AN EDUTAINMENT APPROACH TO ACADEMIC TEACHING BASED ON STORYTELLING

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Abstract: In this paper, we describe an approach to academic teaching in computer science using storytelling as a means to investigate to hypermedia and virtual reality topics. Indications are shown that narrative activity within the context of a Hypermedia Novel related to educational content can enhance motivation for self-conducted learning and in parallel lead to an edutainment system of its own. In contrast to existing approaches the Hypermedia Novel environment allows an iterative approach to the narrative content, thereby integrating story authoring and story reception not only in the beginning but at any time. The narrative practice and background research as well as the resulting product can supplement lecture material with comparable success to traditional academic teaching approaches. On top of this there is the added value of soft skill training and a gain of expert knowledge in areas of personal background research.

1 INTRODUCTION

It is a well-known fact that people memorize facts and ideas better when they are emotionally involved (Aristotle, 1885). For example, Davies says that "the hemispheres of the brain work together when emotions are stimulated, attention focused and motivation heightened" (Davies, 2000). In addition, learning is supported by reception of content through multiple sensory channels (Dryden and Vos, 2000; Wallace, 1994; Yates, 2000). This common understanding is supported by neurological studies (Hurlemann et al., 2005). Various E-Learning tools make use of this knowledge, although emotional involvement, if combined with personal affection or sympathy, can also interfere with objective understanding of the related information (Gaskins, 1996). However, the success of E-Learning often suffers from a lack of motivation for self-conducted studies (Hamada, 2006, Keith 2006).

The reception of a well-told narrative can result in a high degree of emotional involvement. It also often triggers the motivation to learn more about the background facts, especially in a historical, scientific, or technological context. Current documentary productions on TV tend to mix the presentation of facts and dramatic scenes to keep the spectator interested (and emotionally involved). This means that TV and often video games use this emotional involvement to engage and motivate users to continue watching or playing, yet contemporary classroom teaching methods are lacking this factor. Or, as James Paul Gee puts it, "Educators often bemoan the fact that video games are compelling and school is not" (Gee, 2003, p. 68). Hypermedia-based E-Learning environments can fill this emotional and motivational gap and are well-suited to fulfill the desire for background information that is directly related to narrative content.

Active research of literature as well as demonstrations and interviews with experts also enhances learning. Davies states that "once a person is motivated and actively involved, learning is optimized" (Davies, 2000). Gee, who advocates active learning in video games as opposed to passive perception, says that "active and critical learning" is essential and "may well relate to later learning in domains like science, at least when we are talking about teaching and learning science as an active process of inquiry and not the memorization of

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passive facts" (*Gee, 2003*). This is particularly valid with respect to background research for narrative writing. Even for most fictional stories authentic details have to be included (Friedman, 2006) and authors always have to know much more about the background of a story (including the facts behind the fiction) than they eventually tell the recipients. In addition, developing narrative content is a highly creative process, filled with emotion and – maybe even more important in terms of motivation – fun. Fun "create[s] relaxation and motivation" and "relaxation enables a learner to take things in more easily, and motivation enables them to put forth effort without resentment" (Prensky, 2001, p. 111).

The potential of story-authoring in educational environments has been discussed earlier (Aylett, 2006). The existing authoring systems do, however, not include an iterative approach, as they allow only the production of single, finalized stories. Most edutainment products aim at children of primary or secondary school level, while little attention has yet been paid to academic teaching, in particular in combination with active storytelling.

The integration of modular story authoring and non-linear story reception in a Hypermedia environment (i.e. an environment that combines multiple forms of media – like text, video, audio, 3D animation - in one presentation) therefore seems to be a promising concept for edutainment because it effectively links narrative and informational content in an approach that uses multiple forms of media. Thus, the production process – as well as its product – serves as an edutainment system that remains open to active as well as passive use at any time. Active use in this context means authoring of additional narrative modules and passive use refers to the consumption of narrative content.

Digital storytelling is currently almost always discussed in terms of interactivity. While non-linearity of reception is usually not considered interactive, alternative approaches offer options from simple branching to immersive role-playing games in a simulated environment that are inhabited by artificial intelligence (AI) characters. A flexible switch from passive reception to active authoring and back has not yet been included in the discussion within the community – either because this also does not fit to the purist definition of interactivity, or maybe just because it has not yet been realized.

