# Media or Medea Society? Learner and Learning Technology as Full Partners

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## Abstract

*In this paper we will take a closer look at the relationship between users and New Media — in particular at learning technology. Our starting point is that New Media have a lot of potential, but for eLearning the expected lift-off hasn't taken place yet, a problem that is being tackled by the evolving learner-centered technology. We may ask under which conditions such a relationship becomes compatible (i.e. yielding a positively connoted Media Society) or incompatible (i.e. resulting in a so-called Medea society in analogy to the tragic ending of the Greek tale about Medea's and Jason's relationship). We argue that the recent stress on placing the learner in control is necessary but not yet sufficient as it addresses the relationship between learner and learning technology as a one-sided partnership: only the user's status is lifted to a true partner. Therefore, we are arguing for a full partnership. In particular, media designers should set the interaction frame in such a way that mutual partnership can evolve. We discuss three math learning environments and their underlying models to illustrate the connection between full partnership and interaction frame.*

## 1 Introduction

New Media evoke (unspecified) fascination for their broad overall potential. Its "magic" is mostly due to the fact that the computer is considered as universal media machine that enables the user to do actions she has never before imagined. In terms of automation and variability, this effect helps people to perform better, faster, and with a broader action radius, the "empowerment of the user". The growing societal and individual inclusion of New Media into everyday life is sometimes coined as "**Media Society**".

In reality though, New Media also disappoint. The New Media hype especially in eLearning is dwindling; e.g. media pedagogue Werner Sesink proclaims that "*eLearning is almost out again*" [Sesink, 2004, p.116][1] because designers' and users' expectations weren't fulfilled in the way it was anticipated with the universal medium.

New learning technologies try to overcome the gap between New Media's potential and actual usage by focusing on learner-centered technology, that according to eLearning guru Stephen Downes "*is more than just adapting for different learning styles or allowing the user to change the font size and background color; it is the placing of the control of learning itself into the hands of the learner*" [Downes, 2005]. This is not about the properties of the interface, but the status of the learner in the interaction design.

We interpret this movement — in analogy to Web 2.0 recently called *E-Learning 2.0* [sic] — as a transformation of the interaction process between New Media and the user into a "social relationship".[2] The learner is now taken seriously as social actor with individual, non-predictable needs for learning.

Sherry Turkle points out that in the nineties users of computers have started to "*take things at interface value*" [Turkle, 1997, p. 104], in particular that software systems are considered as social actors with which users can do business. In a successful learning environment this implies, that learners (now that they are going to be "accepted" by the software) might

[1] German quotes were translated by the author.

[2] We use anthropomorphic terminology because of its ease of use and its metaphoric ring, not because we envision New Media as autonomous living beings or Cyborgs [Haraway, 1991].

be more willing to learn with support of programs and conceive programs as teachers. But we argue that it must be taken care that the relationship between program and user becomes and stays a compatible one, especially with high initial expectations mentioned above.

A famous example of unfulfilled expectations in a relationship is that of Medea and Jason. In the Greek myth the starting point for their relationship is a legendary treasure that Jason obtains through Medea — like the power that the user acquires through New Media. The Golden Fleece, a unique treasure of princess Medea's homeland Colchis, was stolen by the Greek Argonaut Jason with Medea's magic help, after it wasn't given to him as contracted prize for a heroic deed. Unfortunately, Medea's and Jason's later marriage didn't work out and ended dramatically (as illustrated e.g. by Euripides [Harrison and Affleck, 2000]). As more and more criticism and disappointed hope is directed towards New Media, the relation between user and New Media might become incompatible, which we want to capture as "**Medea Society**".

Because of the interdependency of technology and society, captured by Sherry Turkle as "*we become the objects we look upon, but they become what we make of them*" [Turkle, 1997, p. 46], we are interested how we can tip the scale between "Med*i*a or Med*e*a Society?" towards the first. In particular, we are interested how we as designers can support a compatible social relationship (we refer to this as full partnership) between learner and learner technology and how we as users can make the best of it.

In order to understand our choices better we will contrast the interaction processes of three math learning environments based on their underlying models: MathCoach [Grabowski et al., 2004], ActiveMath [Active Math, 2000], and Cinderella [Kortenkamp and Richter-Gebert, 2004]. We have selected math as learning topic, since it is formalized enough to be fed to a program, and not pose problems in itself.

