7 Suggestions for Better Integrating ICT enhanced Instructional Approaches into Campus-Based Higher Education

Markus Molz, Antje Eckhardt & Wolfgang Schnotz

Centre for Multimedia Applications in Higher Education, University of Koblenz-Landau, Germany
molz@uni-landau.de, eckhardt@uni-landau.de, schnotz@uni-landau.de

Abstract

The particular situation of academic teachers and learners in campus-based Higher Education today gives rise to the idea of an integrated dimensional framework for instructional design (ID). We will relate it to the potential of ICT, especially for blended learning. It is argued that the framework can become the kernel of an advisory system addressing current needs of practitioners in campus-based Higher Education by taking advantage of research evidence.

Keywords: Instructional Design, Blended Learning, Advisory System

1. Introduction

"Only a rare few master the skills required to effectively integrate technology into learning and instruction" (Spector, 2000). This is a recent alarming statement of one of the most involved scholars in instructional design, development and evaluation; still more alerting when contrasted with the analysis of the current vice-president of the International Association of Universities, that technological change and lifelong learning are among the most deep-reaching challenges for Higher Education today (Weber, 1999).

Multimedia, hypermedia, virtual reality and telematics offer an ever vaster array of new opportunities for teaching and learning in Higher Education. It is a huge endeavour however to develop and implement approaches which are psychologically sound, pedagogically effective and practically relevant at the same time.

Genuine distance education institutions and virtual universities have strategically adopted organizational, instructional and technological approaches for online learning. In need of coping with high drop-out rates and growing competition their professional teams continually improve the learning experience drawing on performance support systems, defined workflows and task specialisation.

The setting of campus-based universities however is quite different and they cannot simply copy the approaches developed for pure distance education. Blended learning approaches that combine face-to-face settings and technologically enhanced learning environments seem to be more promising for them (Kerres, 2002; Milrad et al, 1999; Olson & Olson, 2000; Spector, 2000). For organisational reasons, however, task specialisation in the development of technologically enhanced learning environments remains low. Therefore in most cases it is up to the individual academic teacher to realize such models.

Generally, in European campus-based universities there are less of the "rare few" persons adequately dealing with educational technology than necessary, and this for two important reasons. First, a lack of state-of-the-art training and support can be suspected in the majority of traditional universities. But we have to take into account that development of suitable structures, procedures and information generally exceeds the capacities of single faculties or even entire universities. Hence, interinstitutional and international cooperation is paramount, but still sparely developed in this area.

Second, "those who might reap the most benefits (educators and students) are not convinced that instructional theorists have much of benefit to offer" (Spector, 1998: 117). Unfortunately, their impression cannot be discarded as misleading. Prominent scholars in instructional theory and research in Europe and the United States agree that there are serious shortcomings in the field. It suffers from a lack of coherence, integration and service-oriented dissemination of its results. Important joint efforts need to be undertaken in order to bridge the theory-practice gap from the research side (Duchastel, 1998; Niegemann, 2001, Reeves, 1999; Seel et al, 1998, Spector, 1998, Tennyson, 1994a).

"What is more amazing than the wealth of educational resources that we have produced and accumulated is how far we have *not* come in improving learning and instruction" (Spector, 2000; italics by the authors of this article). This is another dramatic conclusion if we take into account the amount of funding educational technology has taken advantage of and still does.

In this situation we consider two huge tasks as being essential for substantial improvements: (1) strategically integrating instructional design theory in a coherent conceptual framework and (2) transferring knowledge from research into practice combined with feedback from practice. In the following chapters we will introduce ideas on how these two tasks can be tackled drawing on the already existing body of knowledge.

2. ID and ICT in Higher Education

"While technology is decidedly the driver of this evolution, the principle challenges we face in ensuring the design of optimum systems lie not in technology itself, but rather in the realms of learning psychology and instructional design (Duchastel & Lang, 1995: 56).

There is sufficient evidence to share this perspective. From our point of view three important and heavily debated questions can be derived from it:

- Which are the crucial ID decisions linking instruction to learning?
- What are the variants of ICT use in Higher Education?
- Where are the links between ID and ICT?

We will deal with these questions in the subsequent subchapters by summarising our view of the state of the current discussion through minimal necessary distinctions, and by suggesting directions of further development.

