MANKIND: A General Description

Abstract: In this paper we present an outline of the MANKIND project: MANKIND is an acronym for *M*ultimedia *A*pplied to *N*etworked *K*nowledge-transfer *I*ntroduces *N*ew *D*imensions. It is an ambitious undertaking that combines know-how obtained through extensive research and efforts in network based training and education with work on digital libraries and the development of the advanced WWW server system Hyperwave (formerly called Hyper-G).

CAI (Computer Assisted Instruction), CBT (Computer Based Training), ITS (Intelligent Tutoring Systems), WBT (Web Based Training) and similar efforts that have tried to support teaching and learning through (networked) computers have generally failed and will continue to do so, unless an integrated approach is taken, i.e. unless all necessary ingredients are taken care of. The MANKIND project is the first such integrated effort. Parts of it are operational and indeed in use (e.g. for distributed training for MOTOROLA employees world-wide, as teaching support at the Graz University of Technology or at Queens University [Skillicorn 1996], or as teaching and lecturing support system at the University of Freiburg [Bacher et al 1996]); other parts have been developed at RISC or are under development and yet others still in the planning stage. This paper is a summary of the main points that are being tackled by MANKIND.

1. Introduction

The history of efforts to use computers for educational purposes is over 35 years old and is (overall) a history of failures. An analysis why this is so, and why - nevertheless - new waves of efforts have started every few years (and we are witnessing another Web-based wave right now) is contained in chapter 1 of [Maurer et al 1996] and will not be repeated here.

Let it be sufficient to say that all attempts, so far, have had serious deficiencies one way of another. Some of them due to technical reasons, some due to the lack of pedagogical theories, most of them through a combination of both and the fact that no system has provided enough flexibility. None has provided a rich enough variety of learning and teaching models allowing it to be tailored towards specific subject areas and particularly towards individual student knowledge acquisition techniques.

The MANKIND project it not trying to follow a particular cognitive paradigm. Rather, it tries to provide facilities that allow the incorporation of very diverse models of knowledge-transfer. Its success will be measured by how flexible educators and students will find the system for the adoption to their needs.

The main section of this paper, section 2, contains the ”Ten guidelines for MANKIND” that we consider necessary ingredients of any integrated network based learning environment. The aim of the MANKIND project is to create an environment satisfying the ten guidelines; it is based on the currently most advanced WWW server system Hyperwave (see e.g. http://www.hyperwave.com and references mentioned later). The guidelines have been derived from much research and concrete experiments starting with COSTOC (e.g. [Makedon et al 1987], [Huber et al 1987], [Huber et al 1989], [Gillard et al 1990], [Maurer et al 1990], to HM-Card (e.g. [Maurer et al 1995a], [Maurer et al 1996], from work in digital libraries (e.g. [Maurer et al 1994], [Marchionini 1995], [Maurer et al 1995 b], [Lennon et al 1995a]) to the development of the advanced WWW - server systems Hyperwave (formerly Hyper-G) e.g. [Kappe et al 1993], [Kappe et al 1994], [Fenn et al 1994], [Andrews et al 1995a], [Andrews et al 1995b], [Andrews et al 1995c], [Maurer 1996a], and taking into account recent related work such as [Mühlhäuser 1995], [Adam et al 1995], etc.

In section 3 we will review which of the guidelines to be described have already been implemented based on Hyperwave and what the situation is like concerning the remaining ones.

2. The ten guidelines for MANKIND

In this section we present ten general theses (guidelines) that must be kept in mind when designing or evaluating an integrated teaching and learning environment. Some of them have already been analysed in more detail in LATE (see [Maurer 1996b]) which provides good background reading. Note that the ten theses presented are also seen as the basic guidelines for the project MANKIND mentioned earlier.

Thesis 1: No matter what technology is used, insights obtained for traditional courseware design both from a pedagogical and content/form point of view must not be ignored.
It is amazing to see that in current multimedia efforts based on HTML (WWW) pages, HyperCard or Macromedia derivatives and the like many of the lessons learnt (see e.g. [Kearsley 1982], [Nievergelt 1980]) on courseware design are completely neglected. Too many persons seem to believe that linking a few HTML pages together produces viable material for teaching and/or learning purposes. Whenever a substantial piece of courseware is designed it is e.g. essential that aims and prerequisites are clearly stated, that the material is well motivated, that features technically available like fonts, colour, graphics, animations, etc. are not used as gadgetry but only when helping to understand the issues to be communicated; that student interaction beyond ”electronic page turning” is essential and can often be achieved using checkpoints with feedback, built-in simulation, guided tours of material presented in one window, a second window used for guidance; that the level of the material is sufficiently concrete (e.g. through the use of examples); that the tone is personal yet not condescending, etc., etc. We refer to the literature mentioned, including chapter 6 of [Maurer 1996] for more details. However, we want to point out that most technologies allowing the creation of courseware permit the creation of both well-done and unsuitable material. They usually do not provide ”built-in guidance” to avoid at least some of the most glaring pitfalls. We consider this an important area of work, yet an area not directly addressed in MANKIND that (see below) takes an open view as far as ”authoring tools” are concerned.

