Design Spaces for Multimedia Composing Tools

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The reciprocal influences of mind and media have been of great importance in the development of culture through written language, scientific and mathematical notation systems, and representational systems such as photography and film. New questions about multimedia composition cut to the heart of some of the most complex questions about computer supports for learning and the evolution of mind-media relations in an informational society.

The full learning value of hypermedia technologies will come where children are empowered to act as multimedia composers, creating their own works, alone and together, and learning by doing in the process. We take for granted the need to put computer-controlled multimedia under learner control for purposes of communicating understanding.[3] This is no small challenge, for it means more than letting learners make choices among pre-defined options. We have in mind student analogs to scholarly research inquiry activities—developing a critical synthesis summarizing a body of literature or film, crafting a compelling argument and carefully weighing pros and cons—in short, the construction of meaning from cultural artifacts or empirical phenomena, the composition of multimedia interpretations. Otherwise, multimedia "educational materials" will be "delivered" to students and we will find the 21st century recapitulating extant problems with texts in education, and the flawed "authority-centered" epistemology they have encouraged in schools.

Background

Our project began in February 1989 at The Institute for Research on Learning (IRL). Our product-under-development, *MediaWorks*, lets students compose multimedia compositions. An IRL club, The Science *MediaWorks* Club, is a multi-cultural after-school club for middle-school students from an economically depressed community. Using *MediaWorks* as a primary tool set, members of the club explore cognitive, social, and technological support issues within an educational environment that exploits "future" technological features for learning (for example, capabilities for computer-controlled multimedia, hypertext, networking, and distributed resource sharing). Club participants come to IRL twice weekly for two hours each time to learn how to work collaboratively in small groups to craft multimedia compositions. They also continually contribute to the "participatory design" of *MediaWorks*. We believe that joint envisioning of tool functionality by designers/researchers and users will yield the tool transparency we hope to achieve in the project.

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[3] Among the important reasons for multimedia objects as building blocks for the construction of meaning are: (1) written text alone restricts information access to many people, (2) multimedia communication shares many properties of learners' primary experiences with face-to-face communication, (3) situating abstractions in particulars can aid understanding—e.g., physics in a film of world events, (4) individual differences in preferred sensory channels for learning, (5) capacities to coordinate diverse external representations (with distinctive strengths) for different perspectives on some phenomenon.

We describe students' activities as "collaborative multimedia composing and learning." Students focus their compositions on "Hot Science:" current science events involving analysis of real-world problems in science and technology which dramatically affect society (e.g., global warming, acid rain, vanishing ecosystems, air pollution).

Small teams of students work collaboratively to browse and collect different media types for research, discussion, and possible inclusion in their compositions. Portions ("media tokens") of six different media types may be used in compositions: (1) text, (2) photographs (color or black & white), (3) graphics (scanned or created two-bit black & white images), (4) videotape and videodisc, (6) sounds (speech, music, environmentals), and (7) animations. We have created a preliminary multimedia database of several hundred documents which students use (and continue to contribute to) for their search and composition activities. Each team develops "multimedia compositions" on their topic of specialization and presents these works to other teams to explain some key phenomena, or to be persuasive about some argument. Through this "reciprocal teaching" approach, student composers learn both subject matter and how to effectively compose integrated multimedia works.

Staff members provide a Macintosh-II-based collection of resources for student design activities. It includes: (a) *tools* for digitizing video imagery, scanning print and graphic images, laser printing, and archiving videos, and (b) *software* for image scanning and processing, graphics file management, animation, 3-D modelling, and sound digitizing/editing. Staff members also serve both as "coaches" to introduce students to the activities and tools and as experts for students to call upon. Students serve as consultants and contribute to design by describing difficulties they experience and operations they would like to carry out but cannot.

Purpose

Our research primarily investigates (a) the kinds of skills—like joint planning and task allocation—that students develop while collaborating in multimedia design, and (b) anticipated developments in student comprehension of the topics and composition activities mentioned above. By using qualitative, ethnographic descriptions, we track the processes by which students collaborate to search, create, and compose multimedia documents. In addition, we are examining the features of tools and conceptual "scaffolds" that will best facilitate students' effective use of hypermedia technologies.

Findings

To date, we have developed a model of multimedia composing as well as a prototype version of *MediaWorks*. Both the model and the key elements (present and future) of *MediaWorks* are described below.

