Introducing e-learning to institutions and classrooms

Contributions to quality assurance of e-education and e-contents

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***Abstract*—E-education is becoming a reality that seems, because of use of technology for teaching and learning, to be more real for students than for teachers. In this contribution we on the one hand take a look at e-learning at the mezzo-level from the perspective of educational institutions. We tried to elaborate where they face obstacles, which are they and what mechanisms they work by. We focus on human resources and human skills and see technology partly as advantage and partly as disadvantage to implement e-education. On the other hand we look at e-learning at micro-level and discuss creating of e-contents and their use in (e-)classrooms. We are dealing with technology just as much as we are dealing with required skills and competences of teachers and students.**

***Keywords*—e-learning, e-education, computer supported learning**

I. INTRODUCTION

With personalization and very user-friendly tools e-education is becoming inevitable. In beginnings of computing (and Internet) it was the schools and companies (so the teachers) those that were pushing technologies to be used for educational purposes. But recently the pressure of "net-gen" (mostly embodied as students) allows no exclusion of Internet from education. So from marketing perspective we came from e-educational overproduction to e-educational overconsumption, to a situation that is in great favour of education providers as any of their products (that satisfies minimal quality standards) will be consumed. However to have a product there still need to be some conditions fulfilled.

The fundamental objective of e-learning is to provide effective and efficient learning on demand and to assure a student a good learning experience. However, e-learning requires on both ends firm skills in handling the technology that connects teachers and students. Next to the problem of technical skills that is assumed to be bigger on the side of teachers there is a more general problem namely the question whether technology is and in which forms it is suitable for learning (and teaching) especially if we try to answer from perspectives of various disciplines, fields and items.

Beside of this, teachers need to be able to evaluate educational software and hardware so that they can make decisions about what software and hardware to purchase and how to use them in classrooms [1]. Furthermore, teachers and other authors need to be able to create effective and efficient e-contents (e.g. e-learning materials). Inadequate to the importance of the issue, there are relatively few studies addressing evaluation and efficiency of e-learning contents [2], [3], [1].

Furthermore we can observe that e-learning was from its beginnings until the emergence of the "social web" or "web 2.0" [4] in dominance of technical disciplines that were determining its quality standards and development trends [5]. With capabilities of the "social web" in education e-learning seems to have overcome technical interpretations and it needs inclusion of human and social sciences to be able to develop to e-education we face in 21st century. Herewith also the use of e-learning prolongs from more formal and technical disciplines (e.g. physics, computing etc.) to fields of most profound human and social sciences (e.g. philosophy, sociology).

In this article we will look at the problems of implementing technology into education, at problems of creating e-contents, and problems of including human and social sciences into e-learning paradigm. In the end we will try to show on solutions, how to approach e-learning and how to prepare e-learning materials.

II. DEFINING E-LEARNING AND E-EDUCATION

The rapid development of computer networks, dramatic improvements in the processing power of personal computers and striking advances in storage technology enable changes in education, providing a new and interactive means of

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overcoming time and distance to reach students. Furthermore, the development of ICT enables the changes of learning methods and the use of new learning sources.

Talking about e-education we refer to much more than e-learning which although not expressed in the term also refers to teaching. According to Steeples and others [6] e-learning covers a wide set of applications and processes, such as Web-based learning, computer-based learning, virtual classrooms, and digital collaboration. It includes the delivery of content via Internet, intranet/extranet (LAN/WAN), audio- and videotape, satellite broadcast, interactive TV, CD-ROM, Blu-Ray and more.

Gonella and Panto [7] suggested renaming e-learning that includes personal learning environments (PLE) into e-education. E-learning is namely built upon learning management systems (LMS) respectively learning content management systems (LCMS) in which the system and the teacher determine the structure and content of learning. Most frequently used of these systems are the open source tool Moodle and licensed tool Blackboard [8]. PLEs in opposite are created by students from applications and contents that are available on the web, like blogs, wikis, social networks and other applications [9].

As a wide using delivery system, web-based learning utilizes the World Wide Web (WWW) resources to create meaningful learning [10]. One of the main features of web-based learning is that it gives students the flexibility to interact with each other at anytime and anywhere through synchronous and asynchronous modes [1]. Therefore, the learning process has also been changing according to ICT development from linear to non-linear learning. For example as hypermedia web-based programs provide students with freedom of navigation, the students can develop learning paths by themselves.

