Gun, and Lucas films, and Wright Brothers, but we don't know where to get them, or how to get them. (Brian, 3 May 1991).

10 Future directions for research investigations and for technology development

While evident in some of our earlier observations, we wish to note several prominent directions that we consider particularly promising for research investigations and technology development given our project findings. We order them in terms of relative importance, given our judgement of their significance to solving problems attendant to integrating media-rich composing environments in the classroom.

(1) *Collaborative work tools.*

Both students and teachers want better support for work in teams. From our observations, two major classes of functionality appear to be needed: for feedback/revision, and for team collaboration.

For the first, facilities are needed which aid in the *collection of peer and teacher feedback for revisions, and of records that it has been attended to in revisions made.* Teachers wish to see what feedback was offered, and whether and how it was reacted to in students' revisions. Achieving these goals would appear to require: (a) *annotation facilities*, at both the overall document level, and at the media token level (i.e., for each video clip, graphic, or audio clip used) where comments may be registered; (b) *read-only access of the critics to the teams' document drafts* (e.g., network file server), so that comments may be left for the composer(s); (c) *annotation-"answer" facilities*, which the composer would use to note which

of the suggested revisions were taken heed of, and in what way. These facilities would support the tracking of revision activities by both the composers and the teachers, who are concerned that critique should be leading to appropriate revisions.

Also, since students preferred making live presentations of multimedia documents to the "canned" playing of their reports by others in their absence, better coupling is needed to collect feedback from the audience in real-time to guide the revision. The facilities described above assume, however, the "canned play" approach to peer and teacher feedback. The preference for feedback from live performance suggests the need for student peers and teachers to have read-only versions of the document being presented which they could annotate in real-time (for example, with wireless notebook computers), or immediately after the live presentation, which would then be aggregated by a file server procedure to a master critique file for the presenting student's use in revisions. In addition, well tuned mechanisms are needed for the presenters so as to allow nonlinear movement through a document, and well timed playing of various parts for live audiences. For question and answer periods, students would like to be able to quickly move back to various screens for replay or elaboration. For this purpose, students will need quick search and retrieval mechanism so as not to lose the momentum of media-enhanced learning conversations.

Secondly, facilities are needed which aid in the conduct of collaborative research for media-rich composing. These include team sub-task assignment, planning and scheduling support, well-integrated research file-keeping and composition environments, and synchronous access across multiple workstations to a document by a group when group revisions are being negotiated.

(2) *Media capture and logging support.*

It became obvious in students' and teachers' experiences that better support is needed for media capture, naming, and logging of audio and video media. Students and teachers find these processes cumbersome. For example:

• *Media capture:* Logging audio and video clips from interviews or other kinds of shooting could have time/date/sequence stamping as defaults for clips.

• *Media storage and retrieval:* There are not well-developed conventions/defaults for naming and numbering the media collected. This is a difficult general problem in multimedia computing, not just in the classroom. But teachers could work with students to help them

learn the need to make substantive annotations describing distinctive properties of different media tokens they are keeping on file.

• *Media editing, and multiple versions of edited clips:* Describing the differences between one version and another of an edited film clip for possible inclusion in a final multimedia document is a demanding task. One solution we can imagine is that once the media can be stored digitally, "difference" previews might be possible, which would provide the user with the ability to select any two media tokens and see/hear the respects in which they are different. Tagging procedures for preferred clips should be encouraged, and regular media "purges" for unused materials are necessary.

(3) *Media overview and structure-editing tools, with "rationale-making" support.*

We observed several negative tendencies that could perhaps be mitigated with technological aides. One was the tendency to overuse real-time, dynamic media without due consideration of their substantive contributions to the content of a project. This issue suggests the need for a background "rationale" window for each media token used. For example, s a rationale window might have flexible fields for teacher (or peer) formulation of guidelines for "appropriacy," and students would need to fill it out for each media token that is used in a multimedia composition. A second tendency was the feeling of a choppiness of media use in MultiMedia Works documents. This could perhaps be remedied with the provision of a high-level structure editor, like an outlining program, which would provide an alternative "view" on the multimedia document. This multimedia outliner would allow the student to obtain a top-down view on media use throughout a multimedia document (rather than a temporal view, as in MultiMedia Works), and his or her work rearranging and editing objects in the outliner would translate into editing changes in the temporal flow and media composition of the multimedia document itself.

