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Teachers College, Columbia University

Institute for Learning Technologies

Toward a New Paradigm of Curriculum Development

A Preliminary Inquiry about

A Multi-Media Social Studies Curriculum

Submitted to the

IBM Program for

Improving K-12 Education

Through Innovative Uses of Information Technology

Submitted By

Teachers College, Columbia University

in collaboration with

The Smithsonian Institution

and

The NYC Mayor's Public/Private School Partnership

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Proposal

We propose to organize a comprehensive multi-media knowledge-base for the social studies. This knowledge-base will contain a full documentation of the American land, people, and experience. We intend to provide a subject-matter resource that Americans will find worthy of use from childhood through maturity. It will further include software that will enable instructional designers, teachers, and students to manage the contents according to their intellectual purposes.

Teachers College, Columbia University will direct this effort through its Institute for Learning Technologies. The Smithsonian Institution and the New York City Mayor's Public/Private School Partnership will be co-participants in it. We seek support for a five-year effort. Development and evaluation costs will total to about $2,100,000, excluding equipment, and production costs for the first version of the project will be about $150,000.

Organizing the knowledge-base that we propose will help engender a new system of curriculum design. We will test this claim by seeing whether our knowledge-base will prove useful in two important efforts to develop computer-based social studies curricula. These are the "Freedom Project" that the JHM CORP is designing and the "Self-Expressive Learning Project" that Don Nix is starting through IBM Research.

Needs

We base our proposal on extensive experience seeking to improve education by using advanced information technologies. We frame it, alert to the uncertainties that impede efforts to improve education with multi-media curricular systems. Among these are the following.

* Traditional curriculum design is costly and cumbersome. With it, educators cannot implement effective multi-media curricula broadly. Through this project, we will strengthen multi-media curricula in two ways. First, we will develop a generic subject-matter resource, lowering development costs, improving content, and diversifying instruction design. Second, with it, we will facilitate a new curriculum design process that will provide schools, teachers, and students with multi-media curricula of exceptional quality.

* Educators do not know which pedagogical strategies will work well with multi-media information technologies. Such uncertainty weakens development efforts. This project will provide flexible pedagogical resources, enabling educators to personalize instruction and to discover through comparative trials which strategies work.

* The social effects of introducing advanced technology extensively into education are still unclear. We will study how social, economic, and ethnic differences condition the results of innovations. Our findings should improve chances that the social effects will help those in need.

* Working schools can reject an innovative curriculum, much as the body's immune system can reject a transplanted organ, no matter how needed it may be. We will work closely with schools and teachers serving diverse populations to learn how to prevent such rejection. We want the knowledge-base to include those materials that will positively induce its adoption. We want the tools we provide for its use to be simple and effective in order not to activate resistance.

The project in broad outline: Reorganizing the processes of curriculum development

How can advanced information technologies transform curricula and curriculum development? How do multi-media, electronic technologies differ from traditional print technologies? Existing curricula rely more on text for presenting intellectual content than will be necessary with multi-media technologies.

With text, powerful strategies for engaging the interests of students are unavailable. A multi-media curriculum will be free of these limitations. In addition, however, less apparent differences between technologies will emerge. What we propose will take advantage of these in a significant way.

In traditional curriculum development, intellectual content and pedagogical form combine in the tangible objects of textbooks and related materials. The textbook contains the information about a subject that a student should learn. In addition, it conveys the instructional regimen through which the student should learn the content. One text has performed two functions: providing intellectual substance and proffering instructional aid. Developers of instructional texts must research, select, and package the content. They must also determine the "scope and sequence," the strategy of its presentation. With these tasks merged in the physical text, the tangible materials serve simultaneously as source of information and as tool of instruction. To change their instructional plan, developers must rewrite the intellectual substance of their curriculum. To change the material their text includes, they must revise their instructional routines. This severely limits instructional experiment while it inflates the cost of instructional materials.

Would it be better to keep intellectual content and instructional design independent? With such a separation of functions, one thorough, comprehensive articulation of content could serve many instructional designs. Changes in instructional design would not then require the recreation of all the content. As a result, instructional designers could better adapt emphasis to changes in the public agenda. They could better correlate subject-matter to the cognitive styles and needs of students. They could better vary the modes of access to materials. Such a functional separation between the organization of subject-matter and the design of its presentation would, of course, be difficult with printed curricular materials, but it may be easy and natural with electronic materials.

We propose to empower this separation between intellectual content and instructional strategy by creating a comprehensive multi-media knowledge-base. Access to this knowledge-base will transform the processes of curriculum design. With it, diverse instructional designers will be able to create curricula efficiently in the social studies and related subjects. They will be able to capitalize on the distinctive properties of multi-media, computer-based technology.

