Navigation and Ownership for Learning in Electronic Texts: An Experimental Study

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Abstract: Feelings of ownership for learning are an important part of the learning process and should be encouraged in e-Learning environments. This paper presents two experimental studies investigating the effects of navigation aids on ownership for learning with electronic texts. Experimental findings revealed that designers should not assume that allowing learners greater control over their navigation through higher navigational freedom, or the ability to create their own navigation aids, will increase feelings of ownership for learning with electronic texts. The results of these studies have implications for those designing navigation in educational electronic texts.

Keywords: ownership for learning, navigation aids, electronic text.

1. Introduction

Electronic texts are an essential component of any e-Learning environment. The way that the user interface is designed to support navigation in electronic texts is critical since it determines the way that the texts can be traversed and it is vital that navigation problems, such as 'feelings of lostness' (e.g. Conklin 1987), are avoided. In e-Learning environments, a key question is how navigation affects learning, and one important aspect of the learning process is that learners feel ownership for their learning (e.g. Cunningham et al 1993).

Previous research has demonstrated that navigation aids affect the way users interact with educational electronic texts and this, in turn, influences the achievement of learning outcomes (e.g. McDonald and Stevenson 1999). We extend this by hypothesising that different navigation aids will also impact upon users' feelings of ownership for learning and we present two experiments designed to investigate these effects. The first experiment examined the effects of the level of navigational freedom offered by a navigation aid on feelings of ownership for learning. The second experiment examined the effects of allowing learners the opportunity to create their own navigation aids on feelings of ownership for learning.

'Electronic text' is used here as a generic term to refer to any text presented in an electronic medium. These texts may be presented in a variety of ways including WWW and stand-alone CD-ROMs. Examples include hypertext documents (nodes of text connected by embedded links), text organised in menu structures, or linear text organised as a set of sequential nodes or as a single scrollable document. We define 'navigation aids' as elements of an interface that allow the user to access and traverse electronic texts; examples include embedded links, menus, interactive maps, and bookmarks.

1.1 What is ownership for learning?

Milner-Bolotin's (2001) working definition of ownership is employed in this research. In this definition, learner ownership is broken down into three interacting components of the learning process: finding personal value, feeling in control, and taking responsibility (see figure 1). Finding personal value is about understanding how the knowledge and skills developed during learning might be useful in situations outside the original learning environment. High feelings of control occur when the learner makes decisions and is a proactive rather than reactive learner. Responsibility in learning, on the other hand, refers to the learner taking responsibility, or feeling accountable, for the process of learning as well as the results of learning. The highest levels of ownership occur when all three components overlap. Situations where only one or two components overlap result in lower feelings of overall ownership.

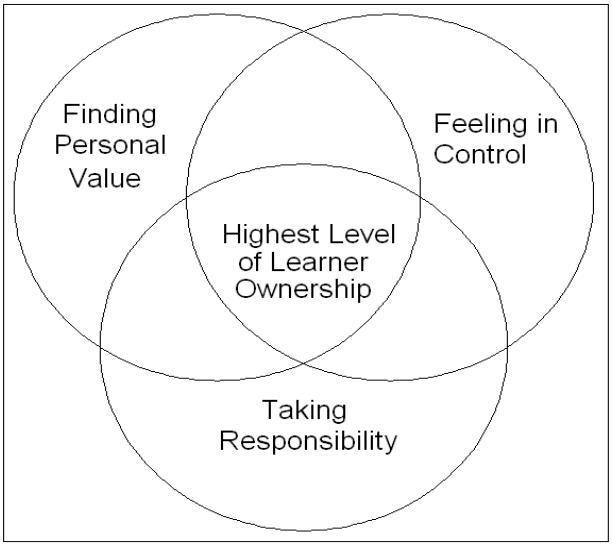

Figure 1: Learner ownership as an interactional effect of feelings of personal value, control and responsibility. Adapted from Milner-Bolotin (2001).

1.2 Why is ownership important in learning?

Learner ownership is promoted as illustrating the student-centredness of constructivist learning (Honebein 1996) and has been proposed to be important in terms of motivation to learn (e.g. Biggs 1999). Gross (1997) reported that attempts to encourage ownership in a classroom setting had positive effects on learning. By stressing student input, students came to feel responsible for their learning and in turn it was found that they grasped material more firmly, exhibited higher levels of inquiry and pursued tasks independently.