(4) *Hardcopy of multimedia document drafts.*

Hardcopy is needed for drafts of multimedia documents, for planning, revision, sharing and critique with others. Capturing appropriate traces of dynamic media for such design activity is a difficult challenge, but both students and teachers observed the need for such "hardcopy" while one is working on a multimedia document.

11 Reflections

Teachers and students throughout the world are in the midst of reinventing education, seeking to make it a more effective process for preparing citizens for an information-rich, multi-cultural, and challenging environment that they will come to lead and participate in. In this project, we have sought to document in a small way a microcosm of change in one of these sites of innovation, a middle school in California that is using new technologies in innovative ways to build on the voices of diverse learners, and to sustain a cooperative culture of learning and mutual respect. We can see the teachers and the students contributing, in a dialog of some consequence, to new norms for multimedia documents that transform the text-based research report. This dialog is one in which teachers brought concerns of substance and content and text, and students brought interests in visuals, and sound, and special effects. The students came to see the differences in multimedia that contributes substantively to the messages they wish to communicate, and the teachers came to see that media effects could contribute to substance and content. In the long term, developments like these promise to transform the information ecology and nature of literacy in society. It is an exciting prospect, but one beset with a host of pedagogical, theoretical, practical, and technical concerns. But it is through changes in the small such as those we observed that the macro effects of media-rich composing technologies in education will become manifest in the decades to come.

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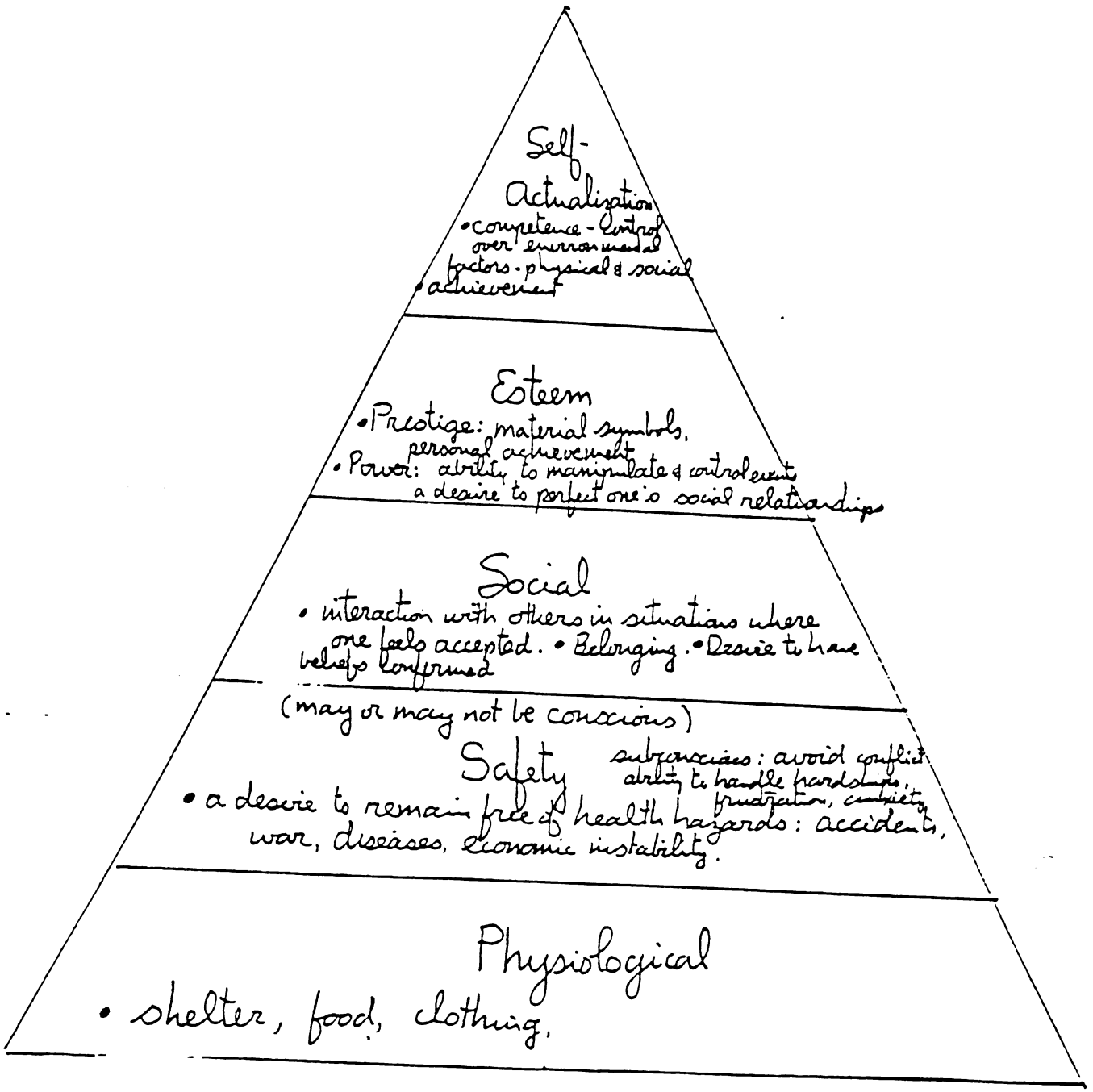
Appendix A: Maslow's Pyramid on Civilizations (adapted for curricular purposes)


