

2002

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Bolz, Andre, "Multimedia Case Studies in IS Education - Methodological Approach and Empirical Findings" (2002). *ECIS 2002 Proceedings*. 25.
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MULTIMEDIA-CASE STUDIES IN IS-EDUCATION – METHODOLOGICAL APPROACH AND EMPIRICAL FINDINGS

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ABSTRACT

Due to the rapid diffusion of modern Information- and Communication Technologies in all business areas the demand for well education IS-professional has increased enormously. As a consequence, controversial discussions on the quality of IS-education and the application of teaching methods in the field of IS came up in the recent years. Teaching experts suggest to shift the emphasis in IS-education from passive and content-transfer oriented teaching methods to active and problem-based learning approaches which address interdisciplinary perspectives. As one of the most effective method for the realisation of active and problem-based learning processes, the case study method is established in management education since decades. Nevertheless, compared to other popular learning methods the case study method has - due the long history of application - a reputation as being “traditional” and not very innovative. This paper reflects the potential of improving the case study method by using hypertext and multimedia technologies for the implementation and presentation of case-related content. Taking the strengths of the case study method and recommendations of constructivist learning theories into account two important didactic concepts have been identified which can be used to support the design and development of multimedia case studies: authenticity and complexity. In an empirical study, the effects of these concepts on cognitive learning objectives, motivational factors and the learning-effort have been analysed. For that purpose, three versions of multimedia case studies with the same content but with different levels of authenticity and complexity have been developed and applied in an Electronic Commerce case-seminar. The results of the survey suggest that with regard to cognitive learning objectives multimedia case studies with a high level of complexity and authenticity promote a deeper processing of information and leads to a higher quality of results than multimedia case studies with a low level of complexity and authenticity. Nevertheless, a high level of complexity and authenticity can also have demotivational effects on side of the learner. The results show that there is not one way to implement complexity and authenticity in multimedia case studies but that these concepts have to be carefully applied and combined to match as effective as possible the educational setting.

1 BACKGROUND

Rapid technological developments, an increased global competition and complex economical and organisational environments lead to the emergence of new managerial roles and practices [Kickul 2000]. Adequate competencies and skills for IS managers do not only comprise knowledge about the design and implementation of technical systems but also to develop an appropriate IT strategy following the overall business strategy and to cooperate with business managers coming from a variety of backgrounds such as finance, accounting and law [Kakabadse 2000]. Taking these requirements into consideration a shift of attention has taken place in the IT-Management-Education changing the focus from pure knowledge transfer to a reality-oriented and action-driven teaching and learning approach [see for instance Greening 1997, Whiddett 1997]. It was recognized that the most appropriate way of learning how to manage complex organisational and technical systems is not to

learn figures and facts but to let the students train to deal with complexity, unstable and multi-facet situations which are typical for their later work.

Learning with case studies is regarded as one of the most appropriate method to realise such reality-oriented and action-driven learning environment [Szpiro 2001]. One of the main advantage of the case study approach in contrast to theory learning is that it stresses the relationship to reality and, thus, involves the learner into a situation similar to the “real” situation described in the case study [Erskine 1981]. By reproducing the complexity of the reality the learner is exposed to a complexity comparable to her or his later working life. Nevertheless learning with cases have also some drawbacks: Often case studies delude a reality to the students which is much more complex and unstructured in its origin. The “simplification” of the real situation and decision processes for educational purposes can blur the real complexity of business situations, ignoring the dynamic processes of management, and create a wrong model of how decisions are made in reality [Burgoyne 2001].

Despite of the popularity of the case method in various educational disciplines like medicine, business administration and social sciences, explicit pedagogical models and theories for the development of cases and the application of the case method are relatively rare. Nevertheless, in the last two decades new theories in the field of learning emerged concentrating on a learner centred and action oriented approaches taking typical elements of the case method into account. In particular the constructivists theories of learning shift the emphasis from teacher driven to learner driven learning processes. In contradiction to traditional learning environments these theories focus on providing complex and authentic leaning arrangements to the learners and on presenting the content from different perspectives as well as try to initiate reflection and social interaction processes [Herrington 2000]. The main assumption of constructivism is that better learning performance is achieved when learners discover relevant information and construct knowledge themselves instead of being a passive recipient of information [Gerstenmaier 1995, Ramirez 1998]. Case-based learning and information technology play an important role in constructivist theories. For instance, the *Cognitive Flexibility Theory* by Rand Spiro promotes the usage of mini-cases on a hypertext basis to train problem-solving skills [Spiro 1990]. Another example is the *Anchored Instruction Approach* which focuses on the development of case-based, multimedia-based learning environments providing the learners “anchors” which support the active construction of own knowledge [Bransford 1990].