In an open modular narrative environment with multimedia components it is possible to passively consume a story and – if inspired for own ideas – to add new modules that show different views on the existing content, add supplemental information, open new branches not yet told or offering alternative paths, thereby contributing to a growing narrative network.

2 THE HYMN PLATFORM

As an extension to previous storytelling paradigms combining several media (e.g.), the Hypermedia Novel (HyMN) has been introduced as a generic concept for digital storytelling (Heiden et al., 2001), as well as a platform for narrative edutainment applications (Heiden, 2006). The HyMN paradigm integrates different user roles like receptor, author, and publisher in a single environment, allowing personalized as well as distributed story reception and storytelling.

Two approaches to HyMN structuring have been described so far (Heiden and Ostovar, 2006). Both define a combination of serial and parallel structure elements for the organization of Narration Modules (NarMo) as semantic units. Atomic Narrative Units (ANU) resemble the “movement” as defined by Sharda as basic narrative building blocks (Sharda, 2005). In a Hypermedia Novel (as shown in Figure 1), however, an ANU is distinguished from media units (Content Modules – CM), which are often, but not always, identical. A Narration Module can either be atomic (and therefore an ANU), representing a particular part of the story through the use of a single form of media (e.g. a movie sequence or a section of written text – a CM) or contain a sub-structure of its own. Serial Containers (SC) represent a logical order of reception, while Parallel Containers (PC) offer alternatives, which are equal in narrative content but are different in regards to media, viewpoint, level of detail, etc. Depending on the choice among these alternatives, several different paths lead through a single story. Branching threads offer the possibility for the recipient to make decisions that may change the plot (thereby strengthening the interactive aspect) – and also of relating information material to the story. (The latter aspect becomes particularly important for edutainment applications.)

The recipients can either choose from a pool of pre-defined paths for a consistent sequence of Narration Modules, or find their own path, navigating via a graphical representation of the story structure.

The relationship of the different structural elements of a Hypermedia Novel is depicted in Figure 1.

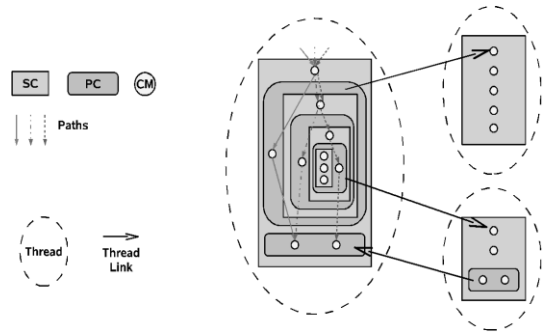

Figure 1: Hierarchical structure of a Hypermedia Novel, showing different types of NarMos (SC, PC, CM)(including threads plus paths and thread links):
SC = Serial Container (sequential scenes, vertical)
PC = Parallel Container (alternatives, horizontal)
CM = Content Module (atomic narrative media unit).

The structure is written to a custom built XML format for generic modular storytelling, which contains links to the Content Modules as URL references. For maximum exchangeability all CMs are integrated in HTML files, although this is not necessary if the player/editor can handle the various multimedia content elements directly.

A typical HyMN offers at least one path with short textual descriptions, supplemented and/or augmented by alternative modules using different media like audio, video sequences or interactively explorable 3D scenes, more detailed substructures or different viewpoints for transmitting the same narrative content.

Given an interface that can easily change from player to editor in an offline environment or a client-server structure (such an interface is currently being developed), every recipient can instantly switch from recipient to author by producing additional Narration Modules and placing them at the appropriate point in the existing structure. Such an environment offers the possibility for everyone to contribute to a growing story universe within one's own skills and temporal limitations without the overall story losing consistency.

3 EDUTAINMENT EXPERIMENT

3.1 Edutainment Concept

Students were asked to produce multimedia content for narration modules extending an existing story given by an exposé. The story was designed such that topics related to the teaching content were covered by essential stages of the plot, thus requiring deeper investigation of the subject in order to tell the story consistently. Different research topics were distributed across several groups of students. The research results were reported by these groups in project-internal workshops, supplemented by additional lectures and educational documents. Visits and discussion with experts from cooperating research institutes offered additional insight into the topics.

For those students with less creative interest there was a more technical work package devoted to the development and improvement of the HyMN platform itself.

Figure 2 shows a screenshot of the resulting Hypermedia Novel "Butterfly Dreams". The structure is encoded in an XML file and the user interface and CMs are rendered by a Flash plugin in a frame-based HTML context using the most widely spread platform for interactive multimedia documents available. Work in progress replaces the Flash plugin with JavaScript.

