Assessment of a Goal-Based Scenario Approach: A Hypermedia Comparison.

Jörg Zumbach & Peter Reimann

Hauptstrasse 47-51
D-69117 HEIDELBERG
(Department of Psychology/University of Heidelberg*)*
joerg.zumbach|peter.reimann@urz.uni-heidelberg.de

ABSTRACT: *A number of studies show that students with no or little domain knowledge learn less from hypertext than from 'conventional' text, despite the cognitive plausibility that is attributed to hypertext. In order to improve the effectiveness of hypertext as an instructional device, we designed a hypertext program that shares many features with Schank's Goal-Based Scenarios (GBS), in particular an authentic embedding of the learners' task. In an experiment, we compared the GBS version with a traditional tutorial and a 'pure' hypertext. The GBS versions let to better structural knowledge than the two other conditions. The GBS condition was also more motivating. These results demonstrate the advantages of using a GBS approach to enhance knowledge acquisition and motivation in students with no or little initial domain knowledge.*

RÉSUMÉ: *Des étudiants qui n'ont pas de connaissances apprennent moins en travaillant avec le paratexte qu'en travaillant avec un texte traditionel - c'est le résultat d'un certain nombre d'études. Nous tenions l'intégration de le paratexte dans le GBS de Schank pour une possibilité prometteuse afin de configurer des environs les plus authentiques que possible. Nous avons comparé la conception du GBS avec un programme d'apprentissage à l'aide d'un tuteur et avec un paratexte « pure ». En utilisant une méthode à base du « Concept-Mapping Method » nous avons obtenu les meilleurs résultats dans le GBS mis en regard des autres possibilités. La méthode de GBS était par suite de son intégration actif aussi la plus effective concernant la motivation. Les résultats montrent l'avantage d'utiliser le GBS pour augmenter l'apprentissage et pour intensifier la motivation en ce qui concerne des étudiants qui n'ont pas de connaissance.*

KEY WORDS: COMPUTER-BASED LEARNING, HYPERTEXT, GOAL-BASED SCENARIO, TUTORIAL, CONCEPT MAP, STRUCTURAL KNOWLEDGE, ARGUMENTATION, TRANSFER, SITUATED LEARNING, MOTIVATION.

MOTS-CLÉS: L'APPRENTISSAGE SOUTENU PAR L'ORDINATEUR, L'APPRENTISSAGE SITUATIONNEL, PARATEXTE, LE CONNAISSANCES STRUCTURELLES, GOAL-BASED SCENARIO, PROGRAMME A APPRENTISSAGE SOUTENUE PAR UN TUTEUR, MOTIVATION, ARGUMENTATION, TRANSFER.

Introduction

Since the early beginnings of educational computing a main research focus has been to enhance and optimize computer-based learning environments. The World Wide Web increasingly provides possibilities to abandon local platforms and to offer classes all around the world. With modern information technology educational computing becomes increasingly independent from local resources. Using learning environments is one issue – another issue is to assess learning processes and to evaluate the outcomes. In particular, as the WWW is based on the hypertext paradigm, more research about the effects – advantages and disadvantages of Hypertext as a learning device – is needed. This study has been designed in order to measure the outcomes of three different learning environments, each designed to realize a different manner of computer-based instruction. The corresponding computer programs – which can be used on a local platform and on the Internet – contain the same information. The material was presented in three different ways: a Tutorial, a Goal-Based Scenario and a freely navigable Hypertext program.

1. The Learning Environments

All three programs are based on an information resource – in hypertext form - which informs students about marine pollution. The Tutorial program was constructed by dividing the information base into seven modules each focusing on a particular aspect of the domain. In the Hypertext-only condition, these parts were combined into one coherent system open for browsing and reading. For the third condition, we have integrated the Hypertext system as an information resource into a Goal-Based Scenario.

1.1. *The Tutorial Program*

Some of the earliest program types for educational computing have been 'Drill and Practice' and Tutorials [ALE 91]. Our Tutorial program consisted of seven coherent and independent modules each presenting some information and ending with a multiple choice quiz. Students were allowed to choose the modules according to their own wishes, i. e., the sequence of working these units could be freely selected. They were instructed to study the information within a given time limit. Reaching the time limit resulted in the quiz being presented automatically. When subjects gave a wrong answer, remedial lessons were offered. This procedure was the same within each of the seven units.

1.2. *The Hypertext Program*

Giving a freely navigable hypertext program is one of the more dubious strategies to enhance incidential and explorative learning [CON 87][GRA 96]. Although many authors emphasize the advantages of hypertextual learning, studies frequently show disadvantages of this program type [GER 97][SPI 90]. For the present experiment a freely navigable hypertext environment has been created. The program contained the same information as the Tutorial mentioned above. The differences consisted in the presentation of the material. In the Hypertext environment students had the possibility to freely access information. No units or tests were given and there were more links between the different parts compared to the Tutorial.

