Interplay between pedagogy and media technology when planning e-learning

illustrated in the Virtual Glass Academy

Martin Stigmar [martin.stigmar@iped.vxu.se]
Ph.D. in Pedagogy, School of Education at Växjö University, Sweden

Rune Körnefors [rune.kornefors@msi.vxu.se]
M.Sc. in Computer Sciences, School of Mathematics and System Engineering at Växjö University, Sweden

School of Education at Växjö University, SE-35195 Växjö, Sweden [http://www.iped.vxu.se]

Abstracts

English Abstract

There is a need to raise the educational level within the European glass industry in order to strengthen the potential of development and competitiveness. The aim of the present paper is to describe the phases of planning and implementing the pilot project the Virtual Glass Academy, the results, and to discuss the evaluation. Included in the aim is also to discuss the three aspects of: why, what, and how from a multimedial as well as a pedagogical aspect. Two different methods for collecting data have been used, namely through field analyses and a pedagogical seminar. The most important result is that multimedia in combination with pedagogy can illustrate complicated processes in a new and more comprehensible way. Thus, giving the course participants an increased understanding.

Swedish Abstract

Det finns ett behov av att höja utbildningsnivån inom Europas glasindustri för att stärka utvecklingspotentialen och konkurrenskraften. Syftet med denna artikel är att beskriva faserna planering, genomförande och resultat samt att diskutera utvärderingen av pilotprojektet Virtuella glasakademin. I syftet ingår också att diskutera de tre aspekterna: varför, vad och hur ur ett multimedialt och pedagogiskt perspektiv. Två olika metoder för insamling av data har använts, nämligen fältanalyser och ett pedagogiskt seminarium. Det viktigaste resultatet är att multimedia i samspel med pedagogik kan illustrera komplicerade processer på ett nytt och mer förtåeligt sätt. Följaktligen leder detta till ökad insikt.

Keywords

E-learning, further education, glass industry, multimedia, pedagogy

Introduction

Recently, there has been a growing global interest in arranging web-based courses. Modern information and communication technology (ICT) render possible new forms of organizing teaching and learning processes, e.g. in terms of independence of time and space (Stigmar & Sundberg, 2001). Moreover new target groups such as elderly, single parents and workers in industry gain access to further education and so take part in life long learning. However, when the centre of attention has been restricted to the benefits of ICT, it has often been neglected to take into account how high-quality learning environments may be arranged. Although considerable research and practical attempts have been devoted to increase the accessibility of net based learning, much less attention has been paid to what new requirements ICT imply on users and teaching and learning methods.

The demands of having an effective, flexible and up-dated workforce increase all the time as global competition grow harder and has heightened the need for flexible learning. As a consequence within an EC pilot project named the *Virtual Glass Academy (VGA)*, 2001-2004, short module-based courses for further education have been developed. The project is focused on developing a pedagogical model for e-learning with multimedia support. The model is primarily intended to be used in vocational training of glass workers and students in vocational training, but the goal is to generalize the model and make it suitable for other target groups. This pilot project is a transnational co-operation between European research institutes, universities, industry, a vocational school, union and trade organisation in the Czech republic, England, Romania, and Sweden.

In the activity plan, as illustrated in Figure 1, the different stages of the VGA project. The field analyses and the pedagogical seminar, described later in this article, are included in the planning stage. The planning, design, production, and translation stages all together resulted in a pilot course. The purpose of the pilot course was to test and evaluate the pedagogical model for e-learning, i.e. to get knowledge about how pedagogy and media technology can interplay in the development of an e-learning course.

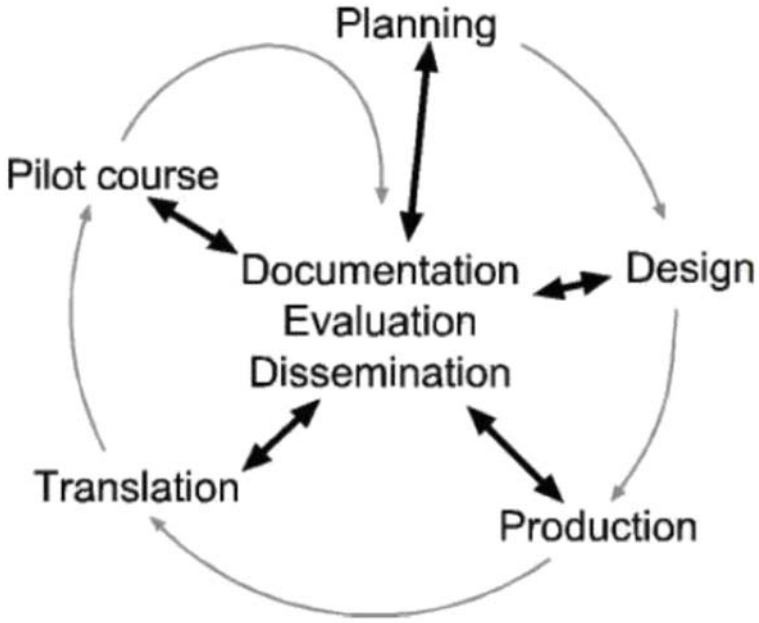

Figure 1. Activity plan for the VGA project.