Self-
Actualization
• competence - control over environmental factors - physical & social
• achievement
Esteem
• Prestige: material symbols, personal achievement
• Power: ability to manipulate & control events
a desire to perfect one's social relationships
Social
• interaction with others in situations where one feels accepted. • Belonging. • Desire to have beliefs confirmed
(may or may not be conscious)
Safety
subconscious: avoid conflict, ability to handle hardships, frustration, anxiety
• a desire to remain free of health hazards: accidents, war, diseases, economic instability.
Physiological
• shelter, food, clothing.

Appendix B: "Response Groups" Handout

RESPONSE GROUPS

A. RESPONSE #1: INDICATE WHAT YOU LIKE ABOUT THIS PAPER. (star it, underline it, use brackets, label it) Sample labels:

good	I can picture it	I know what you mean
great	nice image	more like this
true	good showing	vivid
right	realistic	insightful
funny	I love it	powerful scene
exactly	good logic	catchy beginning

B. RESPONSE #2: INDICATE WHAT YOU DON'T UNDERSTAND ABOUT THIS PAPER. (ask a question; label it) Sample labels:

I don't get it	I don't understand this part
not clear to me	how/why did this happen?
I'm confused here	how did you get from here to there?
what do you mean?	I can't picture this scene clearly
this seems unrealistic	what is the purpose of this
is this true?	information?
this doesn't make sense to me	

NOTE: Response #2 should be specific to the content of the writing.

C. RESPONSE #3: INDICATE WHERE YOU WANT MORE (or MODIFIED) INFORMATION IN THIS PAPER. (ask a question; direct the writer) Sample labels:

show more action here
show some conversation (or dialogue) here
what is the character thinking (or feeling) here?
show more this character
show more of the environment here
this scene could be expanded to include...
this scene could be shortened
can you show an example here?
show more of...
show more about...
can you give more background information about...
show what happened before this
show what happens next
can you describe this so I can picture it?

NOTE: Responses should be specific to the content of the paper and/or should point to a particular place in the paper. General responses are not helpful ("It was good," "It was too short," "Show more everywhere," "I like the whole thing," "Make it longer").

Appendix C: Bio Stack Assignment Sheet

BIO STACK

You will be creating an autobiographical stack that describes you as a person and the important events that have occurred in your life . HyperCard will allow you to enter text, art work, photographs, sounds , animation and anything else that you can think of to represent the stories and events that are important to you.

We will begin with 6 cards. The topics are listed below. Your first task will be to give some thought to how you want to want to design these cards and what you will include on them.

1. Your birth announcement
2. Your immediate family
3. Your family history
4. A childhood memory
5. An important friendship
6. A trip or adventure

DUE : FEB 12

DESIGN ON PAPER

&

6 CARDS

Appendix D: Bio Stack Evaluations Sheet (for student use)

Biostack Evaluations

You are now finished with 8 cards of your biostack. Congratulations! By now, you have figured out that 8 cards can mean a little bit of work, or a whole lot of work, depending upon how much time and care you put into them.