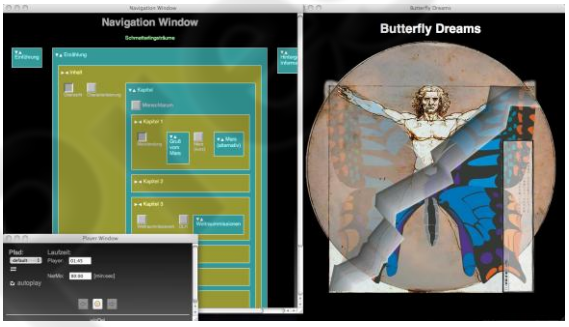

Figure 2: User interface with story structure navigation view of the Hypermedia Novel "Butterfly Dreams".

3.2 Teaching Content

The lecture subject "Advanced Hypermedia" (AHM) included advanced hypermedia application development and immersive virtual environments (VE) as a special hypermedia interface.

3.2.1 Content units

The teaching content (in the VE area) was related to several chapters of a science fiction story ("Butterfly dreams"), covering the following aspects of VE technology and research:

- Virtual TV studios (VTV)
- Immersive Virtual Environments (IVE)
- Human Perception and Simulators (HPS)

The story was designed particularly for this course and describes the quest of a journalist in the year 2020 who suspects that a live transmission from a manned mars exploration team might be a fake. Looking for clues that may either support or contradict his doubts, he investigates leading research institutes (which really exist and have supported the project) and learns about the possibilities and limitations of virtual TV studios and immersive virtual environments. Finally, testing an ultimately convincing simulation environment he finds out that all his earlier experiences have been virtual. Eventually he seemingly manages to escape from the simulation. But can he be sure?

For those who have become curious: The title "Butterfly Dreams" refers to an ancient Chinese poem of the Taoist philosopher Zhuangzi (370 to 301 BCE) where he uses the metaphor of a dream to in a way question the nature of reality (Watson, 1968).

Supplementing the VE topic, students were required to acquire knowledge from the following areas:

- Hypermedia technology, including XML, compression formats for multimedia data, etc. (HMT)
- Storytelling theory (STT)
- Cosmology and space travel (CST)

This sums up to six units of teaching content. The distribution of content among the narrative and practical area is displayed in Table 1.

Table 1: Teaching content.

Narrative	VTV	IVE	HPS	CST
Practical	STT	HMT		

3.2.2 Teaching Channels

Teaching content was imparted through several different channels:

- background research for narrative content, including interviews with scientists at leading-edge research institutes
- practical use of technology for production of multimedia and hypermedia documents,
- seminaristic presentation of research results,
- supplemental information (demand-oriented) on all topics via traditional lecturing,
- edutainment approach by interactive reception of the produced Hypermedia Novel.

A visualization of the input and output from a student's point of view in terms of teaching channels and student's activity, respectively, is given in Figure 3.

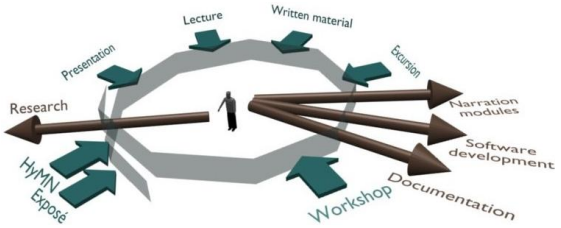

Figure 3: Input and output within a project cycle defined by one study term.

Some topics were learned only on a theoretical basis, through research, internal workshop presentations, classical lectures, online material, and demonstrations visiting research labs. Others were handled more practically, working on improvements of the HyMN platform software.

3.3 Observations

The test participants were a group of 16 computer science (CS) students in their second last term, all with the chosen major discipline "Media Informatics", plus 4 students from the technical journalism (TJ) area. The latter group was assigned to work on the project as a simulation of a professional media production remittance work. For the CS students it was a regular unit integrated with the BSc curriculum of Computer Science at Bonn-Rhein-Sieg University of Applied Sciences.

At the end of the term the CS students had to pass an oral exam. The results of this exam were evaluated in comparison to another examination of the same group of students within the same time period and an identical amount of teaching time, also in the media informatics domain (subject: "Advanced Computer Graphics" – ACG). The second exam was conducted by the same examiners as an oral exam in a comparable style and at a similar level of difficulty. For a comparative chart of both exam results see Figure 4, showing the results of 16 individuals. Marks range from 1.0 (excellent) to 5.0 (fail). Figure 4(b) shows statistics with average and standard deviation.