The development of web-based courses has led to an increased need for interdisciplinary co-operation. Figure 2 and shows that the project brings together people with different competences, thus engaging researchers from different disciplines and traditions.

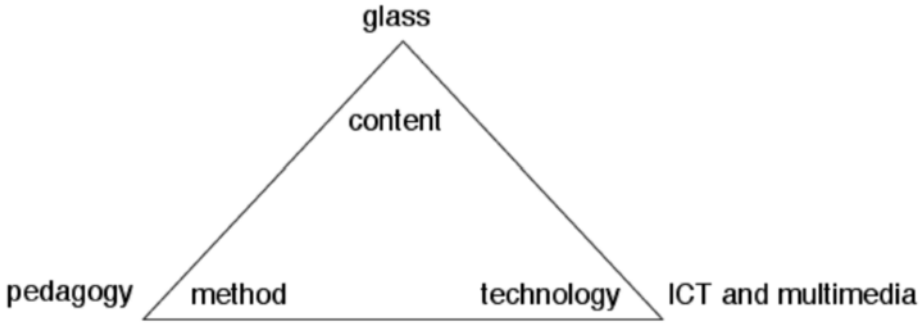

Figure 2. Three different aspects in the project: content (glass), method (pedagogy) and technology (ICT and multimedia).

Aim

There is a need to raise the educational level within the European glass industry in order to strengthen the potential of development and competitiveness. This paper thus reports on the results obtained from the pilot course within the VGA project. The aim of the present paper is to describe the phases of planning and implementing the pilot, the results, and to discuss the evaluation. Included in the aim is also to discuss the three aspects of: why, what, and how from a multimedial as well as a pedagogical aspect.

Method and consequences for the pilot course

Two different methods for collecting data have been used, namely through field analyses and a pedagogical seminar. In the VGA-project, we also considered the questions recommended by Alexander and Blight (1996), see Table 1.

Table 1. Questions recommended (Alexeander & Blight, 1996) for the first stage of planning e-learning.

Context of learning	• Who are the learners (age, experience of learning independently etc.)? • What is the most appropriate location for these learners to engage in independent learning activities (home, work, other)? • What kinds of technologies are available in those locations? • What level of technological expertise do the learners have? • What level of learner support is available in their location of learning and from the institution?
Information technology:	• Is this technology available and accessible for this group of learners? • What is the cost of this technology to the learner? • Does this technology support the most suitable learning design for this content?

	• What kinds of interaction are possible with this technology? • What level of support does this technology require? • Is this technology a viable option in this context, and does it enable the most appropriate learning strategies to be used for this particular content, and for this group of learners?
Teaching/learning design:	• What kinds of learning are needed? • What teaching strategies will best meet these needs? • What kinds of learning designs are made possible? • What kind of assessment activities do learners engage in?

Result from the field analyses and the pedagogical seminar

During the field analyses interviews were held with glass workers, college students, managers, union representatives, and employers. In most cases the interviews took place in the glass hut and lasted for approximately 45 minutes. When analysing the information, which was gathered, focus was primarily on finding out what the different partners had mutual interest in. The interviewees from all four countries confirmed the lack of further education for glass workers and consequently stressed the need for such training. Table 2 presents an overview of the findings.

Table 2. Mutual interests amongst the partners.

Aspect	Czech Rep.	Romania	Sweden	U.K.
a) Interactive and problem-based	X	X	X	X
b) Visualization and simulations	X	X	X	X
c) Collaboration in pairs	X	X	X	individually

In the text below the three mutual interests are presented and commented on.

a. **Interactive and problem-based**

   In general glass workers prefer computer based training as to traditional text books, and representatives from all four countries stressed the importance of arranging easily understood (clear and plain) computer environments that stimulated interactivity rather than inactivity. It was suggested that the different modules in the planned further education were based on realistic problems that glass workers and students are confronted with frequently. The question in focus should be why, e.g. *"why does this or that happen"* or *"why is it important to do things in a certain way"*?

   The concept of interactivity referred to collaboration between course participants in front of the computer, as well as with the computer program. The importance of continuous feedback and testing was also mentioned.

b. **Visualization and simulations**

   In order to motivate the course participants it was also proposed that practical examples were visualized. Photographs, videos and animations were suggested to be central in describing different processes. It was also emphasized that in designing virtual realities and simulations it was important to make the interactivity realistic with an evident connection to real problems.