With the emergence and diffusion of multimedia and hypertext new forms of learning have been proposed and introduced in university and company education. These new technologies have also affected the development and application of case studies. Due to the availability of cheap and powerful hard- and software since the beginning of the 90ties some of the traditional case study producer like Harvard started with the development of the first Multimedia Case Studies [Gallagher 1998]. Since then, a number of multimedia-case studies has been developed taking different educational and technical approaches into account [see for instance Kinzie 1999, Jarz 1996]. Although a number of multimedia-case studies were developed, empirical surveys in the field of the development and application of multimedia-case studies are rare. Often, the surveys focused on general aspects of the design and development of multimedia-software like guidance-facilities [Niegemann 1995] or evaluated the overall acceptance of multimedia case studies [Apostolopoulos 2000] in learning processes. However, a systematic analysis of potential effects of multimedia case studies on learning objectives and related empirical findings could not be found in the literature.

Within an international project funded by the European Commission¹ the author participated in the development and evaluation of multimedia-cases in the field of Electronic-Commerce. On basis of the results of this project a research plan was established which focused on the evaluation of the effects of multimedia-case studies on the result factors of learning processes. The literature research showed that

¹ The project BUSINESS-LINC (Business Innovation Networks - Learning with Interactive Cases) was realised by six European Business Schools from 1998 to 2000. For more details see: www.wi-im.uni-koeln.de/b-linc

the empirical research in the field of the effectiveness of multimedia and hypertext reveals an inconsistent picture. Neither a superior nor an inferior effect of multimedia elements and hypertext on the achievement of learning objectives in comparison to traditional media could be proved [Niegemann 1995, Alessi 1991]. Due to the fundamental technological and methodological differences between multimedia- and paperbased-learning processes many authors suggested that a generalised comparison between the effectiveness of multimedia and traditional learning is not useful. [see for instance, Kremer 1997, Niegemann 1995]. As a consequence for the design of the empirical study, it was not aimed to compare multimedia with paper-based case studies but to evaluate the effects of different ways of implementing multimedia and hypertext elements in case studies and to draw useful recommendations for future developments. In order to get a comprehensive picture of the effects of multimedia case studies it was avoided to investigate a certain technology (e.g. the usage of video or hypertext) but to analyse the effects of didactic concepts which are strongly related to the case study approach and multimedia technologies.

2 RESEARCH DESIGN

2.1 Methodological approach

Using multimedia and hypertext technologies it can be expected that two pedagogical concepts closely related to the case method and to constructivists theories can be realised or improved: *authenticity* and *complexity*. Both can be regarded as didactical principles or concepts respectively, which can be used to support the design and development of multimedia case studies. Authenticity can be described as the extent/quality of realism of the content the learner perceives in the learning process. Complexity is expressed by how far the degree of the complexity of the case study corresponds with the complexity of the “reality”. The following multimedia technologies and hypertext concepts are expected to realise and improve the authenticity and complexity of case studies:

- **Multimedia components**
By using different types of media, like audio, video, animations, it can be expected that in particular the authenticity of the content presented in case studies could be improved. Content presented in video and audio components provide the learner with a direct impression of the “real” subject described in the case study instead of running through the subjective interpretation and abstraction of the case writer.
- **Linearity of the content presentation**
Due to the predomination of textbooks the learners are used to acquire knowledge in a linear way. Linearity can also be implemented in multimedia-case studies by providing a learning path to the learner which let him or her easily grasp the case by going step by the step through the content. On the other side, the content can be implemented following an explorative structure of the content, which provides to the learner a virtual environment which gives him or her complete control of the acquisition of information. The linearity of content presentation affects in particular the complexity of multimedia case studies.
- **Type of content structure**
Whereas traditional paper-based case studies usually structure the content using “analytical” dimensions like environment, company, problem etc. multimedia case studies offer the possibility to present and arrange the information according to the “natural” appearance of information. A typical way of implementing this reality-based structure is to use metaphors like desks or buildings which can be explored by the learner. This type of reality-oriented content structure affects both, the authenticity and complexity of multimedia case studies.