Model of Multimedia Composing

Our model of multimedia compositions is based on hierarchical data objects in *MediaWorks*. A composition is made up of a series of scenes. A scene may contain tokens of one or more static media (text, photo, or graphics windows) and time-based media (video, sound, animation). One "plays" a multimedia composition via a video-controller-like window with forward and backward "play" and "step" buttons and a stop button. Screens appear in the sequence of their design, and the presenter can choose when to turn on the time-based documents or pre-set the timing of their display.

Although our model is based on hierarchical data objects, we do not assume compositions are created through a strictly hierarchical process.[1] This product/process distinction is important. Multimedia composing, like much of the writing of text, is likely to be opportunistic—driven by ideas and connections recognized through browsing and the emergent patterns of juxtapositions occurring during the composing process. Pursuit of one goal may lead to discoveries, which lead to new search or browsing activities, which lead to revisions, and so forth. Rapid interactive development is essential.

Our paradigm for multimedia composing consists of three primary steps. The user(s): (1) first do research in a multimedia database (and off-line, bringing their materials into that database for composition use as necessary), (2) then collect materials on-line into a personal database, and (3) finally, may use these materials "as-is" or transform them for inclusion in their composition.

The Current and Future Design of MediaWorks

Currently, *MediaWorks* is a prototype which we expect to evolve considerably under student use. As of this writing, *MediaWorks* consists of two key elements: "MediaSpace" and "MediaComposer." Three future elements are "Project Coordinator," "MediaMaker," and "MediaAdvisor." Each is described below.

"MediaSpace" is a database. It provides brief-clip views of media tokens of text, graphics, photographs, sound, animation, and video clips. Students may find media tokens either by Boolean search or by browsing through galleries of (a) shrunken images (for photos and graphics), (b) digitized keyframes (for video clips, animations), (c) sound names (a brief clip of which can be played by clicking the sound's name), and (d) text file titles. Users can display the full document and then tag it for later inclusion in a composition.

"MediaComposer" lets users compose their multimedia composition. Users can begin to organize the composition by collecting media tokens (in "MediaSpace") and arranging them into a series of "scenes." Presentation controls let students pass easily between composing and presenting functions so that they can see their presentation as it progresses.

Design of the "Project Coordinator" will be informed largely by the collaborative patterns and project tracking needs (e.g., goal setting, progress monitoring) that emerge in small-group team work in the Club. "MediaMaker" will offer tools for making media to be used in *MediaWorks* compositions (scanning art or documents; video digitizing; sound digitizing). "MediaAdvisor" will be a later phase of the project that provides introductory, on-line, in-context guidelines for good graphic design and layout, appropriate transition effects, sound-image integration, and montage effects.

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[1] Mills and Pea (1989) describe multimedia composing tasks as involving operations—cognitive and physical—on a number of hierarchically-nested units. For example, a multimedia composition may constitute a story composed of episodes and events. Events are composed of dynamic arrangements of scenes in which object relations are expressed. We find this scheme not wholly satisfying in practice. Our experience with *MediaWorks* development shows that consideration of the material substrate (properties of file types, screen displays, etc.) is far more important than earlier envisioned in defining the units of the hierarchy.

Conclusion

Multimedia composing has exciting potentials for learning; however, as a community we are just beginning to explore the complex representational issues involved in making transparent tools for children to create new computer-controlled objects. Multimedia composing is a complex cognitive act. It requires a carefully-designed interface for "off-loading" some of the difficulties in coordinating the control of choreography for multimedia objects over space and time. We expect to make some progress on central issues through our "participatory design" work that involves students as co-designers of the tools with which they will do multimedia composing.

References

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Resources

Product	*MediaWorks*
MediaWorks Station Hardware	• Macintosh II with 8 megabyte RAM and 80 megabyte hard disk drive • Apple® RGB 13" color monitor • 13" multiscan monitor (Sony CPD 1302 recommended) • 45 megabyte cartridge hard drive (recommended for receiving upgrades and for exchanging digital compositions), plus 3-4 blank cartridges. • Laser disk player level III (e.g., Pioneer 4200) • Sony 8mm VCR with 5 pin control port for video input (e.g., EV-S900) • Self-powered speakers or TV monitor with speakers • Copy stand and color video camera for digitizing images • Lavalier or super-directional microphone for narration • VHS VCR for recording output of presentations (e.g., Sony SLV-757) • 8 mm video camera for recording video input (e.g., Sony) • 4-channel audio mixer for balancing audio levels
Software for Each Station	• *MediaWorks* • Macintosh Operating System 6.04 • *SuperCard Desk Accessory* (Solutions International) • SoundEdit and MacRecorder (Farallon) for sound digitizing • *Director* (MacroMind) for creating animations • *Colorspace Init and DAs*: Driver, Desktop Video, NTSC Digitizer
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