Thesis 2: The production of high-quality courseware has to be made as easy as possible.
In a system like MANKIND this means basically five things. First, the system has to be open to let authors choose their preferred tools; second, techniques such as ”authoring on the fly” (a term first coined in [Maurer 1994] and successfully pursued by the group of Thomas Ottmann at Freiburg (see [Bacher et al 1996] for a concrete implementation and [Lennon et al 1995b], [Lennon et al 1994] for background ideas) has to be supported as much as possible; third, software must include simulation and interactive techniques amply investigated by RISC; fourth, statistical information and feed back from students has to be provided by the system for the improvement of materials; and fifth, courseware has to be designed in a modular way so that it is easy to update and reuse.

It is the last issue that is maybe the most important yet often overlooked aspect. It is one of the many reasons why ordinary WWW where all the structure is built into the links cannot be seen as serious candidate for sophisticated MANKIND-like systems. A more powerful WWW system such as Hyperwave [Maurer 1996] is needed to be able to structure the material into modules (called ”collections” in Hyperwave) that can be reused and updated without the need to change any links to and from them. The HM-Data model [Maurer et al 1995a] is another step in the same direction and so is HOME (see [Duval et al 1995]). It is of extreme importance that we understand that in WWW we have to replace links by structure as much as possible in the same way as we have learnt that it is essential to use structure in programs (rather than goto’s) and structure in handling data (rather than employing explicit pointers). Any person not realising that embedded links used for structuring

purposes must not be used in sophisticated multimedia networked educational environments is well advised to consult the literature to fully understand the implications of what has been hinted at above.

Thesis 3: We need guidance but not dictatorship.
Early CAI/CBT systems were often suffering form the ”tunnel syndrome”. When working through material you felt ”locked in”, scarcely able to leave a predefined route, let alone look up electronic background material, have an electronic chat with others, etc.

The advent of hypertext/hypermedia (and WWW) turned this all 180 degrees around. Suddenly, there was unlimited freedom, a spaghetti-bowl of links to be followed, the ”tunnel syndrome” suddenly replaced by ”lost in hyperspace”. Neither for teaching nor self-studies (and we return to those two separate aspects of the use of networked multimedia material in Thesis 10) do we want either of the above phenomena. For MANKIND this means three things: first, a certain amount of guidance through the material to be learnt is provided; second, at each moment in time control on where to continue rests with you, not the system; third, throughout the knowledge acquisition process the ”guided path” can be left in favour of many other activities (see Thesis 2 through Thesis 7), but in particular can be left to consult an electronic library residing in the background. Such electronic background libraries may range from a small selection of dictionaries, books, supporting multimedia material and software to very large electronic archives covering all kinds of knowledge. To be able to work efficiently, this knowledge again must be structured, and ”search scopes” depending on your personal profile must be definable, else the typical information overkill your experience with search engines on the Web is unavoidable. To fully exploit both the associative aspects of linking information and the search facilities and structure delivered by database systems, WWW systems with built-in databases are the most suitable solution for the issues mentioned, one reason why Hyperwave was chosen as basis of MANKIND.

Thesis 4: Facilities for annotations are essential.
As you are working through some material, whether it is courseware in the classical sense, an electronic book, a library of pictures or what have you, you must have the possibility to add personal notes. Such personal notes could be text, pictures, arbitrary documents or even links to other material: how often has it happened to you that you found a piece of information x that you wanted to link to information y so that on revisiting x you would find your note and the link to y but you could not do so: after all, in ordinary WWW systems you cannot add links to documents that don’t belong to you. In MANKIND - since it is based on Hyperwave - you can. And your notes (or links) are visible only to you, a group you define, or the general public, just as you decide.

Thus, annotations not only permit you to add notes as if ”writing into the margins of a book”, they allow you some customisation (personalisation), a crucial issue that is the central point of Thesis 10.

Thesis 5: Facilities for asynchronous computer conferencing are imperative.
As important as it is to be able to take notes and attach them wherever suitable, it is still more important that others can read your notes, can comment them (i.e. attach their notes to yours), etc. Thus a general annotation concept as described in Thesis 4 actually leads automatically to the important tool of asynchronous computer conferences (ACC’s).