Our proposal takes account of a basic difference in the way print technologies and electronic technologies handle information. Electronic information technologies separate the medium of storage and the medium of presentation; traditional technologies do not. Traditional technologies embody information for storage and for presentation in the same object and in the same form. For example, with the textbook that the student totes to class, one physical resource both stores and presents the materials. The ink printed on its pages stores the text's content for preservation from day to day. The same ink on the same pages presents the content to the pupil studying the day's assignment. Electronic technologies store information in materials and forms that differ radically from those that present the information to viewers. For instance, magnetic polarities on tapes or disks store the information. They completely differ from the patterns on a screen or the sounds from speakers that present the information. Thus, the multi-media computer records sound, images, and text for preservation, using representations in binary code registered on magnetic and optical media. The system does not present those sounds, images, and texts to the student by availing access to the code that stores the material. Instead, it processes that code to play the music, to display the image, or to print the text.

In this project, we aim to take advantage of these characteristics of electronic information technologies. We propose to do this by separating the processes that traditional methods have joined. Selecting and organizing the *content* of the curriculum is basically a storage process. Creating the pedagogical *strategies* to guide how students will learn the content is a presentational process. Traditionally, each textbook includes both the content and the instructional strategy. For each instructional strategy there must be a full, specific version of the content it will present. In contrast, we will concentrate on content. Our responsibility will be to furnish a complete, multi-media package of materials useful in the social studies. As a result, one comprehensive organization of content will become available to serve many different instructional plans.

One can find a simple example of separating content from presentation in good map information software. As printed maps in an atlas store geographical information in the map, unsophisticated mapping programs store information in graphic versions of maps. More sophisticated mapping programs, however,

store geographic information as abstract data, (for instance, coordinates, location types, elevations, and so on). To present it, they use retrieval and mapping algorithms, according to a viewer's instructions, to draw diverse maps on demand. Likewise, a word-processing program separates text from format. A writer can revise the content while preserving the format or change the format while preserving the content. In the same way, a program for computer-aided-design in architecture or engineering will store an object in highly abstracted mathematical form. From that data, the designer can present a plan or elevation in many variations according to the presentational algorithm he or she selects. In short, most software takes advantage of the way electronic systems separate the storage of content from its presentation.

We propose to apply this principle to multi-media software for the social studies. We will furnish a comprehensive set of multi-media materials for the social studies, an organized, usable knowledge-base worthy of sustained study. We will leave instructional design to others. We aim to provide those involved -- instructional designers, teachers, students, parents, and the public -- with an unmatched corpus of substantive materials, along with managerial tools for using them. Explanations, documents, pictures, recordings, maps, diagrams, statistics, animations, simulations: these and more we will provide. We will clear rights, check facts, chart relevance, implant links. We will integrate cultural sources with intellectual resources. This material will represent a rigorous, finite selection of data in many forms. Its scope will greatly exceed the scope of any textbook, but it will be neither boundless nor amorphous. Its sequence will be flexible and adaptable, but it will not be without discriminations between the interesting and the essential. We aim to make a generic selection of multi-media social-studies materials available to all. By concentrating on the content, we should be able to make it pre-eminent in quality and economical in price.

Participating institutions

Prime contractor in this project will be the Institute for Learning Technologies at Teachers College, Columbia University. It will concentrate on developing the over-all design of the knowledge-base and providing its core content and information management system. Teachers College will conduct the project in close collaboration with the Smithsonian Institution and the New York City Mayor's Public/Private School Partnership. The Smithsonian's collections will be a major resource in the knowledge-base for the social studies. The Mayor's Partnership will draw teachers from diverse settings into the process of selecting materials for inclusion in the knowledge-base.

* *The Institute for Learning Technologies, Teachers College, Columbia University.* In 1985 the trustees of Teachers College created this Institute with an endowment from the late Ben D. Wood. ILT promotes research and development on how to improve education through advanced learning technologies, especially multi-media technologies. In these areas, it has had projects funded by IBM University Relations, IBM Research, and IBM ACIS. In addition, it has carried out networking contracts for the Russell Sage Foundation and the National Drug Rehabilitation Institute. It has worked with WNET/Channel 13 on a multi-media design project. It has designed a multi-media financial information system for InsightGuide, Inc. The Annenberg/PBC Project has selected its preliminary proposal on "Advancing Visualization through Multi-Media" for submission as a formal proposal this Fall.