## 2 The Interaction Process as a Social Relationship

In order to interpret the interaction process between New Media and the user as a "social relationship", let us start with the sociological essentials of the term "**social relationship**" (taken from [Berscheid, 1985, p.146]): "*At the hard core of the term is the notion that two entities are in a relationship to the extent that they have an* impact *on each other, or are* interdependent *with each other in that a change in the state of one causes a change in the state of the other*". Even though sociologist Ellen Berscheid aims at a relationship between persons here, we can extend its range to general entities capable of interaction. Note, that in Max Weber's classical definition[3] the defining criterion is focusing on the intent rather than the effect of the action as he requires a minimum of *mutual orientation* of the action of each actor to that of the other(s) (see [Heydebrand, 1994, p. 6]), therefore his phrasing doesn't allow the extension directly.

A typical social relationship is that of a teacher and her students. In the interaction process between the educator and the students, she has to react very flexibly on the specific demands of each student and the class at a whole. Vice versa, each student acts and reacts as well. Here, the learning experience not only depends on presented facts in any form, but how teacher and student are able to mutually orient their actions which also depends on how they conceive each other.

We argue that the interaction process between learner and learning technology similarly effect the learning experience and that we therefore should interpret it as a social relationship.

### 2.1 Consequences for eLearning

As such, we can ask under which conditions a compatible social relationship, i.e. a **full partnership**, can be established and maintained. In particular, how can a software designer set the interaction frame to allow for it. In the following, we suggest several design requirements for eLearning systems as consequence of the reinterpretation of the interaction process as social relationship.

First, eLearning software should orient its actions towards each specific user (using the technology's potential for flexibility) as prevailing systems already do.

But, secondly, these actions have to be "overwritable" by the user in each single interaction (which

[3] as an existence of a probability of a course of social action between actors [Heydebrand, 1994, p. 6]

eLearning 2.0 is aiming at) as the interdependence within a compatible social relationship can not be predicted by a software designer and even changes over time.

This effect can often be noticed in the following situation: Imagine your computer breaks down and has to be fixed which leaves you with a two-week period without it. Probably, you won't miss the hardware too much. But what about your work environment? Theoretically, the same software available on another computer device would do the same job. Practically though, you (and the spare medium) laboriously need to restore the composition of the software packages with the exact parameterization, personalization, and customization to feel comfortable with the replacement. Unfortunately, at least in our experience, the interaction level never tops or even reaches the original one. The emergent property of this composition of abstract machines and concrete data constitutes a real (though virtual)social actor, including an affective level. The more you know how to handle this virtual actor, i.e. evaluate and act optimally according to your interaction partner's and your capabilities and needs, the more you will win in the interaction.

Thirdly, this hints at another design requirement for learning technology. In a social relationship the attitude of each actor towards the other is essential. For the relationship between learner and software in particular, it means that not only (the designer of the) software can shape the interaction process, but also the user. Otherwise the partnership would be one-sided and not a full partnership. For example, if the user's conduct doesn't allow trust towards the program she is using, then the relationship will become incompatible at some point. The issue here is not that the program should be bug-free, even though it is of advantage for the relationship. Rather we ask for a user's tolerance of its limitations as well as sensible reasons for a user to trust the program, e.g. by sensible models underlying the software.

### 2.2 Example: Math Learning Environments and their Models

In the following we discuss three learning environments for mathematics that are based on very different underlying models. In particular, we look at the interaction model, the user model, and the math model to distinguish between them. We will refer to possible resulting difficulties for the establishment of a full partnership between learner and learning technology.

#### 2.2.1 MathCoach

MathCoach (developed at the HTW Saarbrücken) is an interactive, web-based learning environment for mathematics that dynamically generates exercises and experiments [Grabowski et al., 2004] so that a learner can solve as many as she feels necessary for her understanding. The students' answers are evaluated by the system by a set of underlying inference rules and a hierarchy of solution levels.