   However, glass design is a handicraft and there are a lot of things that aren't easy or meaningful to simulate in the computer. One example is how to gather the glass melt. This is preferably learned in the workshop and is not easily simulated in a computer.

c. **Collaboration in pairs**

   Representatives from three of the partner countries (the glassworks) considered it suitable to collaborate in pairs when solving different problems in computer assisted learning. The idea of letting an experienced glass worker co-operate and help a novice and less experienced one was put forward. Nevertheless, it was also suggested that the students should work one by one at the computer to prevent annoying sharing.

   In earlier research it has been shown that students not only value feedback on their work, but also *"...high levels of participation by other students"* (Alexander, 2001, p.242). This gives us different requirements on the interaction. If the course participant is alone by the computer there should be a lot of interaction between the user and the course material. But if the students work in pairs, the course material should be presented so that it encourages discussions between them, this way they can use the computerized material and learn together.

Data collected during the pedagogical seminar

All partners were represented during the pedagogical seminar and the following aspects were accentuated as to be considered when designing the modules:

- Try to design a virtual glass factory with a virtual glass master, let the guiding-star be game-based activity in the shape of a learning adventure. Let clues and hints stimulate the need for theory and so combine theory and practice. The modules being problem-based should increase the level of motivation.
- Respect both individual learning as well as collaborative learning, and therefore arrange possibilities for electronic discussions.
- Stimulate good practice rather than correction.
- Give transparent instructions about test-requirements.

It is clear that several of the aspects that were accentuated during the pedagogical seminar also coincide

with the findings from the interviews with the glass workers, vocational students, foremen and mangers in the different countries. Some of the aspects also coincide with trends in technology for the next few years according to Kilby (2001), e.g. streaming video and 3D virtual worlds.

Consequences for the pilot

The pilot derives from the outcome the field analyses and the pedagogical seminar. Firstly, we decided the content to be glass defects. The reason for this was a mutual interest amongst all partners in the project.

At an early stage we also realized that pedagogy as well as media technology had the three questions *why*, *what* and *how* in common. To begin with in this section the three questions are related to pedagogy and media technology. Then an interactive model for web-based learning environments is presented. The final section will discuss three strategies to keep the act and the learning object together.

Why, what, and how in pedagogy

By tradition three didactical questions, see Table 3 are considered when designing goals and structure of a course, namely: *why*, *what* and *how*. The why-aspect is normally connected to the aims of education; the what-aspect is related to the content or the object that needs to be dealt with and the how-aspect is the act of learning in itself, i.e. choice of methods and media. In the present paper the relation of the last two didactical aspects will be the focal point.

Table 3. The why, what and how aspects in pedagogy and media technology.

Didactical aspect **Perspective**	**why**	**what**	**how**
Pedagogy	Motives and aims in educational settings.	The content or object of learning.	The very act of learning (methods and technology used).
Media Technology	Goals of using the program.	The content and functionality. What the user has to do in order to reach the goal.	How the content is to be presented. How to act in each step of the interaction.

Modern technology is easily brought into all sorts of different learning environments, without any deeper reflection on what and how the actual learning process could be supported by ICT. Using ICT is of high-status for teachers as well as learners and thus there is an increased risk for students and teachers to focus *"...on the act of learning rather than on the object of learning"* (Marton & Booth, 1997, p. 169). Nevertheless this is an unfortunate development as the outcome of providing learning environments with ICT might be counterproductive:

> *"Thus, focusing on the object of learning as well as and in conjunction with the way of going about it is found to produce desired approaches and outcomes, whereas separating the what from the how of learning and attempting to train the how without reference to the what is doomed to failure"* (Marton & Booth, 1997, p. 171).

In order to arrange challenging and reflective learning situations rather than trivial and mechanical, there is a need to approach the what- and the how-aspect jointly.

Why, what, and how in media technology

When designing a multimedia application, e.g. e-learning, there are a number of design aspects to consider. These include the design of the information architecture, the multimedia presentation and the human-computer interaction. Questions like why, what and how are important in the different parts of the design. However, usually other terms are used, since the meaning otherwise can be very unclear. For example, the question *"why should the program be used?"* and *"what is the purpose of using the program?"* are almost the same question, but a *"why question"* in the first case and a *"what question"* in the other. Nevertheless, the concepts why, what and how are essential, so this section will describe the aspects in media technology corresponding to these questions. An overview of the aspects is also given above in Table 3.

In information architecture the three aspects could be recognized as follows (Rosenfield & Morville, 1998, p.11): mission and vision (why), content and functionality (what), and organization, navigation, labelling, and searching system (how).

The design of interaction between humans and computers includes the design of the interface between the human and the information. In general this consists of both the hardware and the graphical interface to the information. When dealing with web-based information the interface are the web pages shown in the browser. Then the design is more of a human-information interaction than human-computer interaction.

One method used in interaction design is to do a task analysis (Preece et al., 1994, p. 409), where the goals (why), tasks (what) and actions (how) are analyzed and designed. The interaction design also includes a task allocation, where it is decided where in the program the different tasks will be fulfilled.