ACC’s in their most simple version are like newsgroups or bulletin boards. However, often a better structure (to be able to follow the thread of a discussion) is preferable, even to the extent of supporting such ”networks of annotations” by tools that display a topic as icon and graphically show how many comments in any of a number of user defined categories (”supporting example”, ”counter example”, ”supporting argument”, ”counter argument”, ”generalisation”, ”special case”, ”answer”, ”related idea”, etc.) exist, what reactions those comments have provoked, and so forth. Note that annotations can be attached to a whole file (like a HTML page), or just to a particular part of text; they may be textual, but audio or video comments are equally

conceivable: Observe further that one and the same document should be able to show a completely different set of annotations, i.e. different ACC's, depending on the group of users accessing the document. MANKIND type systems will usually require some kind of identification (see [Flinn et al 1995]) to be able to distinguish various ACC's. It is also desirable to combine ACC's with mail systems. A minimal solution is to inform members of an ACC by email that new contributions have been added to the ACC. Observe that ACC's are a natural extension of (semi-public) annotations and can be a major factor in any teaching and learning environment. It is often desirable to have "moderated" ACC's to avoid the possibilities of "disintegration" of ACC's that is sometimes observable. In passing we observe that ACC's that are structured as a three-dimensional world you can walk around in to choose what interests you offer further new and attractive alternatives.

Thesis 6: Question/Answer dialogues should be possible where users need them.
In traditional CAI/CBT systems authors of courseware usually attempted to predict locations in the material that would require further elaboration (and would offer additional information if you decided you need help); or they tried to determine if you needed help by "asking questions" and reacting to the answers received.

This "static model" of question/answer dialogues is replaced in MANKIND by a much more dynamic approach. First, the system may ask you questions in the traditional sense, mainly for self-test and selection of material purposes as explained under Theses 9 and 10; secondly, and much more important, you as user can ask a question at any point as a kind of annotation: it may be a question to fellow students or to a tutor or teacher; and you may get immediate feedback if one of the persons addressed is currently on-line (e.g. if you ask a question during the official "electronic office hours" of a tutor). Observe that the "technology" for asking and answering questions may vary from text-only, to audio, video, or even 3 D, and may be affected by bandwidth, available hardware, etc. Thus, a general system should allow a "graceful" degradation where necessary.

Thesis 7: An integrated teaching and learning environment needs synchronous communication facilities.
The possibilities alluded to in Theses 5 and 6 might leave the impression that no further communicative features are required. However, numerous experiments have shown that additional functions are required.

First, there is the need for "chatting", where short individual contributions are not treated as separate documents but rather as one dynamically growing (and potentially non-persistent) document. Chats tend to degenerate often, particularly if there are more than a few participants. For this reason it is important to be able to initiate chats only with persons interested in similar topics. Typically, if you work through some chemistry material you may want to chat with fellow chemists, but not with persons currently working on Chinese literature. To be able to narrow down the set of persons potentially interested in a chat it is thus necessary to have the material in a MANKIND system systematically structured, as is e.g. possible using Hyperwave.

Secondly, chats alone are not enough. Of paramount importance is the availability of an electronic workspace (often in the form of a so-called whiteboard but in future also more and more in the form of 3D worlds populated by "avatars" presenting other persons present) that can be shared by a number of users. Typical applications include a "follow me" mode where one person leads others through some WWW pages, software package, etc., with "conversations" between the participating persons going on at the same time. Such a workspace can also be used for co-operative work (on a piece of text, at graphic design in a 3D scene, or whatever) and is particularly useful for explanatory purposes: a question concerning a particular document can be answered and discussed in detail while this document is visible to all involved.

The "ideal whiteboard" is open to all applications. I.e. you can run an arbitrary application in your whiteboard and whatever you do/see is visible to the group sharing the whiteboard with you. Unless the contents of the

whiteboard is transmitted as a movie (e.g. 25 pixel images per second) whiteboards will only handle a certain set of applications. It might be worth mentioning that the whiteboard under development for MANKIND will e.g. support most of the HM-Card [Maurer et al 1996] functionality, including animation editing and question/answer dialogues, and 3D version are likely to be added, later.

Another important way of synchronous collaboration is found in so-called ”decision room scenarios”. Typically, a topic is discussed in a strictly anonymous fashion (to overcome otherwise inherent fears of voicing unpopular opinions). Sometimes this is just done for ”brainstorming” purposes, sometimes the result may be an anonymous vote on how to proceed in a certain matter.

Thesis 8: Question/Answer dialogues should become part of the multimedia database.
As has been explained in theses 6 and 7 there are various ways how questions can be asked in a MANKIND system, and how and by whom they can be answered. While some of the dialogues (e.g. in the chat mode) might well be considered volatile (transitory) other question/answer dialogues should be archived for future use.