1.3 Background and experimental hypotheses

1.3.1 Learner control and navigational freedom

Supporters of constructivism propose that learners should be given responsibility and control over their learning (Honebein 1996; Duffy and Cunningham 1996), and educationalists have argued for some time that providing appropriate levels of learner control benefits learning (Eveland and Dunwoody 2001). In the context of e-Learning, learner control can be used to refer the extent to which learners are able to make choices and decisions when they use a piece of educational technology. It should also be noted that learner control is distinct from feelings of control, because even if control is offered to the learner, it is not always the case that they will feel and recognise this control.

In terms of ownership, Milner-Bolotin (2001) proposed that learning environments that allow students higher control over their learning, allow them to choose topics of investigation which are more relevant for them, and allow them to be more responsible for their learning, provide more opportunities for students to develop a sense of ownership. In digital technology many authors have interpreted this learner control as control over pace and sequencing (Dillon and Gabbard 1998; for a detailed review see Lunts 2002). We propose that one way this control and choice is realised in electronic texts is as the extent to which learners are able to explore the texts in a way they see fit.

In order to investigate control and choice in electronic texts we define 'navigational freedom' as the degree of choice a user has when deciding which page to visit. This equates to the number of outgoing links a learner has to choose between on any one page of the texts. The type of navigation aid(s) employed determines the level of navigational freedom offered. For example, an A-Z index, that allows the learner to choose between every page in an electronic text, represents a navigation aid with higher navigational freedom than paging buttons where the learner only has the choice of going to the next or previous page in a predefined sequence. We hypothesise that navigation aids that offer higher navigational freedom will lead to higher feelings of ownership for learning than navigation aids that offer lower navigational freedom. Experiment 1 was designed to measure these predicted effects.

1.3.2 Learner control and creating navigation aids

Giving learners the opportunity to create their own navigation aids can be seen as another way of offering the learner control over their learning with electronic texts. Through creating their own navigation aid, such as a map, the learner can exercise control when they make choices and decisions about the content, structure and layout of the navigation aid. The learner has the control to tailor the navigation aid to their own needs and make decisions about how they will access materials and in what order.

Recent developments in navigation aids allow the user to adapt the aid and use it to represent ideas in the electronic text. For example, Nestor Navigator (e.g. Zeiliger et al 1997; Zeiliger et al 1999; Nestor is available

for download here) is a web browser add-on that creates a graphical trace of visited web pages as the user navigates. This trace can be rearranged and edited, allowing users to create their own navigable structures such as maps (click here for an example map on Nestor related websites), contents lists and alphabetical indexes which they can use as navigation aids.

Due to the proposed benefits of learner control in encouraging ownership we hypothesise that creating navigation aids will lead to higher feelings of ownership for learning with electronic texts, than simply using navigation aids. Experiment 2 investigates the effects of creating navigation aids as compared to using navigation aids in Nestor.

The next section presents the methods employed in experiments 1 and 2.

2. Method

2.1 Experiment 1

Experiment 1 aimed to investigate the effects of the level of navigational freedom offered by navigation aids on feelings of ownership for learning. Participants used either paging buttons, hypertext, an A-Z index or a map to navigate educational electronic texts. They were then asked to rate their feelings of ownership for their learning with the electronic texts on a questionnaire.

2.1.1 Participants

Twenty-eight undergraduates and postgraduates on an introductory Human Computer Interaction (HCI) course took part in the study. Sixteen were female and twelve male. Ages ranged from 18-39 years. All had a similar level of background knowledge of the topic presented in the electronic text.

2.1.2 Materials

Participants were given electronic text on the subject of usability evaluation, compiled from teaching materials. The text consisted of twenty-three nodes and was approximately 3100 words in length. The materials were created and accessed using the Nestor Navigator browser.

2.1.3 Design

A between-subjects design was employed and participants were randomly assigned to experimental conditions, giving a total of seven participants in each condition. The independent variable was the type of navigation aid. The four conditions and associated levels of navigational freedom were:

- *Condition 1*: Paging buttons (lower navigational freedom).
- *Condition 2*: Hypertext (medium navigational freedom).
- *Condition 3*: A-Z index (higher navigational freedom).
- *Condition 4*: Map (higher navigational freedom).

See figures 2-5 for illustration.