Following constructivistic learning theories, authentic and complex multimedia studies are expected to achieve better learning objectives than simple and linear structured multimedia case studies. In particular, for the training of higher cognitive skills it can be expected that complex and authentic multimedia case studies lead to superior results. In order to evaluate the effects of different levels of

authenticity and complexity it was decided to develop and apply three versions of multimedia case studies which contained the same content but different kinds of media-usage, content-structures and linearity of content presentation.

2.2 Types of multimedia case studies

Case study type I had an analytical structure and a sequential navigation. (see Figure 1). This case study type was implemented in HTML using only text and graphics but no extended multimedia components like audio or video. It was distributed to the students via the Web-Server.

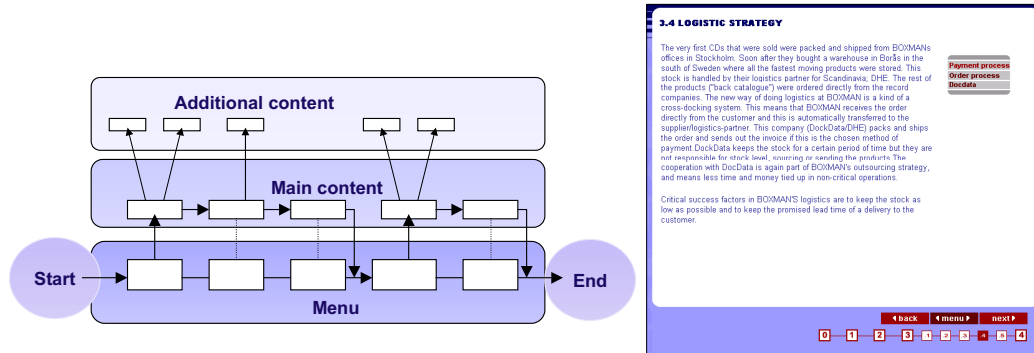


Figure 1: Structure and screenshot of multimedia case study type I

Case study II had also an analytical structure but uses an explorative navigation. That is, no dedicated learning path was provided with the case study (see Figure 2). The learner had to find and acquire all information relevant for the solution of the case study by him- or herself.

In contradiction to case study type I extended multimedia components have been implemented, in particular videos with interviews of members of the depicted company of the case study. Due to the usage of videos the case studies were distributed on CD-ROM to the students.

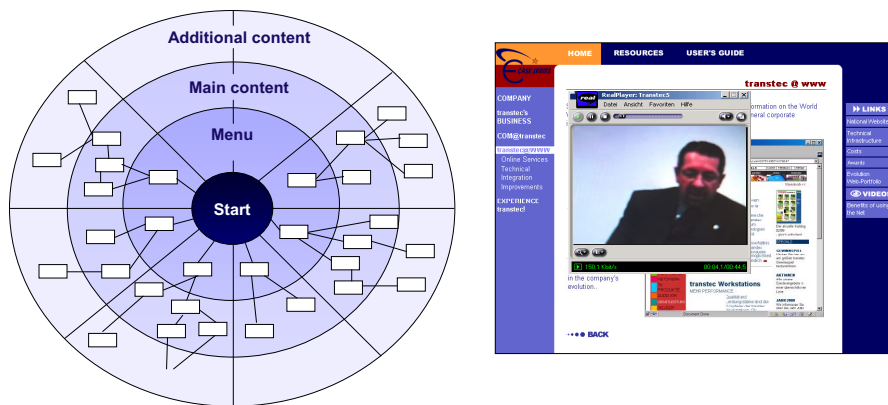


Figure 2: Structure and screenshot of multimedia case study type II

Case study type III had a reality-based and explorative structure (see Figure 3). For that purpose the metaphor of a desk was presented to the learner when he or she starts to work with the case. All information pieces have been remained “un- edited” as far as possible in order to guarantee the highest level of realism.

Similar to case study type II extended multimedia elements, that is videos with interviews of members of the depicted company have been included. Also, the case studies were distributed on CD-ROM to the students.