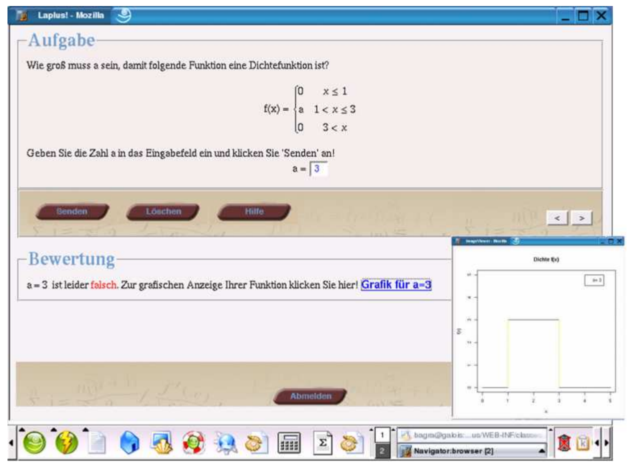


**Figure 1. MathCoach (from official website)**

MathCoach is based on a very rigid interaction model. The learner cannot control the interaction. For instance, if a student practices derivation rules and types an answer with a typo, the system won't permit a sensible shortcut. Moreover, the learner has just one way to communicate with the software: by answers. If the student feels e.g. insecure with the chain rule but solves an exercise right away by chance, the program will assume knowledge and won't help with the chain rule. The only way would be to fake an answer with a chain rule application mistake.

The math model uses simple hermeneutics and an hierarchical reasoning, so that standard problems are covered. If e.g. the standard solution to a derivation problem would be the application of the chain rule and a wrong answer is given, then the system reminds the user of the missing chain rule. The strength of the system is its flexible generation of exercises in which the correct formalization of mathematics is made use of.

In contrast, MathCoach's user model is weak, it only takes into account the last correct answer. Even though MathCoach claims user-adaptivity it really has implemented "inference-rules-adaptivity".

We believe that MathCoach's rigid interaction model can be counterproductive for a learning experience. Of course one might argue that a rigid interaction model can work e.g. in school where a teacher often determines each step a student takes. But this only works if the student is willing to subordinate to the teacher's lead. That is, the rigidity is usually balanced by other factors, e.g. the student's respect towards the teacher. Such respect might be earned by software with a superb math model that treats the student with respect. Unfortunately, MathCoach's user model is a very simple one, so that students might not be satisfied with the help they are getting. In conclusion, we see that the interaction between learner and MathCoach is too mechanical to be considered a social one.

### 2.2.2 ActiveMath

ActiveMath (developed at the German Artificial Intelligence Institute in Saarbrücken) is an interactive, web-based, semantic learning system for mathematics that integrates stand-alone mathematical service systems [Active Math, 2000]. The content is based on a variant of the semantic XML format OMDoc [Kohlhase, 2004] which allows the system to make use of the semantic structure of the knowledge. ActiveMath is user-centered in that it generates and uses individual user profiles to create user-specific courses. A user profile contains fine-granular information about a user's goals, preferences, capabilities, and knowledge. In ActiveMath, the user model of the system starts out with a personal or tested evaluation of the learner's knowledge level. This evaluation together with the implicit, semantic domain model enables the generation of an interaction model in form of a course book that the student can work through. ActiveMath keeps track of the user's click-stream to refine and update the user model in accordance to the perceived user's needs. For instance, whenever the

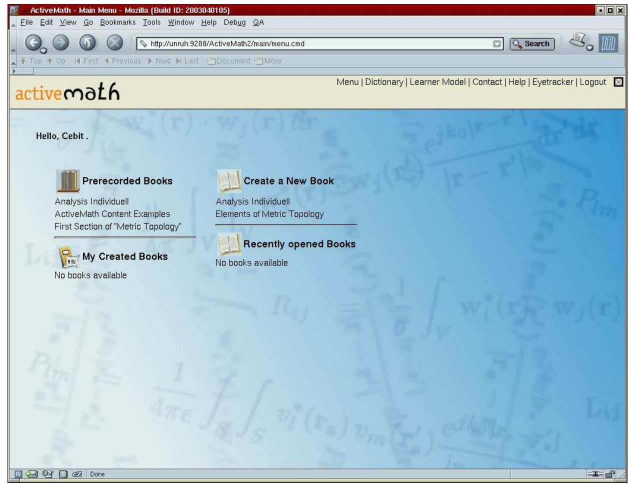


**Figure 2. ActiveMath (from official website)**

student looks at some statement long enough, the system concludes that she has learned the item in question and transfers this information to the user model. Unfortunately, if the student was just daydreaming, the conclusion was drawn incorrectly and the in next session, a new book for this student is generated base on incorrect assumptions. That is here, the user model together with the math model creates the interaction model based on (simple) hermeneutics.