Condition 1 (paging buttons) consisted of 'Next' and 'Previous' buttons that allowed the user to access pages in a sequential order. In condition 2 (hypertext) each page consisted of hypertext and a back button, and the pages in the text were arranged as a network of cross-referential links. Condition 3 (A-Z index) consisted of a left-hand frame containing an interactive alphabetical list of page titles, and a right hand frame showing the content of pages. Similarly, condition 4 (map) consisted of a left-hand frame containing an interactive graphical map of page titles, and a right hand frame showing the page content.

The A-Z and map conditions were both included in this experiment to represent high levels of navigational freedom in order to assess the effects of the different structures they depict. The graphical map shows one possible conceptual structure of the text. The index, in contrast, shows an alphabetical structure.

The dependent variable was the level of feelings of ownership for learning. An ownership measurement questionnaire (Milner-Bolotin 2001), designed for measuring ownership in a classroom setting, was adapted for use in the context of educational electronic texts. The original questionnaire was worded in terms of ownership for learning in a group project. The process of adapting the questionnaire involved rewording the questions in terms of issues specific to the use of electronic texts in learning. The adapted questionnaire consisted of sixteen questions on feelings of control for learning, feelings of responsibility for learning and feelings of value for learning. Questions were rated on a five-point Likert scale from strongly disagree (1) to strongly agree (5). The results of a reliability analysis and factor analysis of the

questionnaire will be discussed further in the results section.

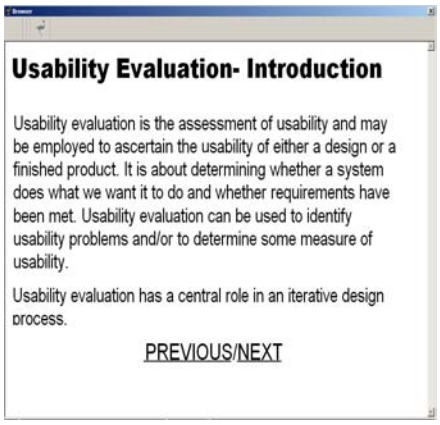

Figure 2: Paging buttons.

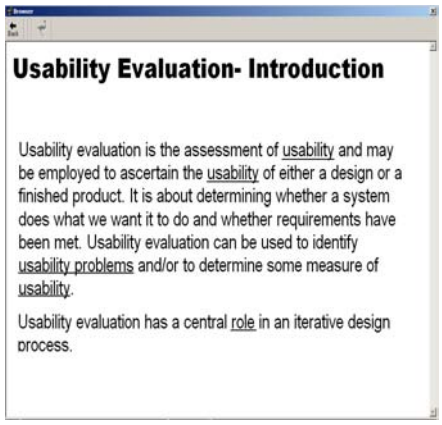

Figure 3: Hypertext.

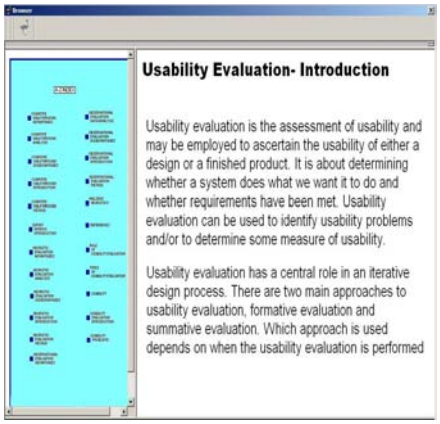

Figure 4: A-Z index.

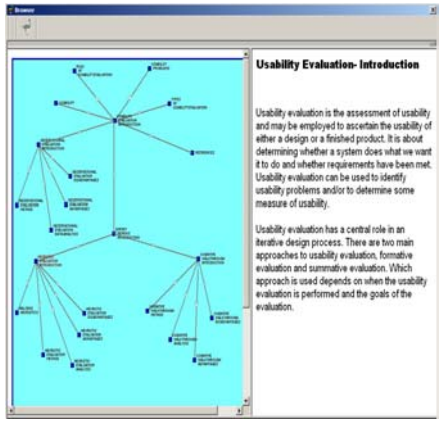

Figure 5: Map.