* *The Smithsonian Institution.* The Smithsonian aims to develop various means to capture and distribute to the educational community the collections within its trusteeship. Through its Office of Optical Publishing, it experiments with advanced computer-managed technologies for the presenting museum-based collections to external publics. Many collections will be of particular relevance in developing our knowledge-base for the social studies: the National Museum of American History, the National Portrait Gallery, the National Museum of American Art, the Office of Photographic Services, the Office of Elementary and Secondary Education, the Office of Folklife and Folkways Recordings, among them.

* *The New York City Mayor's Public/Private School Partnership.* The Mayor's Partnership is a new effort to link leading private schools with associated public schools throughout New York City. For this project, the key institution in the Partnership is the Dalton School, which convenes the Partnership for the Mayor. The Laboratory for Applied Pedagogy at Dalton will coordinate City-wide participation in development by diverse social studies teachers. In addition to the Dalton

School, the project will closely involve the Bayard Rustin School of the Humanities and one or more intermediate schools in Manhattan District 2. Through the Mayor's Partnership, social studies teachers working with diverse students will be able to participate designing the knowledge-base.

A full proposal will detail the extensive prior working relationships among the principal participants.

Key people and their experience

* *Robert McClintock*, Director of the Institute for Learning Technologies, Teachers College, Columbia University. Over-all charge of the project with specific responsibility for design and development of the comprehensive database.
* *John B. Black*, Chair, Department of Communication, Computing, and Technology, Teachers College, Columbia University. Design and development of expert system embedded in the comprehensive database.
* *Glen H. Hoptman*, Editor-in-Chief of the Office of Optical Publishing at the Smithsonian Institution. Design and development of the Smithsonian's contributions to the comprehensive knowledge-base.
* *Frank A. Moretti*, Associate Headmaster of the Dalton School and Executive Director of its Laboratory for Applied Pedagogy. Managing classroom-based design and development work on the project.

Key people and their institutions have had much experience applying information technologies to education, K-12. A full proposal will include details of that experience, along with those of their prior working relationships, which have been extensive.

Specific Goals

This project will result in a comprehensive, multi-media knowledge-base. The knowledge-base will provide the intellectual content for all grade levels with all types of students. Provision of this knowledge-base will be an on-going, long-term concern that will evolve with the underlying technologies. The knowledge-base will consist of intellectual contents and software for managing the selection and activation of contents. It will not, by itself, be a curriculum. To become a curriculum, one must add an instructional implementation which selects specific contents and activates them for specific purposes. A comprehensive knowledge-base that will serve many instructional implementations will provide an important curricular resource. It will reduce the cost of curriculum development while improving the intellectual quality of all the specific implementations.

To create our knowledge-base, we will organize a design and development team. Each of the three participating organizations in this proposal will bring to this team special capacities. Through Teachers College, academic subject-matter specialists and educators skilled in multi-media curriculum design will join the team. Through the Smithsonian, curators of unparalleled collections of Americana and experts in using advanced information technologies to diffuse knowledge through these collections will participate. Through the Mayor's Partnership, teachers working with a diversity of students and conditions will bring their understanding of needs and possibilities to the design effort. From such a group, a knowledge-base worthy of extended study by all Americans should emerge.

This design group will need to accomplish many specific tasks. We can explain these further in a full proposal, but we show the range of them here through a few particulars.

* *Assess existing digital media for resources to incorporate into the knowledge-base.* For instance, Microsofts's *Stat Pack* CD-ROM may include enough statistics appropriate to our knowledge-base. If so, we include it and concentrate on developing the tools needed to integrate it into our knowledge-base. If not, we need some other source of statistical data, which we may find in some other available collection.
* *Develop a compact, core resource that covers the essentials that all students should master.* Although we will scale the entire knowledge-base to fill, in due course, several DV-I discs, it should

include one which concentrates the core materials. Traditionally, working within the limitations of printed sources, excellence in the core meant weakness with ancillary materials and vice versa. Educators can now avoid this tradeoff. We will make a concerted effort to provide for two essentials for quality social studies for all. First, we will craft thorough, lucid explanations of the American land, people, and experience, documenting these through texts, images, and sounds. Second, we will develop the information management tools that will seamlessly integrate these explanations into diverse presentations.

* *Work with teachers and students to select materials appropriate for particular groups, interests, capacities*. Working within the confines of the textbook, the legitimate concerns of special interests have regrettably weakened the quality of curricula. Unable to get much of special relevance *into* the narrow text, the special interests have concentrated on getting *out of it* materials that might offend their sensibilities. The result has been bland mystification. These dynamics will work differently with our knowledge-base. Exclusion will be hard; inclusion easy. The effort to include materials of special interest to special groups will add richness, diversity to the whole. New York City diversities will be a superb resource in developing this potential inclusiveness.