The aim and goal are in some situations considered as two separate questions, where the aim is to achieve the goal. In media technology these two are often treated together and sometimes just called purpose or goal. The first question a designer has to analyze is the user's goal, i.e. what the user will achieve by using the program. As an example a user perhaps wants to write a letter or learn an object. If there could be several options for the user to achieve the same goal (e.g. different kinds of word processing programs, a typewriter, pen and paper, etc. for writing a letter) it is important to consider the question why the program that is to be designed should be used. Will it be a word processor to write the letter and a web-based course to learn the object, or is something else a better solution. This is a choice of the "device" (technology) that is to be used for the goal (Preece et al., 1994, p. 412).

The why question concerns the purpose of the program and justifies the design of it. The overlaying why question, e.g. why the user wants to write a letter or learn the object of the web-based course, is not directly considered in the design phase.

In the design of the information architecture and multimedia presentation the content is considered. The question is *what* the content will be. How it will be presented (pictures, movies, animations, etc.) is not decided at this stage of the design. Furthermore, the functionality is designed, but only on a conceptual level, i.e. only what the user will be able to do and not how. The functions are also allocated to different parts of the program. This can for example be done in a scenario describing in what way the user will go through the program.

In the interaction design it is considered what the user has to do to achieve the goal. This can be called the user's tasks, which can be divided into sub tasks. Questions to ask at this stage of the design could be what are the steps in the interaction, what will the user do, what will the program do, and what will the result be?

This phase of the design is called a conceptual design, where the content and in what way the program will be used, is decided.

In the physical design it is decided *how* the content will be presented and *how* the user could act in the program. The organization and structure of the information and *how* to navigate through the program (or web site) is also decided.

In the interaction design the tasks are divided into sub tasks which are physical actions, e.g. click a button, drag an object on the screen, etc. The actions are simple tasks describing how the user can act and how the computer will respond (feedback on the user's actions).

Similarities and differences between pedagogy and media technology

The aspects why, what and how in pedagogy and media technology are sometimes used in similar ways and sometimes differently. Thus, occasionally the same words are used, but with different meanings. This can make it difficult to understand how to take advantage of all aspects in both subjects. The connection between the aspects in both subjects is not completely apparent, but Figure 3 is an illustration of the relationship.

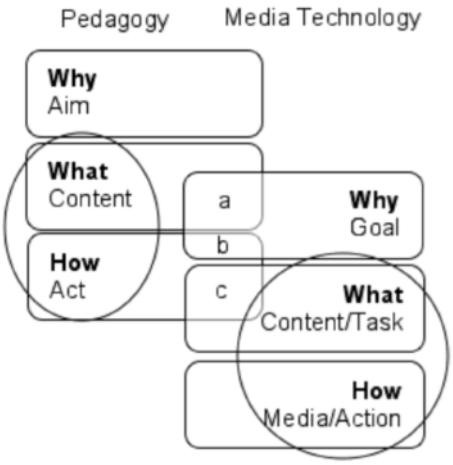

Figure 3. The relationship between the aspects why, what and how in pedagogy and media technology.

In the text below is illustrated the congruence between the what and how in pedagogy and the why and what in media technology:

- The what-aspect in pedagogy match the why-aspect in media technology. In the VGA project an example of this is that the object is to learn about glass defects. This is the what aspect (content) in pedagogy and the why aspect (goal) in media technology.
- A minor part of the how-aspect in pedagogy intersects the why-aspect in media technology. In pedagogy the how-aspect implies the usage of methods and technology. However, in media technology the choice of technology is referred to as the why-aspect. In the VGA project an example of the intersection between the two different disciplines is that of the course being given as web-based e-learning.
- The what-aspect in media technology represents what content and functionality is to be used in the program. This corresponds to the method in the how-aspect in pedagogy. In the VGA project one course module is designed as a virtual glass house and is thus an example of the interplay between the how- and the what-aspect of the two different disciplines.

To sum up, in order to maintain good quality learning outcome in web-based courses, it is imperative to consider the what-aspect in interplay with the how-aspect and not as separated aspects. Focus on only one of them jeopardize the possibility to establish high-quality learning environments.

How to design web-based learning environments based on the interplay between the *"pedagogical what - and how - aspect"*

The model presented below is based on the target group's (i.e. glass workers and college students) demand for interactive learning environments.

Teaching and learning has for long been regarded as a mere transmission of information from one point to the other using different media (Fox, 1983; Larsen, 1988; Laurillard, 1993). This out-dated view of teaching and learning has under recent years been challenged by modern pedagogical theories based on the importance of interaction. Hence, the concept of interaction frequently replaces that of learning as transmission. Interaction in this context refers to the interplay between student (-s) - teacher and medium (e.g. ICT). Figure 4 captures the modified concept of learning.