The technology also enables an implementation of constructivist and socio-cultural paradigm [11]. Using instructional audio and video tools such as hypermedia learning materials, slides, videos, movies, and audio/videoconferencing, optimal implementation of electronic mail, fax, real-time computer conferencing and Web applications, gives the opportunity to increase student's activity and motivation and also enables student-to-student and student-to-teacher interaction. The incorporation of most recent topic related materials (e.g. journal articles, textbooks, popular books, case studies, workbooks) and the interactive audio or video conferencing to cost-effectively incorporate guest speakers into course curriculum, enables bringing recent and valuable knowledge to student' home.

It might sound as a paradox but PLEs that follow the paradigm of self-directed learning [12] and are based upon students' creation of own, different from teacher's reality are enabled by »achievements« of Web 2.0 that is based upon collaboration between users. The point of e-learning is, like Siemens tries to explain in theoretic but unfortunately in very mechanistic way, that students use internet links to create own networks of knowledge but do not need to remember (and mentally process) the contents as this is done in computers and can be accessed any time [13].

III. PROBLEMS OF IMPLEMENTING E-EDUCATION

LMSs Moodle and Blackboard that are like mentioned above most frequently used by educational institutions and teachers are entirely different from Facebook and resembling social networks and PLEs students use in their everyday web presence. In brief most evident differences are: LMS follows linear way of thinking, visual component is dedicated minor importance and communication function is (just) one of functions provided by LMS. Facebook is built upon associative principle, communication and visualization (for more detailed analysis of differences between LMS and PLE see the Table in [9]). Ideally the application being used every day by students should be the same as or resemble a lot the application teachers use for training. It is not development of educational tools that is to blame for the gap namely it would be no problem for technicians to adopt the tools if the pressure of teachers recognizing this problem would exist. The problem is that teachers who are in comparison to students older and have undergone more training favour the tool supporting linear way of thinking whereas younger and less trained students do not see the advantage of it. Perhaps the differences in tools mentioned above are representative for differences between teachers' and students' way of thinking. A very common teachers' argument not to use implement e-learning is that there are to many tools to pick from [14]. Teachers namely look at technologies from economic perspective and would therefore need guarantee that the (time) investments they put into getting acquainted with technology will result in being able to handle the Technology. Students in opposite use technology quite uncritically by the principle "trial and error" as their goal is to solve the problem (and not long-term competence) and for that they use what comes across.

To sum up, problems occurring in e-learning derive from differences of web use for everyday leisure and web use for learning, and from differences between teachers and students. Here we have to make a comment: When we are talking about teachers that presumably are "old-fashioned" and are able to think only linearly (and students who are "hype" and throughout associative) we are aware that we are generalizing and exaggerating and that there are "hype" teachers and "old-fashioned" students.

There are cases, but in our opinion to few, of teachers successfully implementing social networks, wikis and blogs into basis of their pedagogical activities. Talking about this we have to consider that implementation of e-learning depends on (or as Clarke and Wells put it: "is determined" [14]) by the "nature" of the course. So it would be practically impossible to use Facebook for statistics or chemistry whereas it can be a welcome tool for contributions, discussions, or group work on topics that often occur in Facebook community (e.g. social, environmental, consumption issues etc.) A further example: Podcasts (audio-recordings) are "made for" and frequently used in foreign languages training.

Considering sources for e-education first we have to constitute that classic learning represents a full time job for educational employees. Normally there is no full time post for an expert whose job would be to support, technically *and* didactically, teachers in preparing e-learning courses. Of course

there are experts who can help with educational software however they lack pedagogical knowledge to create a didactically firm course with it. And if there are individuals who are experts in e-learning (software and didactics) they usually lack time to help their peers with it. E-learning needs more than just uploading lecture presentations and references to LMS. It needs ICT-compatible contents that are joint together into a course with potential to self and group learning.

The problem of institutional implementation of e-education even grows if we recognise that institutions for education of teachers (pedagogical universities/faculties/institutes) do not have capacity to train them in e-education.

On the side of students the main problem can be derived from their opinion that e-learning is "inspire less" [9]. Therefore one of the main challenges for teachers is to produce contents in a motivating way which requires from them technical skill at least on the level of students if not higher. The problem however is that teachers are in practice less technically skilled than students so it appears hard for them to make motivating contents. Moreover teachers feel insecure to be in such an inferior position as they are used to be dominant in the class. As a consequence teachers feel insecure especially as they cannot rely on their knowledge that would enable them to use technology in the moment and in the way they need it [14]. In technical skills and technical "self-confidence" we might also look for the reason that many teachers are by default against e-learning and that they show up at e-learning workshops.