2.1. Dimensions of ID crucial for learning

ID is quite a complex process requiring decisions conceming many issues on several interrelated levels. Therefore ID-models are helpful devices for practitioners provided that there is research evidence that their prescriptions really result in what they pretend to bring about. There are important barriers, however, substantially impeding the desired and desirable impact of ID-models on actual teaching and learning practice in campus-based universities (and beyond):

First, there is a confusing number of different ID-models (Dills & Romiszowski, 1997; Reigeluth, 1999a; Ryder, 2002; Seel et al, 1998, Tennyson et al, 1997). Evidently they have blind spots, fuzzy zones, and overlaps, but systematic comparison of value for practitioners is still lacking (Duchastel, 1998). Second, even with these many ID-models often none of them fits exactly to the given situation. As scope and conditions of use are generally unspecified or underspecified (Duchastel, 1998), it is actually hard to know how to combine different models or parts of them, and whether parts cut apart from the rest still work.

As a consequence it can be presumed that more often than not academic teachers don't explicitly use any of these models in their ordinary practice, and if ID-models are used than rather in an eclectic manner and an unsystematic associative way.

There are three perfectly complementary ways to uncover the real impact components of instructional models have on learning under different conditions. The first reductionist one is to submit single features to comparative empirical testing in controlled laboratory settings. The second, more holistic one is to realize complex design experiments or development research including practitioners (Reeves, 2000, van den Akker, 1999). The third one is to systematically analyse and compare instructional design models, their prescriptions, explanations and empirical evidence.

We would like to outline the third alternative in more detail because it is the least pursued for the moment being, even if design experiments are rarely conducted as well (Reeves, 2000). Our main hypothesis is that the multitude of ID-models hides a much smaller set of universal dimensions of fundamental design decisions. These decisions have to be made in any case, be it explicitly or implicitly, following a particular ID-model or not.

First of all hierarchical levels of design decisions have to be differentiated, where upper levels are defining constraints for lower levels, and lower levels are specifying features in the pre-existing frame set by upper levels. As an alternative lower levels can trigger expansion of the preliminary frame, or inductively generating a new frame. The process is top-down and bottom-up until reasonable fit of all layers to each other is reached.

We differentiate between three layers, consistent with the most simple systems capable of cybernetic regulation. We will indicate a static and a dynamic aspect, and we add the sources from which the main insight stems for each layer:

1 strategy layer: basic ID-decisions and sequencing of instructional event modules, including performance assessment consistent with instructional goals and strategies (insight coming from developmental psychology, assessment research and expertise development research).

2 information layer: content segmentation, clustering and sequencing (insight coming from domain knowledge and task analysis, see Jonassen et al. 1999).

3 presentation or operation layer: selection and combination, design and sequencing of formats, codes and modes, plus, if necessary, screen and interaction design (insight coming from universal laws of human perceptual and cognitive processing on the one hand, and aesthetic and cultural aspects on the other).

Existing ID-models already diverge because they stress different layers. Elaboration theory (Reigeluth, 1999) e.g. is strong on content sequencing, fairly good on strategy and poor on the presentation questions. The cognitive apprenticeship approach (Collins, Brown & Newman, 1990) is very well developed on strategy in all phases of the instructional process, but relatively indifferent about the other two layers. The theory of multimedia learning (e.g. Mayer & Moreno, 2002) derives prescriptions for the presentation layer from what has been found in cognitive psychology about processing multiple representations, quite independently of any specific content or instructional strategy.

Hence, ID-models can be split in what they prescribe (or omit to prescribe) on each layer, and only then be submitted to comparison on one layer at a time. Comparisons are crucial for advancements in instructional design theory and its dissemination, because shared conclusions as well as contradictions or lack of evidence can only be detected in this way.

Analysis should include the prescriptions per layer, the conditions under which any prescription holds true, the theoretical explanations given, why any prescription is considered to promote learning, and the supporting empirical evidence. The analysis can be done on the basis of the publiccations presenting an ID-model and the related empirical research, additionally including prominent examples of implementation. It should be complemented and validated through a questionnaire study addressing the authors of ID-models directly, or instructional designers with experience of using a particular model. The questionnaire needs to be constructed in a way allowing representation of both the universal and the unique aspects of a model.