* *Create mark-up conventions that will permit a single, stored resource to appear at different levels of difficulty and in multiple contexts of concern*. We aim to create a knowledge-base that makes the cultural contents of the social studies available to students, teachers, and instructional designers. To do this efficiently, we need to store materials so that the system can present them in many different ways. Take, for instance, historical statistics on American population from colonial times to the present. Different instructional designers, teachers, and students will want endless different views on these statistics. Were we to anticipate each of those views, as we would in a printed volume, we would store a separate selection of the data appropriate to each view. Instead, we can mark-up the data in one comprehensive table, enabling viewing algorithms to create, ad hoc, the particular view that a particular teacher or student may want. A major task of the design team will be to endow the knowledge-base with such full flexibility in use.

* *Analyze how to use in the social studies the special collections that electronic technologies now make easily accessible*. Up to now, the social studies have been largely a text-based inquiry, with pictures and maps serving a limited, 'illustrative' role. Multi-media technologies amplify the resources available for working with texts, but they also promise to expand the usefulness of images and sound even more. Electronic technologies make collections, once bound to a unique place, accessible independent of place. What can students learn from these collections? Which are worth including in our knowledge-base? How should we present them for study? These are significant questions our design team will need to answer.

* *Design expert systems guides to the materials contained in the knowledge-base*. Not everyone likes the teeming bazaar. The choice might be great and the prices low, but without a guide, many will fear that they will not find in the chaos precisely what they need. The fuller the knowledge-base that we create, the more we must endow it with intelligent navigational resources. If our knowledge-base is hard to use, instructional designers will develop their lessons with more limited materials that they can easily manage. If it is not easy to manage, students and teachers will resist adopting curricula developed from it. Repositories of authoritative content have always been available in encyclopedias and the like. They have been a pedagogical Casbah; we seek instead the educational department store. Our design team must develop user-resources that will enable all, as the phrase puts it, "to go with confidence."

Expected results

By pursuing these specific goals, we expect to organize a digitized, multi-media knowledge-base for the social studies of peerless quality. We will make this knowledge-base available in a series of versions determined primarily by technological constraints. Thus the constraints of CD-ROM (possibly DV-I), a 386SX CPU, VGA graphics, token ring networking, and Dos 4.x and Windows 3.x would shape Version 1.0 of our knowledge-base. The limits of the following generation of hardware and software would determine Version 2.0. With a duration of five years, the project would complete and test Version 1.0, integrating

those results into the design of Version 2.0. Version 1.0 would digitally integrate materials in multiple media -- text, still pictures, graphics, animations, recordings. We do not expect digital video to be a practical matter for Version 1.0, but it will a key addition to Version 2.0.

Evaluation Process

We will evaluate our project by testing in practice the basic proposition on which it stands. The proposition: a quality knowledge-base developed independent of specific instructional implementations will be of inestimable value in improving the quality of education that children receive. Evaluation of this proposition will come as we work with groups designing technology-based programs in the social studies. They will tell us whether our effort has been useful and effective, whether it enables them to do a better job.

Specifically, in developing Version 1.0, we will work closely with the JHM CORP and with Dr. Don Nix of IBM Research in their instructional design projects. The "Freedom Project," a comprehensive, technology-based instructional program under development by the JHM CORP, will stress thematic coherence and a carefully designed sequence of lessons. The "Self-Expressive Learning Project," which Dr. Don Nix of IBM Research plans at the Mary Bethune Elementary School in Central Harlem, will encourage pupils to define their thematic interests as they form and express views about American historical experience.

Both projects involve the social studies but each reflects a distinctive instructional style and design. JHM's "Freedom Project" will have a well defined sequence of instructional lessons linked by clear thematic focus on the open, uncertain struggle to create freedom in history. Nix's self-expression learning project, in contrast, will be strongly student-centered, cohering around the interests that students articulate in the process of study. Although pedagogically quite different, both share the problem of efficiently mobilizing appropriate content resources. In both cases, this problem complicates achieving instructional design aims. Our project should facilitate both efforts, despite their pedagogical differences, by making quality content more easily accessible to them.

We expect, if you will, to get a "preliminary summative" evaluation in this way. Our goal in working with these two projects will be to test how well our representation of data can simultaneously provide substantive material for significantly different educational experiences. We believe both projects will find our knowledge-base very useful. This would support our new paradigm of curriculum design, indicating that a single, comprehensive knowledge-base can indeed help diverse educators create instructional experiences of unparalleled substantive richness and pedagogical flexibility.