So if an institution has no human resources to implement e-education it could release financial resources for outsourcing of these tasks. A middle way is to create faculty centres for e-learning, like many universities did. External colleagues and experts from these centres support development and execution of e-learning at university. Like already mentioned we cannot expect from teachers to be experts in e-course and e-content development so they need support, help and consultation to be able to use ICT for instruction. As we have traditional print shops that design and print handbooks and handouts we need now "multimedia" print shops that will enable e-content creation and e-learning implementation.

IV. Problems of E-Learning in Humanities

As already mentioned the e-learning academic discourse has until recently been a domain of technical disciplines (informatics, automatics etc.) therefore it lacked notions from human and social sciences. From technical perspective e-learning is human-computer interaction and knowledge can be simplified to syntax that corresponds to computer communication. The early technology gave clear advantage to the fields that required linear way of thinking and knowledge could be presented in short audio-visual sequences. So formal disciplines like mathematics, physics, software engineering but also foreign languages could better use automated audio-visual presentation and evaluation space of LMS than more interpretative courses like sociology, literature etc.

Next to the "nature of courses" also staff from technical disciplines is less revolted towards technology than staff of humanities and social sciences. Firstly technology is their research object and secondly they saw more advantages in LMS and its capacity of multiple-choice quizzes whereas humanists had to keep on reading essays to find out how students understood the lesson.

With technology development also the role of e-education changed. LMS was supporting and/or upgrading classical learning, and social web represents a parallel reality to it. In other words LMS is (just) a tool whereas social web is a good visualization of real social and learning settings. So social web enabled human and social sciences to catch up in e-learning. Moreover if LMS was favouring technical disciplines social web and its participative applications favour human and social sciences.

V. Constructivist Theory as Basis for E- Content Design

When an institution defines problems of implementing e-education and resolves them on global level the next steps are analysis, development and design of e-learning content (e-content).

Didactical and methodological aspects of e-learning content define the effectiveness of learning. The most important factors are attention, motivation, emotions and experiences of the student [15]. The course could have been developed following various e-learning strategies, for example using method with respect to behaviourism, with the ideas of cognitive and with ideas from constructivist learning [16].

As basic strategy when creating the content, we have used the constructivist learning strategy. The basic premise of this strategy is that an individual student must actively "build" knowledge and skills in a collaboration environment and that information exists within these built constructs rather than in the external environment.

In order to develop the use of e-learning content from a pedagogical and didactical point of view, it is not enough to study the existing practice. Instead, it is necessary to have an understanding of theoretical principles of the learning process and of the ideal e-learning environment. It means that the use and design of e-learning content should be grounded in a learning theoretical approach and cannot be based only on an existing practice [17]. Lately, researchers suggest e-learning grounded on constructivist and socio-constructivist theories of learning [18].

As already mentioned, many researchers argue for the implementation of the constructivist learning paradigm in e-learning. According to the constructivist theory, articulated by Jean Piaget, learning is an active construction of knowledge. Individuals build new knowledge on previously acquired knowledge and experiences [19]. Therefore it is important to be aware of the student's abilities as well as his/her previously acquired knowledge and to stimulate his/her activity [20].

According to Vygotsky, the process of learning and cognitive development is dependent on social interaction. Students also learn through the problem solving under adult guidance or in collaboration with more capable peers [21]. Vygotsky's socio-cultural theory, however, requires the teacher and students to play untraditional roles as they collaborate with

each other. Instead of a teacher dictating her/his meaning to students for future recitation, a teacher should collaborate with students in order to create meaning in ways that students can make their own. Learning becomes a reciprocal experience for the students and the teacher.

Recently, teaching and learning process has been changing. The new teaching and learning process, based on constructivist learning theories, brings up the following shifts:

- From instruction to construction (e.g. problem solving, discovery, collaborative, cooperative learning).
- From teacher-centered, to student-centered.

In teacher-centered education, focus is on the lesson to be taught. In student-centered education focus is on the student and on the learning process. It is important to know student's previous knowledge and experiences as well as his/her needs, motivations and characteristics such as personal abilities, learning strategies and learning style [22]. The teacher and students discuss the subject and about students' understandings and their problems in learning. The student is guided to find the knowledge. However, the teacher is no longer the transmitter of knowledge. He/she is the facilitator and provides supports or scaffolds to students. Scaffolding is a recommended teaching strategy, where the teacher provides scaffolds or supports to facilitate a student's ability to build on prior knowledge and internalize new information [23].