We modestly started this research programme recently by analysing eight theoretically founded and widely used ID-models (for more details see Molz et al, 2002) in order to get a first grip on basic dimensions of instructional strategy decisions (first layer). The goal was to come closer to a framework potentially more widely applicable and more easy to communicate to practitioners than the current panacea of dozens of ID-models. The models considered in detail were:

- direct instruction (Engelmann, 1997)
- elaboration theory (Reigeluth, 1999a)
- inquiry teaching (Collins & Stevens, 1983)
- cognitive apprenticeship (Collins, Brown & Newman, 1990)
- instructional transaction theory (Merrill, 1999)
- goal-based scenarios (Schank, 1994)
- anchored instruction (Bransford et al, 1990)
- learning communities (Bielaczyk & Collins, 1999)

In order to determine dimensions of instructional decisions we have adopted an iterative procedure. On the one hand we have induced self-ascribed characteristics from the above set of ID-models, and determined which more general design issue they concern. On the other hand we couldn't but keep in mind the well-known and long-lasting debates in educational research and instructional design following the advancement of constructivist thinking.

The result is what we call the knowledge space and the participation space of instructional strategy decisions - following Sfard's (1998) two metaphors of learning: learning as knowledge acquisition and learning as increasing participation.

The knowledge space of instructional strategy decisions is composed by the following three bipolar dimensions:

- explicitation – automatisation
- contextualisation – decontextualisation
- canonical – problem-oriented knowledge organisation

The instructional strategy decisions concerning participation have to be made along the following three dimensions:

- one-way – multi-way interaction
- external regulation – self-regulation
- receptive mode – productive mode

The dimensions are independent from each other. In each dimension in both spaces the instructional designer respectively the learner himself (in the more self-regulated case) can choose more extreme or more median positions. For each successive instructional event module the precedent instructional strategy decisions can be revised or reproduced.

The next step in our approach consisted in mapping the characteristics of each model considered to sections of the dimensions. This has been done tentatively by the authors first separately and then jointly until consensus was reached. The comparison of the above mentioned ID-models on the six dimensions have produced the following general results:

On each dimension there are similarities, overlaps and differences, depending on the models compared. So, each dimension contributes to the differentiation between some instructional approaches, and at the same time uncovers similarities between others. A comparison between two models in general reveals some similarities, some overlaps and some differences, depending on the dimension considered. This is a supportive argument for the singularity and potential usefulness of all the different ID-models.

There are locations in the two spaces which are not completely covered by the considered set of models. It remains to be further investigated whether models not yet submitted to dimensional analysis will fill these gaps or whether there is potential for learning not yet exploited by instruction. From our point of view there is no a priori reason to exclude combinations of strategic decisions not yet merged into an ID-model.

Taken together a few models already suffice to cover the whole range on each singular dimension. If the models don't contain unnecessary features it could be supposed that the whole range on each dimension, the most opposed extremes included, have valuable contributions to offer to learning. It remains to be clarified however under which conditions which instructional approach is most adequate.

This brings us back to the absolutely necessary linking of the results of situational and goal analysis to instructional decisions. Furthermore they need to be backed by explanative elements from one learning theory or another. These are the very foundational but often forgotten concerns of instructional design theory (Gagné & Briggs, 1979, Tessmer & Richey, 1997). Tennyson (1988, 1994b) is one of the rare scholars advancing this type of work for a good deal of time now. In the future it is of the utmost importance for the relevance of instructional design to deepen and refine it, and formalise its results in falsifiable rules.

Up to here we tried to make evident through a first partial analysis of the design variables of the first layer how we would suggest to proceed on the other two layers and on the side of the conditional variables as well. The overall goal is to create easier conceptual access for practioners to ID compared to the opaque range of ID-models and their different vocabularies and various scope. We claim that this goal can be reached without diminishing the differenciations necessary to tune instruction to learning.

2.2. Dimensions of ICT relevant for education

There are various suggestions for taxonomies of ICT use in Higher Education (e.g.; Bonk et al., 2000; Paquette, 2001). In order to put it most simply for practitioners without missing the essentials we tied them down to two basic dimensions: the physical – virtual continuum, and the information product – communication process complementarity, communication being either synchronous or asynchronous.