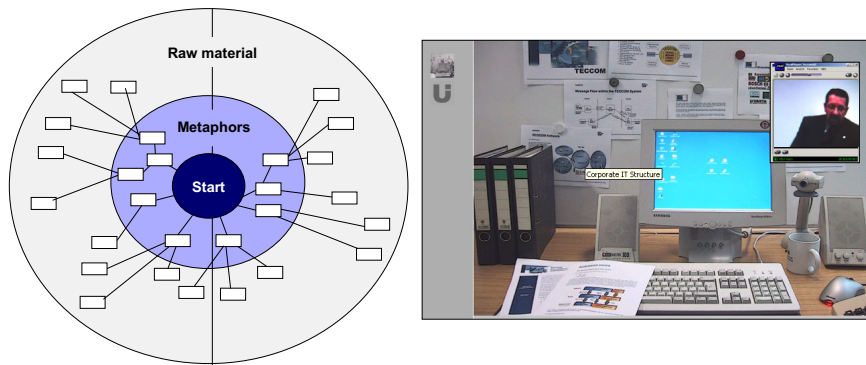


Figure 3: Structure of and screenshot of multimedia case study type III

In order to ensure that each student or, respectively, group was able to use and evaluate each type of case study 3 different E-Commerce case studies have been applied in the course. All cases dealt with successful E-Commerce solution presenting the company, the market, organisational and technological success factors as well as the change process which led to the solution. For each of the 3 case studies 3 versions containing different levels of authenticity and complexity have been developed. Thus, all in all 9 different versions of the multimedia-case studies have been distributed to the students.

The multimedia case studies have been applied in an Electronic Commerce Course which was held at the Chair of Information Systems and Information Management at the University of Cologne in the winter term 2000/2001. The case work was organised according to the traditional Harvard-style of case learning: In the beginning of the seminar the students form groups with 3 students per group which stayed together during the entire course. In total, 7 groups (21 students) worked on the 3 cases. After they have received the case material and the assignments the students had two weeks available to work on the assignments and prepare a meaningful presentation. The assignments consisted of questions addressing the analysis of the current situation of the company, the identification of strengths and weaknesses of the business model and suggestions for a further development of the company.

1.1 Result factors

For the evaluation of the effects on cognitive learning objectives Blooms learning taxonomy for cognitive skills was used. This taxonomy arranges the cognitive skills which can be addressed by learning processes according to an increasing level of complexity of information processing (see Figure 4).

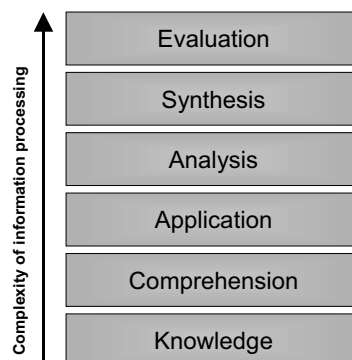


Figure 4: Blooms taxonomy of cognitive skills [Bloom 1973]

The empirical study addressed the following cognitive levels:

- *Acquisition of knowledge in the field of E-Commerce (Knowledge & Comprehension)*
On this level the acquisition of new knowledge in the field of Electronic Commerce was evaluated. After students have worked on all three case studies and have presented their results

to the audience they were asked to evaluate each case with regard to their perceived increase of E-Commerce knowledge.

- *Application of knowledge (Application)*
Directly after the case-work and -discussion the students were asked to reflect their application of knowledge during the learning process. This question referred only to knowledge acquired in the University.
- *Identification of problems (Analysis)*
The evaluation of problem identification was done by assessing the presentation of the groups using quantitative and qualitative criteria. In the quantitative assessment the number of items of problem identifications was counted. The qualitative assessment of was done by giving marks to the quality of the presentation (relevance, logic, structure).
- *Development of problem solution and new ideas (Synthesis)*
Similar to the evaluation of problem identification the development of problem solutions and new ideas was evaluated by counting the number of items presented in the students presentations. Additionally, also a qualitative assessment was done taking the quality criteria *relevance, logic and structure* into account.

In addition to the cognitive learning objectives the effects of different levels of authenticity and complexity on two other important output-factors of learning processes were analysed:

- *Motivation to learn*
The motivation to learn is an important prerequisite for the achievement of cognitive learning objectives. This output factor represents the willingness and wish to learn and supports the active involvement of the learner in the learning process. Authors claimed that using multimedia provides a more stimulating and motivating learning environment to the learner than traditional teaching methods [Euler 1992]. After the case work the students were asked to indicate how much fun they had when working on the cases.
- *Effort*
In order to receive a comprehensive picture of the effectiveness of different levels of authenticity and complexity not only the achievements of learning objectives and motivational factors but also the effort spent in the case based learning processes had to be analysed. In this evaluation the students were asked to indicate the amount of time spent individually and in group while working on the case and on the presentation.