Some changes are also in student's role. Students should be complex problem-solvers rather than just memorizers of facts. They should observe topics from multiple perspectives, refine their own questions and search for their own answers. Group work, where group members work on more collaborative/cooperative assignments, has significantly increased. The widely adopted implication of constructivist theories is that successful student should be active in an online learning environment. Therefore should teachers and authors of web-based learning courses and materials encourage activity on student's site. Students are constructors of their own knowledge. More emphasis is made on students as autonomous, independent, self-motivated managers of their own time and learning process and access to resources has significantly expanded. Furthermore, recent research findings suggest that course and content designers should pay considerable attention to scaffolding student self-regulated learning processes (e.g. goal setting, self-monitoring, self-evaluating, task strategies, help seeking and time planning and management) to ensure learning success [18].

Using all of these, learning can be enhanced with scaffolding and instructional scaffolding where the teacher provides supports to facilitate the student's development. McKenzie states following characteristics of scaffold web-based learning [24]:

- Providing clear directions, e.g. offering step-by-step instructions.
- Providing activity (e.g. keep students on tasks).
- Offering assessments to clarify expectations.
- Clarifying the purpose "Why are we doing this?" Scaffolding keeps the idea and motivation in forefront. Built around essential questions scaffolding helps to keep the "big picture" central and in focus.
- Pointing students to valuable web sources and therefore helping them to save time,
- Reducing uncertainty, surprise and disappointment (e.g. web-based learning contents should be previously tested to eliminate errors and distracting frustrations to the extent this is possible)

McKenzie's advices include pedagogical and didactical issues as well as software usability issues.

An important part of e-contents is (continuous) students' comprehension evaluation. Just like for contents the multimedia interactive environment also for comprehension evaluation offers many creative options from most frequently used multiple-choice »quizzes« to submitting own multimedia works.

Furthermore, there are some other advices an author of web-based learning content or course should follow. Chickering and Gamson believe that quality teaching and learning should encourage the student - teacher contact, cooperation among students and active learning, should give prompt feedback, emphasize time spent on task, communicate high expectations and respect diverse talents and ways of learning [25].

In e-learning content design and implementation, all these aspects should be considered.

VI. E-COURSE AND E-CONTENT PEDAGOGICAL PLANNING

Experiences at the design and development of e-learning courses has showed that teachers and trainers are mostly the people who have the skills to choose the educational models best adapted to specific forms of knowledge, identify particular training situations, and select the most appropriate forms of evaluation and maintain relationships with (and among) students [26].

Therefore, teachers and trainers should pay attention to the following activities:

- Preparing eLearning materials.
- Providing learning support (e.g. scaffolding learning) and motivation.
- Developing self-regulated learning.
- Stimulating group work.
- Promoting the transfer of learning to the concrete working situations.
- Evaluating the learning process.

In any case, every teacher should be supported by the experts at didactics of e-learning, ICT and graphical design.

A. *Planning of e-content*

The e-content is not a book translated into a web page format as many teachers mentioned. However, it should contain at least following three elements:

- Presentation
  - *publication in electronic way (PDF, HTML, XML),*
  - *multimedia (e.g. combination of text, sounds, static and dynamic pictures).*
- Interactivity
  - *links to the other web pages,*
  - *interactive animations and simulations,*
  - *interactive questionnaires,*
  - *virtual or remote laboratories*
  - *interactive hypermedia.*
- Communication and collaboration
  - *personal messages (e.g. email),*
  - *group work (e.g. videoconferencing, forum, chat),*
  - *social networks.*

In the Figure 1 and Figure 2 we have two examples of well prepared eLearning materials within an e-course (Digital Systems). On the both figures we can see a SCORM-compatible e-course that is consisted of multimedia elements, animations, interactive question with automatic feedback and the links to the external hyper video streams. On the Figure 1 we can see an example of a topic containing an individual assessment. The results can be seen (for self-evaluation) by activating the link to the flash animation.