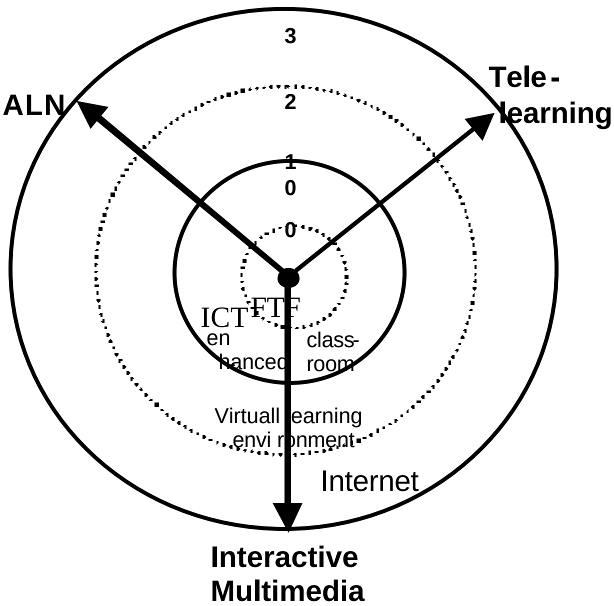

Figure 1: Types and levels of ICT use for

Figure 1 displays the various types of ICT use for educational purposes. We are starting form the face-to-face-situation (FTF) in the traditional classroom setting (level 0). Without altering the basic classroom setting instructional events can be enhanced with ICT (= level 1), e.g. by integrating already well-known (multi-)media presentations (downwards arrow), asynchronous messages as in interactive lectures (Wessels et al, 2002) with large audiences (upper left), or may be an expert invited to join per videoconferencing (upper right). These additional possibilities allow for more flexibility, more variety and better use of cognitive capacity, with potentially positive effects on motivation and understanding.

On level 2 an organised and circumscribed virtual learning environment is involved, either with multimedia or hypermedia information resources or interactive educational programmes (arrow downwards), with e-mail, newsgroups and commenting / rating of documents of others (upper left), or chat respectively videoconference utilities (upper right), or diverse combinations integrated in a platform. Level 3 is the Internet with all its opportunities and pitfalls. Moving downwards we come to the largest interconnected multimedia library of mankind (and an even larger collection of useless, ridiculous, misleading or harmful information). Moving to the upper left means asynchronous learning networks (ALN) or virtual communities with members all over the world sharing particular interests and working with advanced collaboration tools. And last but not least moving to the extreme upper right means distributed synchronous Tele-learning, e.g. through desktop videoconferencing or desktop sharing.

The FTF campus setting can become enhanced with either level of virtualisation 1, 2 or 3, or several combinations, and in either direction, multimedia / hypermedia information, asynchronous communication or synchronous communication, or several combinations thereof. Different blended scenarios can be derived from this picture, combining levels 1, 2 and 3. In the first blended scenario the virtual becomes part of the classroom experience during FTF lectures and meetings. In the second scenario physical presence can be complemented by learning tasks to be accomplished in the virtual realms between FTF sessions. And finally a curriculum can be built combining traditional or technologically enhanced FTF courses on the one hand and 100% virtual courses on the other. But there are as well blended approaches which operate the other way round. With presentation recording e.g. FTF lectures can be quite quickly transformed in net-based materials (Kandzia, 2001).

Even if the proposed framework allows to derive the different possibilities of blended learning the question remains which approach should be used for which purpose? This will be dealt with in the next subchapter.

2.3. Relationships between ID and ICT

For two decades there has been a controversy on the question whether media influence learning (a summary can be found e.g. in Tennyson, 1994). It seems to us that there are no substantial contradictions if, once more, levels to which statements belong are properly differentiated.

On the level of cognitive processing there is in fact impressive evidence that media cannot account for differences in learning (if the still inconclusive results concerning learning styles are suspended). On this very level Spector (2000) is quite right to state: "Many have implicit faith that technology will make education better. Such faith is ill-founded". As a consequence it cannot be expected to improve learning directly by introducing new media in education.