And 8 cards can **look like** someone put them together fast, or like someone made them into a real story.

---

1. Writing: How many stories are in the stack? Are they too short, too long, confusing? Do they have good beginnings and endings?

Judge the Writing [] Great [] Good [] OK [] Fair [] Poor

2. Artwork: How many pictures are in the stack? Are the scans good? Do the pictures tell you anything about this person? What?

Judge the Artwork [] Great [] Good [] OK [] Fair [] Poor

3. Sounds: Why are these sounds in the stack? Is the sound quality good? Are the sounds interesting to you? Why?

Judge the Sounds [] Great [] Good [] OK [] Fair [] Poor

4. Scripts: Are there any interesting scripts in the stack? Are they just for show, or do they help tell anything about this person?

Judge the Scripts [] Great [] Good [] OK [] Fair [] Poor

5. Navigation: Is it easy to move around in the stack? Are the buttons easy to understand?

Judge the Scripts [] Great [] Good [] OK [] Fair [] Poor

Appendix E: Davidson Middle School 's Term Paper Guide

D A V I D S O N M I D D L E S C H O O L ' S

TERM PAPER GUIDE

Developed by:

Genie Colteaux

G E T I T

T O G E T H E R

ORGANIZING YOUR RESEARCH PAPER

A research paper will probably be the longest writing assignment you'll receive in any class. It may seem overwhelming at first. How do you decide what to write about? How do you get started? Where should you go for information? What should you include in your paper?

First, keep in mind that you'll have several weeks to work on the assignment. Planning your time efficiently is the most important step in organizing a research project. You will find the job more manageable if you think of a research paper as a series of small tasks - research, notetaking, writing, rewriting, and proofreading.

The step-by-step plan below will help you organize your paper one job at a time. Either individually or with your teacher, work out a schedule of deadlines for each step along the way. Write the due dates in the blanks provided and check off each task as you complete it.

RESEARCH

Jobs to be done:

	Due Dates:	Check-off
1. Think of a general subject that interests you and narrow it down to a specific topic.	_____	_____
2. Go to the library to see what is available on your subject. Make a list of all available sources on bibliography cards. (See the card forms on the "Go to the Source" sheet in this kit.)	_____	_____
3. Research and take notes on the materials you have listed.	_____	_____

ORGANIZING YOUR PAPER

4. Decide which information from your research you would like to include or omit.	_____	_____
5. Arrange your notes in logical order.	_____	_____
6. Write an outline based on your notes. (See the "Game Plan" sheet for an outline form.)	_____	_____

STEP I: LIMITING YOUR SUBJECT

The most common error in research projects is the selection of a topic so broad that only a full-length book could do it justice. If your topic is too broad, then you are forced into a hasty, superficial and incomplete treatment of it. Narrow your topic to a size that you can cover in your paper or supplementary A-V presentation. For example, do not attempt a project on the Civil War; instead, write about the assassination of Abraham Lincoln.

My revised, limited subject is as follows:

INSTRUCTOR'S APPROVAL: _____

STEP III:

GO TO THE SOURCE

WRITE BIBLIOGRAPHY CARDS

After you decide on a topic, the next step is to check your library to see if there is enough material available to write about. Here are some sources to check:

... The encyclopedia can provide you with an overview of your subject. Many encyclopedias also list related books on a particular topic.

... The card catalog is a good place to check for books on your topic. Look through the subject cards for related books. Also check the card catalog to see if books mentioned in the encyclopedia are available.

Check the subject listings of the Reader's Guide to Periodical Literature for magazine articles about your topic.

... Newspaper indexes, almanacs, and atlases are also good sources of factual information.

On the bibliography card forms below, list all the source materials about your topic. We have provided two samples for you.

Books	Book Title	Articles Author	Title of Article	Magazine

Date Published	Publisher	Volume	Date of Magazine	Pages of Article

STEP V:

A C K N O W L E D G E M E N T S

BIBLIOGRAPHY PAGE

A bibliography includes all the sources you used to research your paper. On the form, list all the books, articles, and other printed materials you researched. (You can get this information from your bibliography cards.) Arrange the entries alphabetically by author, if the author's name isn't indicated, write in the entry alphabetically by the title of the article or pamphlet. Here is the correct way to write a bibliography entry:

FOR BOOKS: Cornell, James C., Strange, Sudden, and Unexpected, New York, Scholastic magazines, Inc., 1972.