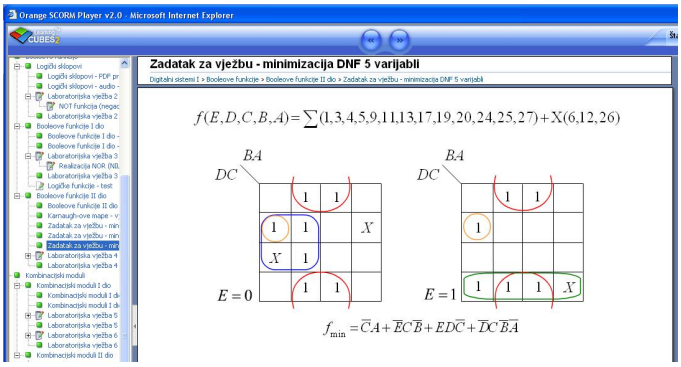

Figure 1. Example of e-content with link to flash animation

In Figure 2 we see another topic within the same course. It contains a link to hypervideo presentation of a laboratory practical that is being loaded from a streaming server.

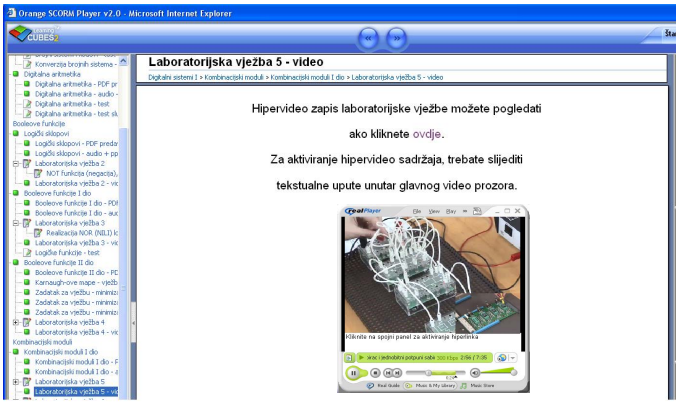

Figure 2. Example of e-content with link to hyper video presentation

As we see in Figure 3, during the planning phase the following details have to be considered first:

- learning objectives and
- the characteristics of the students (e.g. their pre-knowledge, abilities, learning type).

Furthermore, the teaching strategies and the ICT technologies together with interactive learning and communication activities should be defined. All of this defines pedagogy of e-content (Fig. 3).

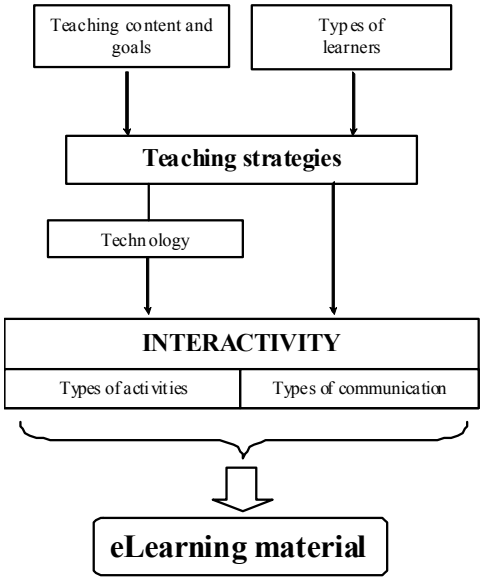

Figure 3. Planning of e-Content

Mayer claims that design effects are stronger for low-knowledge students than for high-knowledge students, and for high-spatial students rather than for low-spatial students [27]. Mayer agrees that students with higher prior knowledge seem to be able to construct a mental model of the described content also only from the text. Schnotz indicate that presenting graphics is not always beneficial for the acquisition of knowledge. Their study suggests that pictures facilitate learning

if individuals have low prior knowledge and if the subject matter is visualized in a task-appropriate way [28].

When considering the implications of the modality principle it is important to be aware of circumstances that may impact its application. These circumstances can include the capability of student's hardware to support audio, his hearing ability and whether the physical environment is appropriate for audio. Therefore the multimedia principle should be implemented considering students' prior knowledge and whether the subject matter is visualized in a task-appropriate way. The modality principle should be implemented considering the learning environment and cognitive abilities of the students.

Nevertheless we can assume that pictures related to the subject variegate the content representation and therefore influence students' motivation.

B. Communication issues

Communication and learning activity of the participant is important during e-learning course. Passive participation should be avoided – passive following and reading from the display with no interaction from users' site is not motivating. E-learning materials have to consist of interactive and communication elements, which support learning activities of education participants.