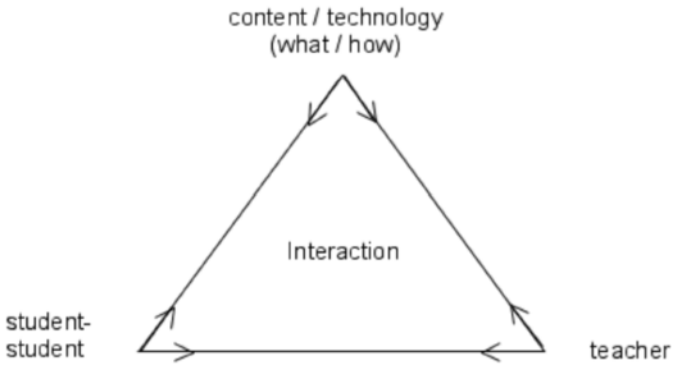

Figure 4. The central role of interaction in a communicative context (a modification of Hopmann's didactical triangle).

As a consequence of the movement from transmission to interaction, the ability to learn and re-learn by way of reflection, i.e. metacognitive competence, develop into an important learning ability. The capability to use ICT (how) in combination with a particular content or subject matter (what) will thus also grow increasingly important.

Three strategies to keep the act and the learning object in combination

New learning situations require new learner qualities and in an attempt towards defining how teachers and students should interact, Marton and Ramsden (1988) present a list of strategies. The selection of strategies presented in this article is appropriate to reflect upon when designing web-courses, trying to consider the act and the learning object in combination:

1. Present the learner with new ways of regarding learning.
2. Make the learners' conceptions explicit to them.
3. Use reflective teaching strategies.

In the text below, the three (1-3) different strategies are presented.

Present the learner with new ways of regarding learning

Modern pedagogy and the current debate on networked learning (see e.g. Kennedy & Duffy, 2004 and Rico 2003), focused on interactivity and participation, requires awareness amongst course administrators to consider what differences in the organization of a learning situation that are needed. Table 4, illustrates some dissimilarities between web-based learning and a more traditional teaching and learning situation.

Table 4. Examples of diversities between traditional classroom teaching and web-based learning.

Traditional classroom teaching	Web-based learning
a) Restricted (educational settings)	Freedom in time (spare time)
b) Spatially controlled	Freedom in space
c) Limited responsibility	Vast responsibility
d) Shared	Individual (or in collaboration)
e) Synchronous verbal human feedback face-to-face and body language	Asynchronous verbal human feedback and synchronous electronic feedback
f) Content concretion	Content abstraction

All dissimilarities presented in Table 4 have implications on how future learners in web-based courses will approach their studies. In the following the diversities are commented:

a. Traditional classroom teaching is normally restricted in time by a timetable where as web-based learning can take place anytime. Consequently web-based learning is frequently completed in the course participant's spare time.
b. In general traditional teaching is organized in a school setting and thus is spatially controlled by a classroom. Web-based learning on the contrary is free in space and is therefore often carried out at home or elsewhere.
c. The school environment and timetable were natural limits of responsibility and planning in traditional education. In web-based learning in contrast, the individual holds vast responsibility to plan his or hers own learning.
d. Traditional school settings offer shared learning experiences within the group in the classroom. It is quite the opposite in web-based learning where it is typical to study individually. However, individual studies do not exclude collaboration in web-based learning.
e. In a web-based learning situation the course participant gain from synchronous feedback from the computer but suffer the loss of the teacher's body language. Feedback has earlier been identified as the most powerful single moderator that enhances students' achievement (Marton & Morris, 2002) and accordingly justifies consideration.
f. Organizing web-courses also involve an automatic content abstraction compared to classroom teaching. To compensate for the abstraction that transforming practice into theory often results in, web-based courses often are based on animations, simulations, and visualizations, i.e. multimedia productions. Nevertheless, students unfamiliar to theoretical studies may be facing problems when

participating in e-learning.

The dissimilarities presented above have all been considered in all stages of the VGA project (Figure 1). For example the course takers have had the opportunity to take the pilot course whenever suitable and at an appropriate location. Another example, of how the dissimilarities have been taken into account, is that feedback has been given immediately by the program as well as asynchronically by a teacher. In order to limit the content abstraction we have visualized the content by use of an extensive amount of graphics, e.g. films and animations (Figure 6 and 7).

Make the learners' conceptions explicit to them

When organizing learning situations it is important to make potential course participants aware of how they conceptualize learning at large. Conceptions of learning and knowledge can diverge immensely and therefore it is essential to clarify what understandings different participants occupy. To survey different conceptions of learning is additionally vital in order to prevent misunderstandings and redundant frustration. Furthermore, a mutual standpoint between course participants and course organizers will support the learning process and enhance the process of reaching shared aims.

Marton et al (1993) have identified six different conceptions of learning with two overriding categories of how students conceptualize learning:

> *"One group focuses on learning in the context of tasks of learning (the act and the consequences of the act) whereas the other focuses on the object of learning (finding meaning through the learning tasks)"* (Marton et al. 1993, p. 35).