2.1.4 Procedure

Participants were tested individually. Initially participants were given a pre-test questionnaire on their knowledge of usability evaluations, followed by a ten-minute training task in using the navigation aids with sample materials on the American Museum in Britain. For the main task, participants used electronic texts on usability evaluation in a realistic educational task. They were given a setting for a usability evaluation including details of a budget, timescales and access to users. They were then given up to forty-five minutes to use the task materials on usability evaluation to choose a usability evaluation technique for the given setting. After they had finished, they were asked to complete the questionnaire regarding their feelings of ownership for learning with the electronic texts.

2.2 Experiment 2

Experiment 2 aimed to investigate the effects of creating navigation aids on feelings of ownership for learning. The experiment had two parts, each carried out by different participants. Participants in part A of the experiment used electronic texts with an existing map or facilities to create their own map as navigation aids. Participants in part B used electronic texts with an existing A-Z index or the facilities to create an A-Z index as navigation aids. They were then asked to rate their feelings of ownership for learning on a questionnaire. Data collected from the hypertext condition in experiment 1 was also used as a comparison condition in parts A and B of this experiment.

2.2.1 Participants

Twenty-six undergraduates and postgraduates on an introductory HCI course took part in parts A and B. Thirteen took part in part A and thirteen took part in part B. Of the twenty-six, thirteen were female and fourteen male. Ages ranged from 18-49 years. All had a similar level of background knowledge of the topic presented in the electronic text.

2.2.2 Materials

The same text content was used as in experiment 1. Again the materials were developed and accessed using the Nestor Navigator browser.

2.2.3 Design

A between-subjects design was employed for both parts A and B of this experiment and participants were randomly assigned to experimental conditions.

The independent variable was the type of navigation aid. For part A the experimental conditions were:

- *Condition 1*: Using a Map (+ Hypertext)
- *Condition 2*: Creating a Map (+ Hypertext)

For part B the experimental conditions were:

- *Condition 3*: Using an A-Z (+ Hypertext)
- *Condition 4*: Creating an A-Z (+ Hypertext)

Six participants took part in conditions 2 and 3, and seven participants took part in conditions 1 and 4.

Condition 1 (using map + hypertext) consisted of hypertext and a back button, and a graphical map of page titles in a left-hand frame. In condition 2 (creating map + hypertext), initially the participants accessed pages using hypertext. When the participants visited a page, the page title and the visited link were represented as a graphical trace in a left hand window. The page titles were interactive and could be used to access pages in the electronic texts. The participants were asked to arrange the map according to their own preferences by re-arranging the shape of the map, adding new links and deleting links.

Condition 3 (using A-Z + hypertext) consisted of hypertext and a back button, as well as an interactive alphabetical index of page titles in a left-hand frame. For condition 4 (creating A-Z + hypertext) the participants could access pages using hypertext. When the participants visited a page the page title was represented in a window on the left hand side of the screen. These titles were interactive and could be used to access pages in the electronic text. Participants were asked to arrange page titles into alphabetical order by clicking and dragging them into position.

As with experiment 1, the creating and using A-Z and map conditions were both included in order to assess the effects of the different structures that they depict. The map shows one possible conceptual structure of the text, where as the A-Z shows an alphabetical structure.

Finally, the following condition was also added as comparison condition in both parts A and B, since it forms a baseline for the conditions in both parts A and B:

- *Condition 5*: Hypertext

The data collected from the seven hypertext participants in experiment 1 was used here as condition 5. The use of this data as a comparison condition is valid since the procedures and measures used in experiment 2 are the same as experiment 1. As such, data from the hypertext condition can be compared against conditions 1 and 2, as well as against conditions 3 and 4.

The dependent variable was the level of feelings of ownership for learning as measured by the ownership questionnaire detailed in section 2.1.3.

2.2.4 Procedure

The procedure was the same as that used in experiment 1, except that the participants in the creating navigation aids conditions were asked to create the respective navigation aid as they used the electronic texts.

3. Results

3.1 Reliability analysis and confirmatory factor analysis

In order to assess the quality of our ownership questionnaire, we performed an analysis of its internal reliability. This process led to the removal of three questions due to low-item total correlations, indicating that these questions were measuring a different construct to the rest of the questionnaire. The final questionnaire, used in the following analyses had thirteen questions, and was found to have a Cronbach's alpha of 0.8, indicating good internal reliability.

In addition we performed a confirmatory factor analysis to identify factors in the final questionnaire. Three factors were revealed relating to: control over use of the electronic texts; responsibility for learning with the electronic texts; and value for learning with the electronic texts. See box 1 for the questions that fell under each factor, and the questions that were removed.