Participants can use synchronous and asynchronous communication tools, audio and video sequences (at most 2 or 3 minutes), animations, pop-up pages, links and simulation applets, which are supporting participant's activity. As additional features, use of virtual and remote laboratories is increasing and these encourage the use of remote laboratory exercises regardless of the laboratory location [29].

C. Assessment issues

The knowledge evaluation should be formative and summative. The technology enables automatic or partially automatic feedback. For knowledge assessment we use various techniques such as online tests, online tasks, individual or group projects, discussions. Online tests enable automatic feedback and the possibility to review the correct answers and the result (e.g. number of points, gained percentage or mark). Debates take place in discussion forums where students can exchange information, interesting links or additional examples. The teacher should moderate the discussion forum.

D. Motivation issues

For students to be motivated they need to be partly sure their engagement will be rewarded with corresponding mark and they need to recognize in their work final sense, e.g. improved knowledge and/or personal growth. In both aspects teacher's role is crucial. Whereas this is obvious for evaluating/ marking students the sense of using e-learning tools seems to be left over for solemn students' evaluation and the teacher cannot influence it. But he/she can. Firstly by using e-learning tools the teacher gains reputation that his/her colleagues lack. And secondly he/she can obviously use technology (if he/she can) for the purpose that serves the goal that is education. Like stated above the goal oriented use of technology as opposite of using it to analyse or just to use it is the way students use technology (and teachers usually don't). When students recognise a (technical) peer in their teacher who in addition is due to more information, experience and (presumably) better skills superior to them they will more likely believe into the sense of what they are obliged to do. Despite the reputation just described the teacher has to engage him/her to use technology during the course and force students to do so as well. Students see the advantage of technology predominantly in immediate feedback [14]. So the teacher has to contribute at least to forums if not to all students' activities.

VII. HOW TO BEGIN WITH IMPLEMENTATION OF E-EDUCATION?

We believe that the main problem of implementation of e-education is teachers' fear of technology respectively of technically better skilled students. Therefore we suggest that teachers start by using technology. After starting problems with implementation of technology the situation will soon develop to a satisfying level not only for teachers themselves but also for students.

With teachers that are determined (not only declared) to use e-learning technology the institution will have to look for solution in this field. In the beginning probably with own (technical) human resources. However if teachers set high pedagogical standards resources (human and/or financial) will have to be looked for outside own institution. Especially financial resources should be easy to get as there are many calls and tenders for e-learning programmes.

A reverse way that by experience is less effective is implementation of LMS on institutional level. In this case teachers get acquainted with basics of e-learning tools with the goal to satisfy management efforts of implementing e-education. They upload lecture presentations to LMS and enable students to upload their works. Quizzes (in technical disciplines) are used for knowledge evaluation. Teachers often think it is enough to create and publish e-contents but they forget that after that the process of e-learning especially from students' perspective has just begun: following students' activities, on-time answers to students in asynchronic communication, participating in synchronic communication. The teacher especially needs to be active and start threads in course forum, generate periodical (non-)obligatory activities, using social networks, evaluate the course, its contents, didactics, and results. Many teachers do not recognize forum as the basic (or equivalent to face-to-face) communication channel with students. These situation does neither satisfy teachers that believe in e-education nor does it satisfy students that expect different handling of technology for educational purposes.

VIII. CONCLUSION

In this paper we tried to explain why e-education remains at the start despite great technological developments. Our answers to the situation were lack of human and financial resources, incompatibility of educational software, and probably the most influential cause would be the gap between teachers' and students' technical skills. Moreover we came to the finding that it is not just skills that vary it is the way of thinking that prevents teachers to be closer to students' ability of handling

technology. It is the sympathy towards linear structure and the fear of losing time and energy with learning something that will run off in short time that prevents teachers to engage more into getting skilled with (e-learning) technology. On the other end there are students who engage in anything that has to do with technology without giving it more than a thought (but certainly not remorse).

Talking about the future of e-education there are lots of topics that needed research outside the context of case studies (and own teaching experience) in which many at the time occur. In practice the future of e-education is like said in the paper in the hands of teachers and their ability to come free from "technology pressure". In fact if we describe the state-of-the-art as relationship between pedagogic and technology it is additionally concerning as technology develops much faster than pedagogical approaches do. So if teachers do not catch the ride of technology it will only get harder. It was probably the easiest for those (technically skilled) teachers that used LMS as state-of-the-art of e-education. Today when students navigate in social networks easier than teachers do in university halls it is quite awkward to present a course in LMS which probably represents the last reliquary of linear thinking.

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