The first group of students (A-C) describes learning as a process of gathering facts and information from a text. Memorizing facts for later use will thus be important. The second group (D-F) regard learning as finding meaning, seeing things in a new light, they see learning as changing oneself in some way. The six different conceptions are presented in Figure 5.

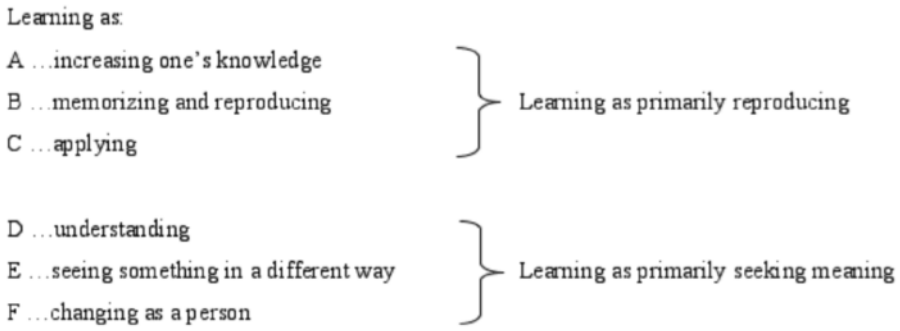

Figure 5. Summary of six conceptions of learning (Marton, Beaty, & Dall' Alba, 1993).

Dependent on how course administrators regard the concept of learning, they will organise web-based training in different ways. Consistently course participants will approach a course with certain expectations dependent on their understanding of the concept of learning. Consequently, it is important to make these understandings explicit. In the VGA pilot, it is primarily learning as seeking meaning (i.e. D-F) which are focused.

Use reflective teaching strategies

It is central to separate between study ability and learning ability (Nisbet & Schucksmith, 1988). Study ability generally means: the technique of taking notes; the importance of making underlinings; suggestions and advice how to sit when studying; how the light should be; length and frequency of pauses (Marton et al, 1977) it deals with the *external* study behaviour and is also called study technique. Study ability is applied when a *certain* limited and well-known content is to be accounted for in an examination.

Learning ability on the other hand deals with the *mental activities* (internal activities) and not just the understanding of a limited subject area but also the application of the understanding in a new context (transfer).

The reason why it is important to separate the two conceptions is that high external activity is not necessarily consistent with high internal activity. This leads to an increased risk for a mechanical and instrumental learning approach (Stigmar, 2002). Course participators tend to be characterized by low motivation and low responsibility for the learning outcome. An attempt to stimulate favourable attitudes to learning and inner mental activity is to challenge course participants with reflective questions. Nisbet & Schucksmith (1988), see Table 5, suggest that the following reflective teaching strategies are used: asking questions, planning, monitoring, checking, revising and self-testing:

Table 5. A list of commonly mentioned strategies. Nisbet & Schucksmith (p. 28, 1988).

Asking questions	Defining hypotheses, establishing aims and parameters of a task, discovering audience, relating task to previous work, etc.
Planning	Deciding on tactics and timetables, reduction of task or problem into components: what physical or mental skills are necessary?
Monitoring	Continuous attempt to match efforts, answers and discoveries to initial questions or purposes
Checking	Preliminary assessment of performance and results

Revising	May be simple re-drafting or re-calculation or may involve setting of revised goals
Self-testing	Final self-assessment both of results and performance on task

These findings suggest that study techniques alone, are not enough when applied in a web-based learning environment. As a consequence the VGA pilot aimed at stimulating the learning ability of the course taker. In the next section we will demonstrate the result of the project.

Result

The virtual environment

During the field analyses we found that most of the potential course participants didn't have much computer experience. The experience was *"surfing"* the web, paying bills over the net, and playing computer games. The students in England had some further experience, since they using computers in their education.

In all countries all interviewees had experience of computer games, we therefore decided to use ideas from adventure games. The virtual environment, Figure 6, is visualized by 3D images showing a virtual glass hut, an assignment is presented, and the course participants have to pick up the tools needed for the assignment.

Figure 6. The virtual glass hut, where the foreman presents the assignment. The course participants then pick up the tools needed.

However, we didn't implement the course as a game. In an adventure game the aim is to examine the virtual environment and find out how to do different things. The glass workers are already familiar with the glass hut and how to make glass pieces. The purpose of the course was instead to explain *why* glass defects occur and explain good practice to avoid them. Therefore we chose to have a linear structure instead of letting the course participants move around freely in the environment. The course participants go through the process of making a wine glass in a chronological order. At each stage they will get a presentation of possible glass defects that can occur.

The learning environment offers a minimum of text. Instead a lot of animations, images, videos, and voice recordings are used. There are also a lot of combined videos and animations, e.g. a work operation is first shown with a video clip from a perspective that the workers are used to, then from another perspective to be able to show more details in an animation, see Figure 7.