For the empirical research two types of questionnaires had been developed and distributed to the students. The first type was provided to the students immediately after the discussion of each case via the internet. The second type of questionnaire was distributed to the students after they finished the work and discussion on all three case studies. The purpose of this questionnaire was to enable the student to make a concluding comparison of the three multimedia case studies they have worked on.

3 RESULTS OF THE EMPIRICAL RESEARCH

3.1 Acquisition of knowledge

The results regarding knowledge acquisition indicates that the students prefer the multimedia case study type II which has video components and an analytical and explorative structure (see Figure 5). This case study achieved a slight better assessment than the less and more complex authentic types of multimedia case studies (type I and type III). Nevertheless, as the difference between the results are rather low, it is difficult to identify a significant influence of the different types of case studies on the knowledge application. It can not be confirmed that an increasing level of authenticity and complexity in multimedia case studies have a positive effect on the knowledge acquisition.

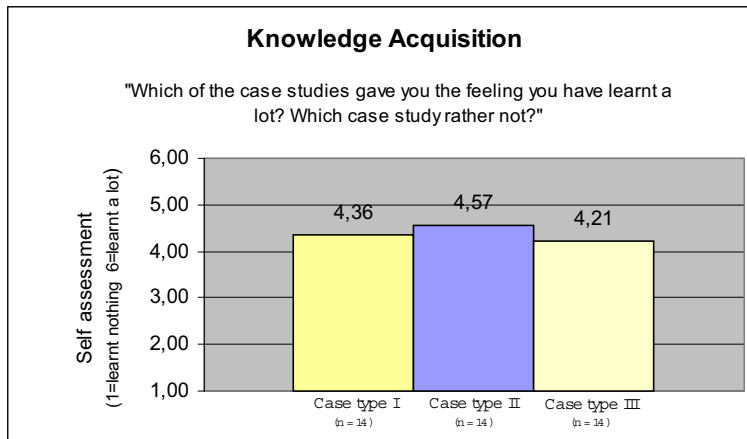


Figure 5: Results regarding the knowledge acquisition

3.2 Application of knowledge

Directly after the case work the students were asked to indicate, if they have used knowledge acquired in the university and if yes, which kind of knowledge. Figure 6 shows the number of students which confirmed the application of knowledge.²

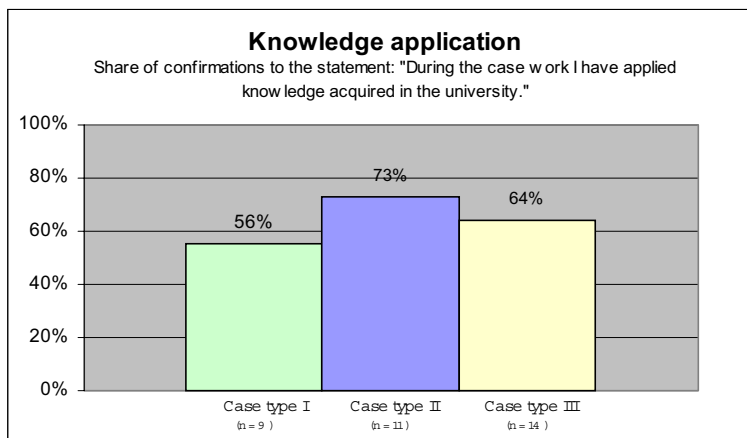


Figure 6: Results regarding the application of knowledge during the case work

The best results are achieved by the case study with the middle-level of authenticity and complexity (case study type II), followed by the most authentic and complex case study type III. In order to analyse also the quality of knowledge an additional analysis was done by distinguishing different levels of concretisation:

- General knowledge in Business Administration and Information Science
- Specific fields of Business Administration and Information Science (e.g.: Marketing, organisational science)
- Specific knowledge in fields of Business Administration and Information Science, e.g. theories or concepts like „Porter“ etc.