1.3. *The Goal-Based Scenario*

Designing situated learning environments has become an increasingly important strategy in supporting a better transfer from learning settings to real world tasks [BRO 89] [COL 89]. Goal-Based Scenarios (GBS) stay in the tradition of situated learning approaches like cognitive apprenticeship or anchored instruction approaches [CAM 94][COG 91][COG 92]. A GBS is characterized by an authentic and realistic story in which the student plays a certain role. The student as part of the scenario is confronted with a problem situation that has to be completed [SCH 94a][SCH 94b]. Completion means here to produce an outcome, a product. This is the goal of the scenario [COL 94]. Given enough information resources the student should be able to solve the tasks [CAM 94][SCH 94a]. For this study, a GBS has been developed called the ”Heidelberg University Press”[1]. The learner had the role of an editor in a newspaper agency. Working on his central desktop – which was simulated by the computer program - the student was supposed to write an article using news-agency messages, the telephone and an information database. The task involves evaluating the messages and searching background information. The entire hypertext mentioned above was integrated into the GBS program and used as the background information resource. This resource provided the opportunity to search new information, find relationships and extend contextual knowledge.

In order to provide comparable treatment in all three conditions, all subjects received an introductory training in the use of metacognitive search strategies and strategies of evaluating information.

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[1] A full GBS would also include a case-base containing information in form of story-like structures and algorithms which retrieve stories that help a student in a particular problem situation. No such case base is intergrated in our simplified version of a GBS.

2. Evaluating Learning Effects

One of the most important aspects when using computers in educational settings is the question of learning outcomes. Regarding knowledge acquisition we need to distinguish between different aspects of knowledge: declarative knowledge (how many facts and details does the student know?), structural knowledge (does the student know the relationships between facts and concepts?) and knowledge transfer (can students apply the new information in argumentation or in any other context?). Another important aspect is motivation: In which way and to what extent is the training motivating for the students? A learning environment which is intrinsically or extrinsically motivating should enhance students' engagement and thus further the learning outcome [MAL 81]. Since we did not provide for external reinforces, our main interest in this study is on intrinsic motivation.

2.1. *Sample and Materials*

Sixty subjects between the ages of 17 and 53 took part in this investigation. Each condition consisted of 20 students that were randomly assigned to one of the programs. Mean age was 28 years, 31 subjects were male, 29 female. Each student participated in one program type (Tutorial, Hypertext or GBS), each program lasted about 3 hours.

Knowledge acquisition was measured in three ways: The multiple-choice questions of the Tutorial were applied to all three groups after their respective treatment. The results of these tests can be regarded as a measurement of factual knowledge. In order to assess structural knowledge each subject had to create a concept map before and after working with one of the programs [JON 93].

In order to measure the ability to apply the new information to different contexts, every subject had to discuss a specific topic before and after the treatment (by using a two-columned "pro and contra"-form). Finally, motivational parameters were obtained by self assessment on rating scales at the beginning and in the end of a session using questions like ”Did you have fun using this program?” or ”How much do you want to continue with this program?”.

2.2. *Results*

The tests used in order to measure fact-related knowledge showed a significant better performance of students participating in the Tutorial program than students taking part in any of the other two program types. Also, the GBS was superior to the ‘pure’ Hypertext ($p<.01$) on this outcome measure.

Structural knowledge has been measured by comparing subjects' concept-maps with an optimal concept-map representing all and only the correct relations between important concepts of the domain. With subjects displaying no differences in structural knowledge before using the programs, all groups could significantly

increase their structural knowledge during the lesson ($p<.05$). In the posttest the GBS condition produced significantly better results in this dimension than both of the other groups ($p<.05$) who displayed no significant differences.

Assessment of motivational parameters showed that all students were highly motivated before working with the programs. In the course of the experiment, a significant decrease in motivation occurred for subjects working with the Tutorial ($p<.01$) and the Hypertext ($p<.001$). No such decrease of intrinsic motivation took place in the GBS condition; in the post test, the differences between the GBS group and the other two became significant ($p<.05$).

In order to measure the quality of subjects' argumentation (discussion of a specific topic), each student statement was independently rated by two research assistants (Spearman $R=.56$) using the dimensions "acceptance", "relevance", "rationality" and "distinctiveness". In general the GBS group showed higher quality of argumentation than the Hypertext or Tutorial condition. Significant differences were detected between GBS and Hypertext in the dimensions "acceptance" ($p<.01$) and "relevance" ($p<.05$) and an overall difference in the category "rationality" ($p<.01$).

3. Discussion

The results of this study concern different aspects of hypermedia learning environments. First, it provides evidence that integrating the learner by means of an active role to play into the learning task enhances motivation. In addition, a clear goal seems to be an important factor for enhancing motivated knowledge acquisition [COL 94][MAL 81]. Furthermore, we accrued evidence that students in Tutorial program types perform well in remembering isolated facts but lack structural knowledge. Detecting and constructing relations as well as understanding underlying concepts by building coherent networks seems a more important learning outcome, we would argue. The GBS condition thus led to more interesting learning outcomes because subjects acquired more structural knowledge in this condition.

One of the most serious disadvantages of traditional computer-based courses is the lack of transfer from training material to real world problems [BRO 89][GRU 95]. We would claim that courses which engage students and provide them with cognitive tools (such as tools for argumentation and information evaluation) lead to deeper processing, more elaborate knowledge structures and to more understanding. They thus should help the learners to overcome the lack of transfer to real world situations [SCH 94a][SCH 94b], an expectation we could not test in this study.

Finally, it does not matter whether a course is designed for a local platform or for the WWW. With the increasing use of modern technologies quality differences will disappear. Especially when training people for real life tasks an instructor's way of creating courses according to situated learning principles seems to be most preferable [COG 92][COL 89].

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