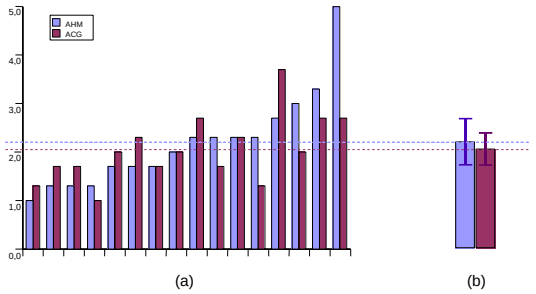

Figure 4: Performance in Edutainment teaching AHM (blue/left) vs. traditional teaching ACG (red/right).

The figure shows no significant difference in average performance between both teaching methods, indicating that traditional and HyMN method work equally well.

Special consideration was given to the preparation of the exam, e.g. whether a topic was primarily learned through background research, traditional teaching material, or from the resulting HyMN. Each student was assigned to one work package related to the teaching content units named above (3.2.1). The six content units were assessed separately, each one rated from 0 to 4 points. The performance of the subjects in their area of expertise (i.e. the topic on which they worked in their particular work package) related to their overall rating is given in Figure 5. Figure 5(b) again shows statistics with mean value and standard deviation, which favour the own research topic slightly, yet the overall difference is not significant. It can be seen that some students achieved the best rating in their own research area, while most performed almost equally well in all areas. Remarkably, two of the participants performed significantly better outside their work topic (which was not the same in both cases).

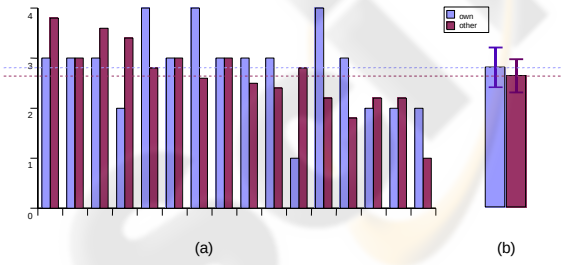

Figure 5: Performance in own research area (blue/left) vs. other topics (red/right).

3.4 Second Term Evaluation

The experiment was repeated with another group of students as a follow-up project based on the results and output of the first cycle. Overall results (again compared to a parallel traditionally taught course) support the observations described above.

As in this second cycle the HyMN product of the first one – although in a prototypic state – was available from the beginning as an additional resource of learning content, now a focus was placed on the evaluation of how students made use of the different teaching channels.

When students were questioned which portion of their preparation time for the exam was spent on which source of information, they stated that the provided lecture material was still most important, while all other sources used for exam preparation (including the edutainment product of the course itself) had more or less equal parts. The average evaluation results for the use of resources is displayed in Figure 6.

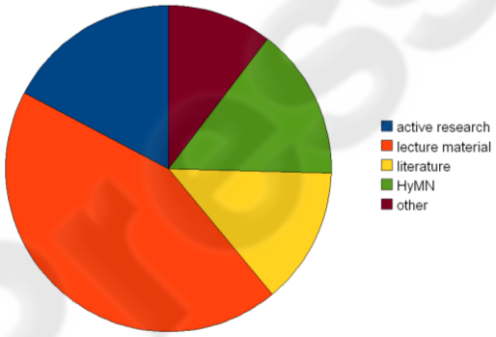

Figure 6: Use of different information resources for exam preparation. Lecture material covers almost 44%, followed by active research (17%), HyMN (15%), and literature (14%). About 10% of other resources have been used.

4 CONCLUSIONS

Although results from an evaluation with 16 participants in a single unit over one semester with 8 hours per week cannot be considered a representative result (the second cycle has not yet been analyzed completely), observations have been made that allow preliminary conclusions. However, further evaluation is desperately needed. In particular future experiments will require a comparative assessment of different teaching methods with identical content rather than different courses.