On the content level it is clear that a particular content won't be represented in different media in exactly the same way or with the same ease. Transposition from one medium into another affects the content, or may sometimes turn out not to be possible at all. Eg. a script, a theatre presentation and a movie will differ, even if they follow the same story line. But if their specific potential is used properly they simply won't be used for the same purpose. Comparability is limited. In this respect the famous statement of Marshall McLuhan holds true that the medium is (also) the message.

On the level of instructional strategy it seems clear that media can enable or restrict the use of the best fitting instructional approach in a given situation. In general more than one medium will be able to properly support a method. In this case the least expensive can be chosen. Often the medium best supporting a method cannot be used for lack of resources, lack of competence, or lack of information about affinities between media, methods and situational constraints. On the other hand internet platforms often convey a lot of ready-made tools which are useless if no instructional function is attributed to them.

Newsgroups e.g. are an excellent tool for medium-sized distributed learning communities, but if the students personally meet each other every day on campus they will hardly be used. Videoconferencing is not the best choice for multilateral interaction but acceptable for the transmission of ordinary lectures. CBT is good to deliver standard content to an important number of individual learners. At first sight this appears to be a good deal for undergraduate studies. But a closer look reveals that CBT use requires developed competencies for self-regulated learning often still insufficiently acquired by undergraduates. Access to the Internet diminishes the need for the teacher to be the most important channel for distributing information. Complex problem solving can thus more easily be used as an instructional strategy. On the other hand new problems arise, like information overload.

As a summary it can be said that the context factors (Tennyson, 1994b; Tessmer & Richey, 1997) induce constraints on the instructional design options and the set of media which can be used, however without determining the final selection. The instructional decisions have an affinity to certain choices of use / non-use of certain types of technology and media, without determining them either. What we still need as complement of dimensions of instructional design decisions are media profiles and their own dimensional underpinning.

Every ID-model can be realised with or without ICT, even if some are regularly implemented with ICT (like goal-based scenarios). We couldn't detect any ID-model exclusively useful for ICT enhanced settings, nor did we find any model which could not be enhanced by ICT in one way or another. The decisive question remains in which cases ICT enables a desired method. If new media enable new methods or old methods better then learning may indeed start to benefit from media. After thousands of years of instruction however one is much more unlikely to invent a new method than to invent but just a tiny new tool without additional value for learning. For this reason the rhythm of improvement of learning remains much slower than the rhythm of technological innovation.

On the societal level the spread of new media undoubtedly induces social change. New tasks, new experts and new practices arise, new visions and ideals can be hold or even realised, a reorganisation of labour division and social life occurs (Debray, 1991). The acquisition of the competencies necessary to use the dominant media becomes a strategic learning goal in its own right for everybody, not less important than the acquisition of domain knowledge. This is true today for computer literacy and (multi-)media competency. In this particular case, the goal and the medium to be used coincide and precede the method. In the long run the whole set of educational goals will likely to be expanded or modified. With overall change in labour organisation the roles in the formal teaching-learning process have to be adapted as well. In all these respects media in fact influence learning, but this occurs indirectly, slowly and meshed with numerous other causal factors.

2.4. Building an advisory system for blended learning

"The design and planning of instructional systems and learning environments have not become simpler on account of advances in technology. Rather, they have become significantly more difficult" (Spector, 2000).

In campus-based Higher Education these difficulties exceed a level which can be handled on a hands-on basis. There is tremendous need of qualified support. Support can consist in reliable and up-to-date information, in training and networking opportunities, and in just-in-time performance support. Information is even more useful if integrated in performance support. We see basic awareness raising and kick-off training as an initial need, and performance support and networking as continuous needs.