We also expect to get very useful formative evaluation by working closely with these instructional design efforts. By separating the development of storage and instruction, efforts to improve the quality of the knowledge-base used in education can become cumulative. "This explanation isn't clear." "That information is missing." "I had difficulty using that component." "Could you provide better resources for automatically checking the information a student acquires?" "You know, we could try this if you would put in that." Through such exchanges Version 2.0 will improve, not only because the technology has advanced, but far more because our understanding of the effort will have deepened.

Costs and Cost-sharing

We expect to produce three CD-ROM discs in developing Version 1.0 of our knowledge-base. These will include subject-material materials and software tools for managing the information on those discs. Direct production costs for preparing information for placement on the discs and for mastering the discs now would be about $50,000 each. We expect to sub-contract this work to people specializing in such services. The real work of the project involves the selection of materials and the design of systems making them useful. For Version 1.0, this work will fall broadly into two phases -- one pre-production, lasting about three years, and one post-production, lasting about two years. The post-production phase of Version 1.0 equally serves as the pre-production phase of Version 2.0.

Throughout both phases important questions will be essential. What would different teachers, different students, different communities, and different families want included were they to have access to a quality knowledge-base for the social studies? What materials -- texts, images, recordings, animations,

simulations -- will best support those interests? What tools should we build into the knowledge-base to make it fully usable? The Mayor's Partnership will provide an applied laboratory and access to diverse settings for posing these questions directly to practitioners. The Smithsonian Institution will provide access to quality materials and curatorial knowledge to help select among them. Teachers College will provide the over-all design of the knowledge-base and the integration of materials and tools within it. It would be premature to supply precise budget requests. The following summaries suggest the approximate annual needs of each institution.

* *The Smithsonian Institution*. Essentially, the Smithsonian's contribution will generate four budget categories. It will need a strong commitment of effort from its Office of Optical Publishing to manage its work. Selecting materials for inclusion in the project will require the effort of curators in specialized areas. In cases, they will need further collections research in order to carry their work out. Finally, significant image capture and technical processing costs will arise.

	Summary
Project management	$20,000
Curatorial support	20,000
Collections research (images, recordings, artefacts)	15,000
Image capture and technical processing	45,000
Smithsonian Institution overhead (at 15%)	15,000
Smithsonian annual total:	115,000

* *The Mayor's Public/Private School Partnership*. The Laboratory for Applied Pedagogy at the Dalton School will maintain a key development location for the project. They will provide project management for this part of the effort and a Laboratory staff member devoted largely to it. That staff member will work closely with teachers recruited from throughout the Partnership. The teachers will participate, with pay, sometimes working with students, sometimes not, in design-development work. Their role will inform the selection of materials and tools for inclusion in the knowledge-base.

	Summary
Project management	$15,000
Laboratory of Applied Pedagogy Staff	35,000
Teacher/designers (12 at 1/5th salary each)	60,000
Mayor's Partnership annual total:	110,000

* *Teachers College, Columbia University*. The Institute for Learning Technologies will provide over-all project management. Professor Robert McClintock will direct the selection of contents for the knowledge-base and Professor John Black will oversee development of expert-system tools included in it. Each will have an advanced graduate student working closely with him as a project associate. In addition their work will generate technical processing costs in the form of document digitization and programming. Finally, project management and administrative staff costs, as well as some overall budget categories for the project such as travel, need resources.

	Summary
Professorial (2 at 2/5th salary each)	50,000
Research assistants (2 at $20,000 annually each)	40,000
Technical processing	30,000
Project management and administration	20,000
Travel, etc.	15,000
Supplies and Contingencies	10,000
Teachers College overhead (at 15%)	25,000
Teachers College annual total:	190,000
Project Annual total, Direct costs, excluding production:	415,000
Approximate production costs:	150,000

In addition to these direct costs, we seek equipment for five locations. Four of these will be classroom-type development locations, one at Teachers College, one at the Dalton School, one at the Mary Bethune Elementary School (P.S. 92) in Manhattan District 5, and one at St. Andrews School in Boca Raton, Florida. The former two will be key development locations, the latter key evaluation locations. All

four will need a server with gigabyte-plus capacity to store materials for inclusion on the CD-ROM's. These should, on the average, have about ten workstations networked to them -- PS2, Model 70's, with appropriate sound and image cards for multi-media work. Each location should also have a color projection monitor and multi-media peripherals (videodisc, videotape, etc.) integrated into the system. As digital video becomes available, we will integrate it into the systems. The fifth location will be at the Smithsonian. It should have capacities like the servers in the other locations, along with the full complement of peripherals there, but it need not have the multiple workstations attached.