Figure 7 shows the result of the qualitative analysis of knowledge application

² In detail, the number of confirmations (“I have applied knowledge”) and the number of negations (“I have not applied knowledge”) have been counted. The values in the figure ??? show only the number of confirmations of confirmation related to the sum of confirmations and negations.

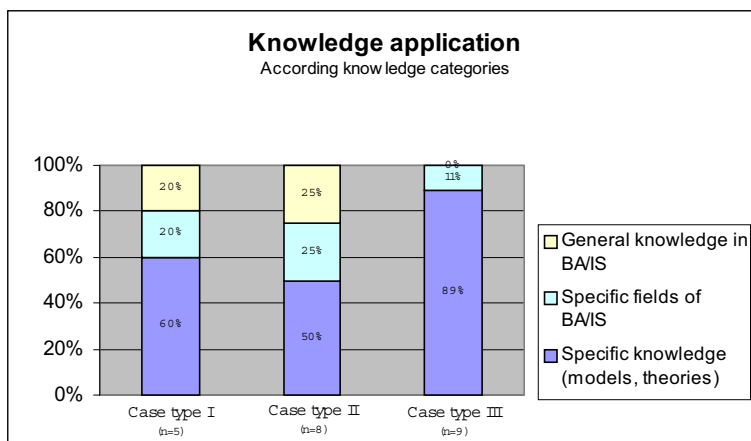


Figure 7: Results regarding the application of knowledge during the case work

Taking not the *quantity* but the *quality* of the indicated knowledge applications into account, the most complex type of multimedia case study (case study type III) performs better. The results indicate that an increasing complexity and authenticity in multimedia case studies does not necessarily affect the quantity of knowledge application but supports the application of specific and more elaborated knowledge. The reason for this difference may be the reality-based structure of case study type III in contrast to the analytic-pre-structured of case study type I and II. Due to the lack of an analytical structure in case type III the learners have to construct their own individual framework and rely on the theories and concepts they have learnt in University.

3.3 Problem identification

Figure 8 shows that the most complex case study type (type III) received the best overall performance in problem identification.

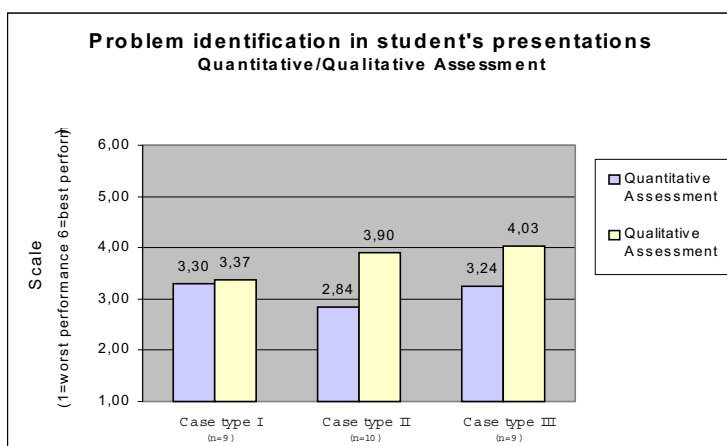


Figure 8: Results of the assessment of problem identification

Interestingly, with regard to the quantity of problem identification there is almost no difference between the case study with the lowest and the case study with the highest complexity. Nevertheless, the quality of the problem identifications increases with the complexity. As both case studies with an explorative structure and view performed significantly better in the qualitative assessment it can be assumed that these characteristics support the assessment of the identified problems and the transfer of these problems into a logical framework which can be presented to the audience. This means, that just for the *identification of problems* less complex structured case studies seem to be as appropriate as complex structured multimedia case studies but for the *assessment and the cognitive transfer of*

identified problems multimedia case studies with a high level of complexity and authenticity are more effective.

3.4 Problem solution

The results regarding the assessment of problem solutions in student's presentations show a similar picture as the results of the problem identification in Figure 8. Also, the most complex type of multimedia case study (type III) shows the best overall performance.