We will turn to performance support as an largely unexploited possibility to promote ID and ICT in campus-based Higher Education. Performance support can be given individually by an experienced advisor or coach, or by an electronic performance support system (EPSS – Gery, 1991). As there is a shortage in personal advisors at the crossroads of ID and ICT, and coaching is not usual at universities, an EPSS seems worth considering. In fact, an EPSS is useful if

- performers have easy access to computing (true for academic staff in European Higher Education)
- computer literacy is given (basically true for academic staff)

- the task is complex (absolutely true for ID with technology)
- the task is critical (ID is indeed crucial for formal learning)
- the rate of change for the task is high (content, conditions and learners change all the time, and research evidence as well)
- the task is not extremely time-critical (preparing courses and lessons is no immediate urgency business)
- turnover rate is high (true for the majority of staff without tenure track)
- alternatives are difficult to realise (training is possible as well, but scaling while maintaining quality is difficult, an EPSS would be rather complementary to some initial training, but not dependent on it)
- empowerment is a goal (true for ID and ICT competence)
- the task is not frequently repeated (as one of the main tasks of academic staff teaching is frequently repeated, but blended learning is still considerably less frequent as long as the current transformation process lasts)
- there are complex decisions involved (true for ID)
- the system can be maintained and updated (true if universities cooperate with each other)

These criteria (Reeves, 1995) apply perfectly well to the ID-tasks with which academic staff in campus-based universities has to cope while adopting blended learning scenarios. Hence, the development of an EPSS to support teaching and learning with ICT seems well justified and the number of professionals in European universities which can be potentially addressed with such a system is impressively high.

There are different types of EPSS: expert systems, advisory systems and tutoring systems (Duchastel, 1990). Expert systems are intransparent for the user concerning the reasons which lead to a certain conclusion, and they automatically take decisions on the basis of their in-built intelligence. Tutoring systems give feedback on a simulated task and not on the real one at hand. Only advisory systems fit to the needs of ID in Higher Education. They are immediately useful for the accomplishment of the real task, providing hints, background information and feedback on inconsistencies, giving explanations on demand, and making alternatives comparable. But the decisions are always to be taken by the user himself as ultimate authority.

In the 1990s several EPSS for ID have been developed for particular purposes, like the development of online courses, of interactive multimedia programmes, or of simulations. Some have implemented one particular ID-model, others are overtly eclectic (Paquette, 1999; Spector et al, 1993; Tennyson, 1994c; van den Akker et al, 1999). None of these systems however addresses the far more numerous academic teachers of campus-based universities, which have far more modest needs, but generally far more heterogeneous situations to cope with. The goal is to enable persons with various prior knowledge in ID and ICT to generate valid instructional approaches for blended learning scenarios and to make adequate media choices.

As far as the dimensional analysis advances and the rules can be derived and formalised step by step, in time the conceptual framework will become the core of what we would like to call the online advisory system TELEMAP (standing for "teaching and learning with multimedia applications"). As an EPSS it will contain five hierarchical levels (Duchastel & Lang, 1995), which can be built successively. More details can be found in Niegemann (2001) and Niegemann et al (2002):

- basic online help (direct access to topic modules and descriptions of fundamental procedures)
- extended help (access structure follows dimensional approach, there are forms and pop-up reminders signaling inconsistencies)
- demos and examples
- customized help and training (relating to domain specific resources)
- process illustration: conditions, rules and design decisions

The content of TELEMAP will be entirely based on current research evidence, to counter misconceptions and discard unfounded advice. Development, implementation and maintenance of TELEMAP will need an interinstitutional effort which, however, can be considered worthwile because of the far-reaching benefits of quality just-in-time support and the shared costs. TELEMAP could potentially interface with a virtual community for blended learning in Higher Education.

3. Conclusion

Twenty years ago, during the early history of the personal computer and the Internet, the visionary John Naisbitt (1982) already announced the famous formula: "the more high tech the more high touch". Recently he found interest in reissueing and extending this very same basic tension (Naisbitt, 2001). Blended learning as the future of the campus-based university is promising the best of both worlds. The profound transformation towards this end has already begun. Academic teachers and learners have to be actively supported to positively cope with their changing roles, tasks and tools. They have to learn smoothly to adapt to the requirement of becoming more techie and more touchy at once.

To be able to do so, we have to dig for what is already known in scientific discourse on ID, ICT, learning and their complex interrelationships. We have to look behind and above the controversies in order to carefully salvage the essentials like a treasure. We have to clean and sort them in order to finally present them in a useful manner to the public. An online advisory system for teaching and learning with multimedia applications is a coherent way to promote blended learning at the university. It would be impossible without ICT merged with an innovative instructional approach. It becomes itself an example for what it is designed to promote: a new medium usefully enhancing and democratising a former method, best complemented with FTF training.

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