All participants (with one exception who was uncertain because he had expected more from the final product) expressed their preference in terms of motivation for the described edutainment approach to academic learning as compared to traditional

lecture-and-practice units. The result indicates that this form of teaching seems to perform equally well as traditional academic teaching in terms of gaining knowledge and skills on a technical level, with some added value provided by the non-technical content (e.g. storytelling theory) learned on the way together with the training of soft skills through teamwork in a project-oriented context. However, the expected improvement of results, in particular for weaker students, as a consequence of enhanced motivation, could not be observed. Therefore, there is still much potential for improvement. Probably the most promising target is the improvement of the HyMN story, which in its current state is not yet sufficient as a learning platform for VE technology. It is, however, one central element of the HyMN concept to always remain open for modular expansion, which is expected to take place in similar future units. In this regard, we are currently working to extend the present HyMN concept by means of two immersive virtual environments (i.e. display systems like CAVE™ (Cruz-Neira, 1993) or Immersion Square (Hetmann et al., 2002)) that are connected via the Internet. We strive to create a virtual environment that can be explored together with others. With this collaboration in an immersive 3d environment we aim to foster collaborative learning in groups, similar to how teenagers already solve tasks in Massively Multiplayer Online Role-playing Games like World of Warcraft, Lineage 2, Diablo 2, etc.. With our approach we want students to experience a topic, rather than routinely memorize information.

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REFERENCES

Aristotle, 1885. The Politics (B. Jowett, Trans. Vol. Vol 1). Oxford: Claredon Press.

Aylett, R., 2006. And they both lived happily ever after? Digital stories and learning. In: *G. Dettori, T. Giannetti, A. Paiva, A. Vaz (eds) Technology-mediated narrative environments for learning.* Sense Publishers, Amsterdam.

Cruz-Neira, C., Leight, J., Papka, M., Barnes, C., Cohen, S. M., Das, S., Engelmann, R., Hudson, R., Roy, T., Siegel, L., Vasilakis, C., DeFanti, T. A., Sandin, T. J., 1993. Scientists in Wonderland: A Report on Visualization Applications in the CAVE Virtual Reality Environment. *Proc. IEEE Symposium on Research Frontiers in VR*, 59-66.

Davies, M. A., 2000. LEARNING ... The beat Goes On. *Childhood Education*, 76, 148.

Dryden, G., Vos, J., 2001. The Learning Revolution - To change the way the world learns. Stafford, Network Educational Press Ltd.

Friedman, A., 2006 Writing for Visual Media. Focal Press.

Gaskins, R. W., 1996. `That's just how it was': The effect of issue-related emotional involvement on reading. *Reading Research Quarterly*, 31, 386.

Gee, J. P., 2003. What Videogames have to teach us about Learning and Literacy. Palgrave Macmillan, New York.

Hamada, M., 2006. Visual Tools and Examples to Support Active E-Learning and Motivation with Performance Evaluation. *LNCS* 3942, 147-155.

Hetmann, F., Herpers, R., Heiden, W., 2002. The Immersion Square - Immersive VR with Standard Components. Proceedings *VEonPC2002*, Protvino / St. Petersburg, Russia (Sep. 09-15, 2002).

Heiden, W., Frühling, C., and Deuer, H., 2001. Hypermedia Novel HYMN - A New Storytelling Paradigm. *Proceedings cast01*, (St. Augustin, Germany, 2001).

Heiden, W., 2006. Edutainment Aspects in Hypermedia Storytelling. *LNCS* 3942, 389-398.

Heiden, W., and Ostovar, A., 2006. Structuring Hypermedia Novels. *LNCS* 4326, 98-103.

Hurlemann, R., Hawellek, B., Matusch, A., Kolsch, H., Wollersen, H., Madea, B., Vogeley, K., Maier, W., Dolan, R., 2005. Noradrenergic Modulation of Emotion-Induced Forgetting and Remembering. *J. Neurosci.*, 25(27), 6343-6349.

Keith, T.-S. (2006). Early Attrition among First Time eLearners: A Review of Factors that Contribute to Drop-out, Withdrawal and Non-completion Rates of Adult Learners undertaking eLearning Programmes *Journal of Online Learning and Teaching*, 2(2), 73-85.

Prensky, M. (2001). Digital Game-Based Learning. St. Paul: Paragon House.

Sharda, N., 2005. Movement Oriented Design: A New Paradigm for Multimedia Design. *International Journal of Lateral Computing (IJLC)*, 1 (1), 7-14.

Wallace, W.T., 1994. Memory for Music: Effect of Melody on Recall of Text. *Journal of Experimental Psychology*, 20, 1471-1785.

Watson, B. (translator), 1968. The Complete Works of Chuang Tzu. New York: Columbia University Press.

Yates, F., 2000. The Art of Memory. Pimlico, London