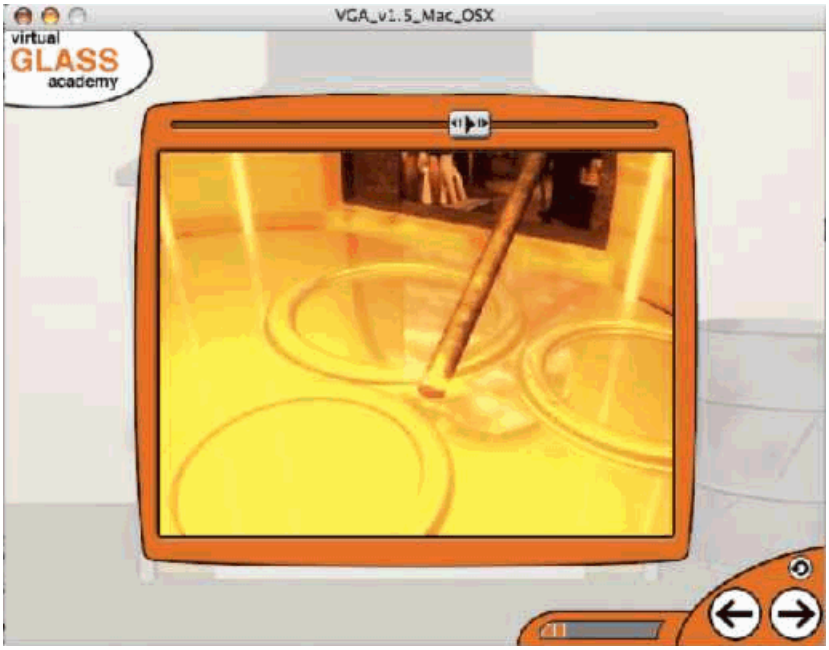

Figure 7. An animation showing the furnace from the inside. [watch animation]

At some stages we used popup questions and limited interactions. The purpose of these were to activate the course participants and encourage them to reflect on the content and discuss with each other.

All texts and voice recordings were translated into the four native languages used in the project (Czech, English, Romanian, and Swedish). The course participants chose language before starting the course module. The language files are stored separately, consequently it is quite easy to translate the course into another language.

Conclusions

The most important result is that multimedia in combination with pedagogy can illustrate complicated processes in a new and more comprehensible way, which result in a pedagogical surplus value. Thus, giving the course participants an increased understanding.

The conclusions are based on the evaluative results reported from the partners in England, Romania and Sweden. The summary is based on the following evaluative questions, answered by glass workers, students, and teachers:

1. Positive and negative things in general and suggestions for improving the module,
2. how long time did the course take,
3. what do you find positive or negative about collaborating in pairs,
4. what was the degree of difficulty,
5. did the course takers enjoy the module, if so why
6. what do you think you have learned about glass defects occurring during forming,
7. teacher comments.

It should be noted that the target group who attempted the pilot in the three partner countries varied and so might have affected the result. In England approximately 40 students participated, some individually some collaborating in pairs. A group discussion with eleven students was also held. In Romania 16 students took the pilot course . Lastly in Sweden four glassworkers, two experienced and two beginners endeavoured the pilot.

It is a difficult challenge to find a reasonable balance between motivation and enjoyment, so called *"serious fun"*. Seek as a homogenous target groups as possible, otherwise consider offering different entrance levels/levels of difficulty when the target group is disparate. Allow collaboration as well as individual studying. Express clear formative goals (not only summative learning aims). Provide immediate feedback based on multiple-choice questions. Finally, it is time consuming to develop a course with as much multimedia material as described in this paper, although several parts can be re-used, e.g. the environment, background graphics, structure, and navigation, but a new content (i.e. subject matter) must be developed from scratch. However, languages can quickly and easily be altered.

Discussion with findings linked to the initial requests

The target group asked for a problem-based and interactive learning environment and the evaluation results from the three partners undoubtedly show that the VGA-project in this aspect has been successful. It is particularly interesting to note that the course takers express their approval of the integration of pedagogy and multimedia in the module. The course takers together with teachers emphasize that video clips, graphics and images as well as the 3D illustrations work well together in illustrating the forming process. The course takers found the module to be *"...straight forward..."* and *"...very easy..."*, thus the attempt to design a learning environment based on the pedagogical ideas of *"keeping it simple"* and *"less is more"* seem to have been winning.

The module is net-based, but the module containing several large files with movies, sounds and pictures, could cause long download-times if the Internet connection isn't fast enough. Some of the project partners only had access to slow Internet connections; consequently the module was distributed on a CD. The program was installed on the course computers by the teacher in each country before the course was given. An advantage with this was that all technical problems could be taken cared of before the course participants took the course.

It is also important to note that not only is the aim of the course fulfilled, i.e. to give course takers the

chance to increase their understanding how to avoid glass defects during forming. But the interviewees also express that the training has given them a chance to reflect on why they do a thing in a certain way. This could be what is described as *"...the move from propositional knowledge ('knowing that'), towards performativity ('knowing how')..."* (Trowler, 2002, p. 14).