In contrast to MathCoach, the ActiveMath technology is centered around the user model. Sherry Turkle found that individuals "*want to deal with technology that makes them feel comfortable and reflects their personal style*" [Turkle, 1997, p.41]. It implies, that in such an interaction frame the potential of software can be made use of, yielding the system as a very worthy partner in a social relationship. Unfortunately, ActiveMath's user model is much too simple as it has to model a complex interlocutor from a sequence of clicks. From this the system deduces - guided by just a handful of didactic rules - a customized learning future. Because of the semantic strength of the underlying math model, the content in the generated course books often covers what a student might need. So, a student might be willing to trust the software in its choices. But the interaction model assumes a linear sequence of learning steps and imposes it rigidly on the user. As ActiveMath doesn't know much about her, we fear that the system often misunderstands her and she might in turn often feel bored by this style of teaching.

Boredom in a social relationship between learner and learner technology not only lowers the learning efficiency, it also wears away the technology's envisioned status as a full partner.

### 2.2.3 Cinderella

Cinderella (developed at the TU Berlin and commercially distributed by Springer) is an interactive learning environment for geometry [Kortenkamp and Richter-Gebert, 2004]. Here, the user can experiment with geometrical objects in spherical and hyperbolic geometry by constructing and experimenting with them by direct manipulation. Geometry is not only visualized by Cinderella, it can also be experienced. The action of the user is evaluated by an underlying theorem prover to give sensible feedback. The interaction model in Cinderella is

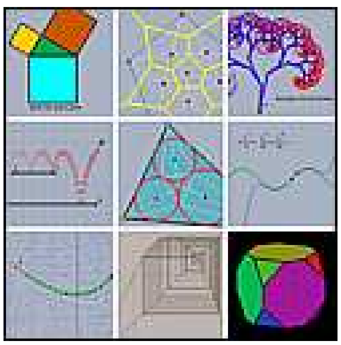

**Figure 3. Cinderella (from official website)**

guided by its underlying sophisticated math model in form of a theorem prover. For instance, if a user is asked to draw a right-angled triangle and the produced angle is obviously not right-angled, then the color of the legs of the angle change to red. In this interaction model the action of the software is solely based on the math model and leaves space for any user action. Furthermore, the interaction can be directed by the user. She can e.g. drag points around, lean back, and then watch what happens to the construction when the points are moved around. She can interfere or she might want to correct the given points right away. This is possible, since there is no interfering (judgemental) user model.

Interaction with the Cinderella system is dominated by its math model on which its theorem provers foot. As we have already pointed out, mathematics as a subject of learning is maybe the most formal one and can therefore be easily "fed" into a computer: Pure computational objects, that can be handled elegantly by the system, form the center of Cinderella. This fit allows an evocative effect on the user who is ready to experience more — either digging deeper in the specific object or heading for a new one. We believe, that this kind of openness is due to the social relationship between learner and learner technology, which offers a learner a satisfying learning experience. Their interaction process can be metaphorically compared to a dance in which one has to know and trust the other in order to fly.

Note, that the Cinderella designers decided to stay very low on the interaction- as well as the user model, so that the interferences between the models do not wash out the strength of the math model. In particular, we have seen that in MathCoach and in ActiveMath the mutual influences of the underlying models have a big impact on the interdependencies of learner and software. Here, the interferences are missing and a full partnership can evolve between the interactors.

## 3 Conclusion

In this paper, we interpret the interaction process between learner and learning technology as social relationship and explain the contrast between the potential of New Media (Media Society) and the declining usage by users (in eLearning) as a consequence of an incompatible relationship (Medea Society).

We contrasted different math learning systems and their underlying models to illustrate the effects of the social relationship between user and software. Additionally, we hinted at design consequences for learning technology in order to set an interaction frame in which a full partnership can be established and maintained. Interaction designers Jonas Löwgren and Erik Stolterman point out that " *The good of a particular digital artifact also has to be judged in relation to the intentions and expectations present in the specific situation. This means that the artifact user's competence and skills in judging quality has a great impact on how the artifact is assessed*" [Löwgren and Stolterman, 2004, p.4]. We note that a user can assess an artifact much easier, if it does not implement competing underlying models. Moreover, the emergent quality of the composition of distinct modules of a system don't always reflect the strength of each of its modules. Designers need to balance or counter-balance such emergent properties as well as the direct ones.

In conclusion, the future ("Media or Medea Society?") depends on the quality of the social relationship between New Media and the user:

> *In the beginning of the relationship, both [...] bring with them a lifetime of organized behavior sequences as well as current plans in progress. How these two sets of intra-chain activities fit together not only helps determine whether the relationship will be compatible or incompatible, close or distant, but also whether it shall live or die.* [Berscheid, 1985, p.153].

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