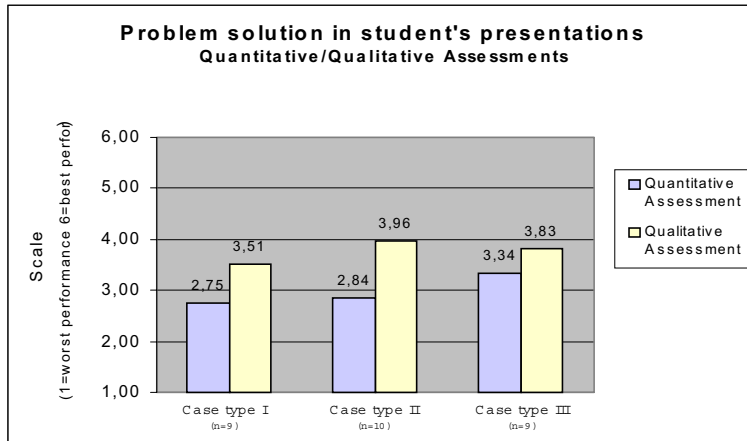


Figure 9: Results of the assessment of problem solutions

The differentiation between quantitative and qualitative assessment shows that the case studies with an explorative structure (type II and type III) achieved better results in both, the quantitative and qualitative assessments than the simple, linear structured case study (type I). It can be assumed that the explorative structure of the complex case studies is more effective to trigger reflection- and creative-thinking- processes than the linear case studies. As the learner perceives these cases studies as open-ended environments, he or she may be more willing to explore the content and to develop new solutions than in the predefined environment of the linear case studies.

3.5 Motivation to learn

After the work on each case the students were asked to indicate how much fun they had while working on the cases.

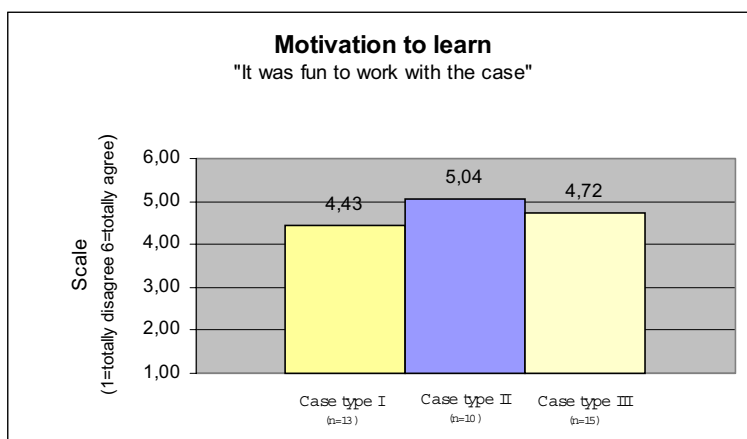


Figure 10: Results regarding motivation to learn

The results show that the middle complex case study type II received the best assessments, followed by the most authentic and complex case study type III (see Figure 10). This is an indication that the

students may like authentic and complex case studies but not necessarily the highest level of complexity and authenticity. It is highly probable that two factors are decisive for the preference of type II: First, in contrast to case study type I video-components have been included in the case study and let the students feel of having an added value using multimedia case studies. Second, the interface and structure of case study type II are very similar to the interface and structure of pages the students are used to find in the World Wide Web (see Figure 2). Thus, the students were very familiar with this type of content organisation and it was easy for them to navigate and find the needed content.

3.6 Effort spent for working on the multimedia case studies

Immediately after each case work the students were asked how much time they spent working individually and in group on the case studies. The results as depicted in Figure 11 show that the learners spent the most time for case type II with video/audio and an explorative, analytical structure.

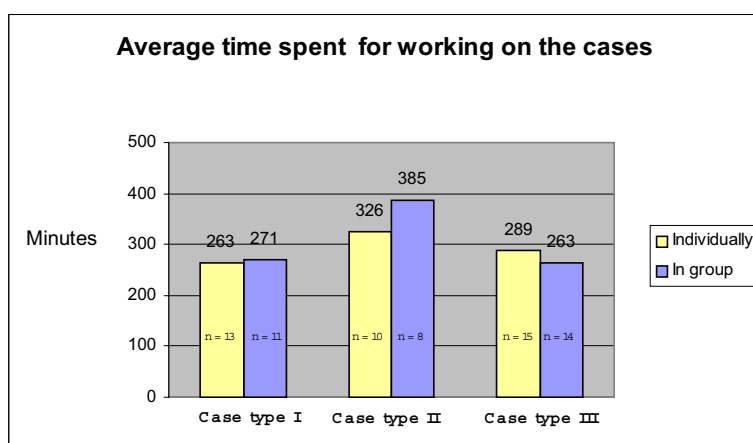


Figure 11: Average time spent for working on the cases

It is interesting that the most complex case study (case type III) does not cause the most effort for the learner but the middle-complex case study (case type II). It can be assumed that not only the complexity and the authenticity are important impact-factors for the time spent working on the cases. Taking the corresponding results of motivational effects into account (see Figure 10), it is likely that the motivation triggered by the different case studies types had a vital influence on the effort as motivated learners are usually willing to spend more time working on the case than unmotivated learners.