Typically, if a student asks a specific question and a tutor answers it, this question/answer pair should be recorded so that when other students ask a similar question later the system automatically can present the answer that might well have been given months ago! Clearly, if such a mechanism can be implemented, whatever material is at issue it will eventually be enriched by ”all possible” questions and answers to them. The difficulty clearly is how the system can recognise that question x is similar to question y. This is (almost) impossible even if x and y are text-only questions, and becomes still more intractable when x and y are formulated using spoken language. However, it has been argued in [Maurer 1996b] that by using the user’s rather than the system’s intelligence many of the problems can indeed be solved. Observe further that a piece of explanation that is soliciting many questions should probably be replaced by a better explanation, anyway!

Thesis 9: Testing and checkpoints are important.
It is, of course, conceivable that a system like MANKIND is enriched by a database of questions and answers and thus can also be used for examination purposes. To discuss the problems involved in this (e.g. from security to how the system evaluates whether a given answer is correct for questions that require more than the selection of a choice or the calculation of set of numbers) goes beyond the scope of this paper.

Note, however, that testing and checkpoints can and should be used for a variety of other purposes.

First, a pre-test can lead to selecting the proper set of ”teaching modules” in the right order (we return to this in Thesis 10). Second, material for self-testing is important for both material repetition (and hence retention) but also as indication to the users how much and deeply they have understood what has been discussed. Third, exercises - even very complex ones - are of high pedagogical value even if (as would usually be the case) the system itself cannot judge the quality of results: the system may present a number of good approaches, plus a number of bad ones - and leave further judgement to the user; the results may be checked (asynchronously or synchronously) by a tutor, or by fellow students, and students of tutors may even decide to incorporate good approaches permanently into the system. This leads to a fourth aspect, the aspect of voting and of ”anonymous discussions” much as mentioned in decision room scenarios at the end of Thesis 7.

Thesis 10: MANKIND cannot live without customisation.
The MANKIND ideas so far described present a fairly general and flexible integrated networked teaching and learning environment:

On the basis of existing modules new ”courseware” is built rapidly and with high quality; you can peruse it at your own speed, and under your complete control; you can browse in background libraries, add notes for

yourself and others, participate in discussions and votes, ask questions to fellow learners or tutors; and, in doing so, you increase the knowledge in the database and you provide important feedback; conversely, the system asks you for your participation, for completing exercises and presents tests that help you retain the material and show you your level of proficiency.

However, the most important aspect of MANKIND is still to be discussed: the aspect of customisation that makes the learning modules fit your needs: your needs will be different from the needs of others for at least three reasons.

First, different persons have different learning styles. According to the often quoted theory by Meeker persons belong to one of the three types: verbal, symbolic and visual. In a perfect environment each "module of knowledge" should exist in a verbal, a symbolic and a visual form. Depending on the individual learning and retention style (that can be determined by appropriate pre-tests) you should always receive modules that correspond to your learning style, a style you may wish to "override" once in a while. Even within styles there are differences.; you may prefer text to be visually displayed or spoken; often a few written words but a fuller audio explanation (if selected) may be the most desirable mode - particularly if you use the material not for self-study but e.g. for teaching others (in a classroom situation with a videobeam).

Second, different persons have different backgrounds. Learning material has to be broken up into very small modules. Intensive pre-tests should be used to determine which modules are useful in which order. This combination of modules depending on the person's background is only possible if links between modules are not part of the modules but e.g. available as structural information or such.

Thirdly, the environment (equipment, bandwidth, location of equipment, ...) and how it is going to be used (by a teacher, a student, a group of students, ...) will also influence the kind and format of the material applicable.

Putting this together, learning environments without customisation facilities can never provide satisfactory solutions. In a WWW environment this means that ordinary servers won't suffice unless an exorbitant amount of scripting is done. Hence the more powerful WWW solution Hyperwave was chosen as basis for MANKIND.

3. Summary

In section 2 we have presented ten theses; ten essential ingredients that we believe are minimal requirements for a solid integrated networked teaching and learning environment.

The ten theses are quite open-ended. Much work will have to be invested to achieve the points discussed, and many details (see e.g. [Maurer 1996b]) have not even been mentioned. However, a concrete attempt to implement a system such as MANKIND is a realistic undertaking. By combining Hyperwave [Maurer 1996a] and HM-Card [Maurer et al 1996] theses 1-6 and 9-10 can be implemented in first versions rapidly (and are indeed in successful use) while theses 7-8 could be ready in a preliminary form within a year's time.

4. References

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