FOR ARTICLES: Ronan, Margaret, "The Psychic Horse, Lady," Weird Worlds, October 1978, 22-23.

BIBLIOGRAPHY

STEP VII:

OUTLINING YOUR REPORT

An outline is very much like a skeleton: it is a framework around which you can build the body of your report. An outline is a useful tool for organizing your material and summarizing your report. It also serves for notes if your report is to be presented orally. Your teacher may request that you prepare an outline as a part of your report.

Your outline should be as clearly and briefly stated as possible and yet cover the main ideas of your report. You must be able to identify which are important points and which are less important details related to each and to assemble them in logical and coherent order. Notes in the outline may be written in either simple sentence form or as phrases, but not both. Each note must imply a statement of fact. Single words do not mae good notes.

Relative importance and order of points is shown in your outline by the use of Roman and Arabic numerals, capital and small letters, and indentations, as in the pattern that follows:

THIS IS THE HEADING

I. A main point or idea

   A. An important sub-point to the main idea

      1. Important detail
      2. Second less important detail

   B. An important sub-point

II. A main point or idea

---------- etc.

Note that numerals are always followed by letters in the sequence (I - A - 1 - a) and that points at the same level (as capital letters) are always indented the same amount. Also note that unless there is sufficient material to need two or more detail sub-headings, non should be used.

Refer to your English Text for further help with your outline.

STEP VIII:

GAME PLAN

OUTLINING YOUR NOTES AND IDEAS

Preparing an outline is one of the most important steps in writing a research paper. A good outline will help you define the purpose of your paper, organize your notes logically, and develop your ideas in an orderly way.

Look over your note cards and any other notes you have written about your topic. Think about the main points you want to make about the information you have researched. Then use the form below to outline a tentative plan for your paper. Keep in mind that an outline is a starting point; you can always change the outline later on if you decide to organize your paper differently.

Topic: _____

Tentative title: _____

What I hope to show in the paper: _____

I. _____

- A. _____
  - 1. _____
  - 2. _____
- B. _____
  - 1. _____
  - 2. _____
- C. _____
  - 1. _____
  - 2. _____

II. _____

- A. _____
  - 1. _____
  - 2. _____
- B. _____
  - 1. _____
  - 2. _____
- C. _____
  - 1. _____
  - 2. _____

III. _____

- A. _____
  - 1. _____
  - 2. _____

STEP X: THE TITLE

The Title

A Social Studies Report
for
(name of teacher)
James B. Davidson Middle School

Date Due

Your Name
Grade and Period

C H E C K I T O U T

A RESEARCH
PAPER
CHECKLIST

You have spent time thinking about a topic, researching it, and writing your paper. Add just one final step, proofreading, and your research paper is complete. Use the checklist below to correct the rough and final drafts of your paper.

ORGANIZATION:

( ) There is a logical beginning, middle, and end to my paper.
( ) The main point of my paper is clearly stated in the introduction and summed up in the conclusion.
( ) Each paragraph has a strong topic sentence.
( ) Each paragraph develops an idea related to my main topic.
( ) All opinions are supported with facts and examples.

GRAMMAR:

( ) I have indented all paragraphs.
( ) I have used capital letters to begin all sentences.
( ) I have correctly punctuated all sentences.
( ) I have used only complete sentences.
( ) I have checked the spelling.
( ) I have checked that all verbs agree with the subject.
( ) I have kept verb tenses consistent.

MECHANICS:

( ) I have included a cover for the research paper that lists the title, my name, the date, and my class.
( ) I have left margins on all sides of each sheet of paper for teacher corrections.
( ) I have numbered each page of my research paper.
( ) I have included a bibliography of my research sources at the end of the paper.
( ) I have written as clearly and neatly as possible.

Appendix F: Students' Applications: MultiMedia Works Projects

DMS Kids MMW Proposals week of 3/21/94

Multimedia works

Topic: Aerodynamics (how a plane can get of the ground, and the best possible way to keep it in the air)

Why do you think Multimedia Works ~~would~~ (Printer mistake) be the best way to present your project:

I believe that I could use Multimedia Works to my advantage mainly because of the sound and the technology of using film on the computer screne. I would be able to make diagrams of how the air flow passes beyond the wing. I would use graphics on the film show in animation of where the wind would be flowing. The jet engine is a major part of what make a plane fly. The sound would make a big effect on haw powerful jet engines are. With the "awesome animation I could graphically show a picture (cut-away view) of a jet engine showing how the air flow gets "transformed" in to a spurting fuel eater that would propel a C-5.