4 CONCLUSIONS

The results show that different levels of complexity and authenticity in multimedia case studies affect the outcome of case based learning processes. With reference to the types multimedia case studies representing different level of authenticity and complexity, the following conclusions can be drawn:

- In no evaluation *Multimedia case study type I*, representing the lowest level of complexity and authenticity, did perform significantly better than the other types of case studies. An average performance achieved this type of case in addressing learning objectives on the lower cognitive level like knowledge acquisition, knowledge application and the quantity of problem identification. With regard to problem solving and motivation to learn this type received rather bad results. Nevertheless, the effort which was spent for working on the case was low. This type of multimedia case study seems to be most suitable for a quick acquisition of knowledge with a low level of learner-involvement.
- *Multimedia case study type II* representing the middle level of complexity and authenticity achieved the best results in knowledge acquisition, quantity of knowledge applications, the

quantity of problem identification and motivation to learn. On the opposite this type caused the most effort for the students, working both, individually and in group on the case. As already mentioned, this high effort can be explained by the assumption that this type of multimedia case study triggers the learner's willingness to work on the cases more than the other case studies. This type of case study seems to be suitable for a time-consuming and deep acquisition of knowledge with a high level of learner-involvement.

- *Multimedia case study type III* with the highest degree of complexity and authenticity received the best results with regard to problem solving and the quality of problem identification as well as the quality of knowledge application. This indicates that a high level of complexity and authenticity in multimedia case studies have positive effects on higher cognitive learning objectives like analysis- and synthesis-skills. Nevertheless, taking the results regarding the motivation to learn into account, this type of case study seemed to be not the most popular case study type in the student's perception but case study type II. This leads to the assumption that - even though this type achieved the best results with regard to higher cognitive skills - there is always a risk of demotivating the students by implementing too much authenticity and complexity.

It is evident, that there is not one single way to produce multimedia case studies which is effectively applicable for all educational settings. Variations in authenticity and complexity lead to different effects on learning objectives. When developing multimedia case studies it is important to match the design decisions to these learning objectives and target groups, respectively. If the target group consists mainly of undergraduate students, usually the transfer and deepening of knowledge is the focus of learning processes. Here, less complex and authentic multimedia cases studies may be appropriate in order to avoid confusion and cognitive overload on side of the students. If the multimedia case study addresses graduate and MBA students, more complexity and authenticity can be implemented. The results show that a high level of complexity and authenticity fosters the quality of problem identification and problem solving.

Finally, some concluding remarks to the presented evaluation:

- Multimedia case studies per se have only an indirect effect on learning outcomes. As they are embedded in a learning process, the design and the organisation of the case work has also a big impact on the learning outcomes. A bad case can be improved by a good and creative teacher by organising interesting activities around the case. Nevertheless, a good case does not guarantee necessarily the achievement of the intended learning outcomes.
- It was assumed that using video and different strategies of structuring the content can enhance the authenticity and complexity of the case study. However, authenticity and complexity are "artificial" concepts which are supposed to support design decisions when developing multimedia case studies. For practical reasons, both concepts have been investigated simultaneously in form of useful combinations. In further investigations, it would be interesting to analyse both concepts separately in order to delimit the different effects on the achievement of learning objectives, motivational factors and effort.
- Even though authenticity and complexity are useful didactical constructs for the design and development of multimedia case studies, there are other concepts which play an important role when producing multimedia case studies. These concepts refer, for instance, to decisions regarding the *level of interactivity* or *the design of teaching notes/assignments etc.* Thus, during the design- and production-phase the development team is confronted with a bunch of design decisions which have to be carefully matched to each other and to the learning objectives, target groups and learning environments. Additionally, design decisions have also impact on development-costs and -time. Even though multimedia cases with the a low level of authenticity and complexity are not as effective as more complex and authentic case studies this type of case study may be – due to development constraints – the only practicable type.

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