There was one question that was addressed to glassworkers only (i.e. not to the students):

> *"If you were to introduce a new employee, what would you tell him or her about how to avoid glass defects?"*

This question was asked at the end of the module, without demanding a written answer. The intention was to make the course participants reflect on this as they returned to work. When the question was asked again at the evaluation it could be noticed that the glassworkers had not considered this question, but the spontaneous answer was:

> *"The importance of not excluding any important steps in trying to find shortcuts while working. For a beginner it is important to try to do right from the start and not get stuck with wrong working technique which may be difficult to get rid of later on."*

According to the answers the course takers enjoyed the course in itself. The module being problem based and interactive provided for this optimistic opinion. However in England, the students found some voice recordings irritating. Similar opinions were not expressed amongst Romanians or Swedes, thus it might be a language problem.

Overall the course takers being somewhat disparate (e.g. college students, university students and glass workers in industry), caused some diverging answers. Some found the module content too undemanding, others asked for more explicit instructions. All the same, the importance of presenting *"...appropriate, specific, and challenging goals"* (Marton & Morris, 2002, p. 10) was underlined by statements like *"...it wasn't clear what was required..."* and *"...some parts of the course are not enough explicit..."*. Feedback was given by the course teachers in writing as well as orally. In order to stimulate the learners, more immediate electronic feedback was suggested to be a useful alternative.

A future course was as a consequence recommended to be more advanced or at least offering different levels of difficulty. On the other hand, accessing flexible modules which enable potential course takers to study at their own pace and when they are free to attend are very high-priced. Furthermore it is evident that studying the course individually as well as in pairs has different pros and cons. On the one hand you are free to study at your own pace and without any embarrassment if you do not understand, on the other the positive effect of collaboration in a learning context never should be underestimated, this is also articulated by all partners.

References

[1] Alexander, S. (2001). E-learning developments and experiences. *Education + Training*. Vol. 43, No 4/5, pp. 240-248.

[2] Alexander, S. and Blight, D. (1996). Information Technology in International Education, IDP, Canberra.

[3] Fox, D. (1983). Personal Theories of Teaching. *Studies in Higher Education* Vol.8, No . 2 , pp. 151-163.

[4] Kilby, T. (2001). The direction of Web-based training: a practitioner's view. *The Learning organization*. Vol. 8, No 5, pp. 194-199.

[5] Larsen, S. (1988). New technologies in education: Social and psychological aspects In Lovis F. & Tagg E., *Computers in education*: proceedings of the IFIP TC3 1st European Conference on Computers in Education - ECCE 88, (pp. 15-22) Lausanne, Switzerland, 24-29 July, 1988.

[6] Kennedy, D. & Duffy, T. (2004). Collaboration - a key principle in distance education, *Open Learning* Vol. 19, Issue 2, pp. 203-211.

[7] Laurillard, D. (1993) *Rethinking university teaching - a framework for the effective use of educational technology*. New York: Routledge.

[8] Marton, F., Dahlgren, L-O., Svensson, L. & Säljö R. (1977). Inlärning och omvärldsuppfattning. Stockholm: Almqvist & Wicksell.

[9] Marton, F. & Ramsden, P. (1988). 'What does it take to improve learning?' in P. Ramsden (ed.) *Improving learning: New Perspectives*, London: Kogan Page.

[10] Marton, F., Beaty, E. & Dall'Alba, G. (1993). Conceptions of learning. *International Journal of Educational Research*, No 19, pp. 277-300.

[11] Marton, F. and Booth, S. (1997). Learning awareness. Lawrence Erlbaum Ass, Publishers, Mahwah, New Jersey.

[12] Marton, F. & Morris, P. (2002). *What Matters? Discovering critical conditions of classroom learning*. Acta Universitatis Gothoburgensis.

[13] Nisbet, J. & Schucksmith, J. (1988). *Learning strategies*. London: Routledge.

[14] Preece, J. *ed.* (1994). *Human-Computer Interaction*. Addison-Wesley.

[15] Rico M. (2003). Constructivist versus behaviourist learners: The weight of previous learning culture in the assimilation of constructivist learning materials, Advanced Learning Technologies, 2003. Proceedings. The 3rd IEEE International Conference, pp. 501-505.

[16] Rosenfield, L. & Morville, P. (1998). *Information Architecture for the World Wide Web*. O'Reilly.

[17] Stigmar, M. (2002). Diss. *Metacognition and the Internet. A study of high-school students' use of information*. Acta Wexionesia No 15/2002. Written in Swedish with a summary in English.

[18] Stigmar, M. & Sundberg, D. (2001). Teachers as reflective Learners - Paper presented at the 26th international IUT-conference in Johannesburg, July 9-12, 2001. Växjö University, Department of Education.

[19] Trowler, P. (1998). *Academics responding to change: new higher education frameworks and academic cultures*, Buckingham: Society for Research into Higher Education & Open University Press.