Main points:

Angle of attack.
Airflow of wind upon the wing. Stupid computer
Change between cruising speed and landings.

Thank you for excepting this "grant",
Paul Barthel

MultiMedia Works Research Paper Request

Your Name Brian DeClouX

Topic idea:

The origin of a motion picture

Some jobs in a motion picture

Explain why you think MultMedia Works is the best way to present your topic.

Multimedia Works is the best way because: First of all, my topics is movies and it would be nice to display the term paper in that way. Second, with Mult. Works you can put video a special effects on. You cannot do that on Hypercard. The only disavantage about MultiMedia Works is its speed. The program can be slow in ways.

Members of your team and the jobs they will do:

Brian

MultiMedia Works Research Paper Request

Your Name Worth Jones

Topic idea:

AIDS.

Earthquake = backup

Explain why you think MultMedia Works is the best way to present your topic.

The ~~Reason~~ reason why I think that multimedia is the Best way to represent aides is

1. It shows good animation and it will be much easier to do the ~~interviews~~ interviews the people and showing the people

2. It helps much better to explain all about the people and the viruses.

3. and it will easier show the aids victims a cancer

Members of your team and the jobs they will do:

Jennifer McGrath & what causes aides.

Worth Jones & getting and arranging interviews

Evan Ng & Jen & If the scientist are working on making a cure and how far they getting.

MultiMedia Works Research Paper Request

Your Name Oanh Nguyen

Topic idea: Aids

Explain why you think MultMedia Works is the best way to present your topic.

I think multi media is best because we can show what people are like with aids. And what their reactions to it.

Members of your team and the jobs they will do:

Oanh - Walkiah - Jennifer

MultiMedia Works Research Paper Request

Your Name Manty, Fayro

Topic idea: The Drought

Explain why you think MultMedia Works is the best way to present your topic.

Because we can have viedo in our "stack" instead of pictures we could show viedos of rain the resuoir stream that used to be dry etc It would be impossible To do this in Hypercard & We can interview peop & show News feo-age

Members of your team and the jobs they will do: Sharing of interviews, resuoir & editing. We will have graphs, sheets of newspa & some writing.

Fayro & Manty

MultiMedia Works Research Paper Request

Your Name Jennifer Woodall

Topic idea: Aids

Explain why you think MultMedia Works is the best way to present your topic.
I think MultMedia Works is the best for my report because you can show what Aids can do to you. You can see actuly people with Aids. If Aids donot get accepted than we are going to to Earthquakes. During Earthquakes we can get footage from new network we can interview people from the 1906 Earthquake and 1987 and see what happened to them and get their reaction. on the computer we can show you the visuable effect, the ocean shaking and the house fall down water going everywhere!

Bye

Members of your team and the jobs they will do:

Kia
Ohun
Jennifer

MultiMedia Works Research Paper Request

Your Name Peter Hoopai

Topic idea: Titanic

Explain why you think MultMedia Works is the best way to present your topic.

Me and Shane would like to show footage of how the titanic was sunked and the submarine biologist looking at the titanic. We would also like to express the how the victims were screaming ~~to~~ there death (don't think of this as a ~~groaun~~ term paper).

Members of your team and the jobs they will do:

Shane = Work with the compater, collect information, sound effects

Peter = collecting information, editing, Programing, Sound effects

MultiMedia Works Research Paper Request

Your Name SHANE

Topic idea: Titanic

Explain why you think MultMedia Works is the best way to present your topic.

We would like to show footage of the submarine biologist looking at the wrecked Titanic, I would also like to express the dramatic feelings felt by the victims of the Titanic by adding depressing and slow music with the sound of people screaming in the background.

Members of your team and the jobs they will do:

Peter = will do documentary editing and collecting info.

SHANE = I will do programming and collecting info.

Both of us = sound effects.

Appendix G: Pea (1991). *IEEE Computer Graphics and Applications* article

(Not included, to be sent in full color copies)