Factor 1 – Control
I felt I could not access the pages I wanted to in the electronic texts.
I felt I was free to choose the way I progressed through the electronic text materials.
I felt I had control over the use of the electronic text.
I think I had control over my progression through the electronic text materials.
I felt responsible for the exploration of the materials on usability evaluation.
Factor 2 – Responsibility
I felt responsible for my final choice of evaluation techniques(s).
I felt ownership for my final choice of usability evaluation technique(s).
I do not feel a personal responsibility for the decisions I made when using the electronic tests to choose a usability evaluation technique.
I feel responsible for the usability evaluation decisions I made when using the electronic text.
I had a sense of ownership for my use of the electronic text materials to choose a usability evaluation technique(s).
Factor 3 – Value
I found no personal value in the information in the electronic texts.
I found personal value in the use of the electronic texts.
I think I will be able to use what I have learned from the electronic text materials in other courses, and/or in everyday life.
Removed Items
I felt that my progression through the electronic text materials was guided.
I think that the skills that I have learned when using these materials will help me to succeed in the future.
I think freedom to decide the way you use electronic text materials is very important to learning with these materials.

Box 1: Questions that fell under each factor and removed questions.

3.2 Experiment 1

This section reports on results from participants in the paging buttons, hypertext, A-Z and map conditions in experiment 1.

Total ownership scores were calculated by reversing the ratings for negatively worded questions and adding together ratings for all questions on the questionnaire. All thirteen questions were weighted equally so the total ownership scores were rated out of 65. The questionnaire responses were then examined in terms of average ratings for each factor.

Average ratings for the control factor were calculated by pooling all the participants' ratings for the control questions and calculating an average for each condition. The same method was used to obtain average ratings for the responsibility and value factors.

Due to the non-parametric nature of the data, Kruskal-Wallis one-way analyses of variance (ANOVA) by ranks were employed to assess differences between conditions, and where appropriate non-parametric tests for post-hoc pair-wise comparisons according to the Siegal and Castellan (1988) method were also used (see table 1). Note that graphs are only given where there are significant differences between conditions.

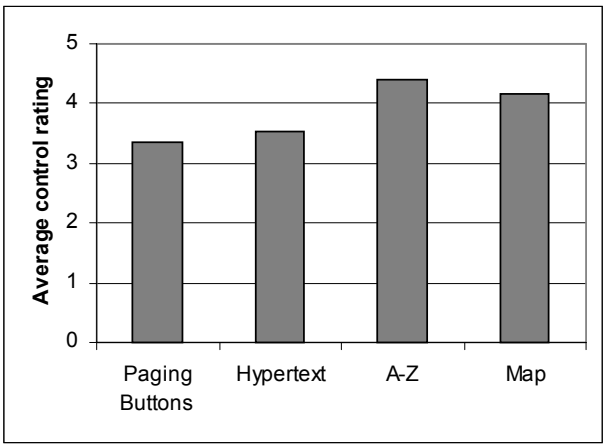

Figure 6: Average ratings on the control factor for conditions in experiment 1

Table 1: Results of analyses performed on questionnaire ratings for the paging buttons, hypertext, A-Z and map conditions in experiment 1

Analysis	Average for each condition	Kruskal-Wallis ANOVA	Significant post-hoc tests (p<0.05)
Total ownership scores (out of 65)	paging buttons – 49.71; hypertext – 49.14; A-Z index – 52.86; map – 50.57.	Non-significant.	N/A.
Control factor (out of 5)	paging buttons – 3.34; hypertext – 3.54; A-Z index – 4.40; map – 4.17. (see figure 6).	Significant (H(3,140)=20.82,p<0.000)	paging buttons vs A-Z; paging buttons vs map; hypertext vs A-Z; hypertext vs map.
Responsibility factor (out of 5)	paging buttons – 3.91; hypertext – 3.97; A-Z index – 3.57; map – 3.54.	Non-significant.	N/A.
Value factor (out of 5)	paging buttons – 3.91; hypertext – 3.97; A-Z index – 3.57; map – 3.54.	Non-significant.	N/A.

3.3 Experiment 2

Firstly we present the results of the analysis of data collected from the using map and creating map conditions in part A of experiment 2, compared with data from the hypertext condition in experiment 1. We then present the results of analyses conducted on the data from the using A-Z and creating A-Z conditions in part B of experiment 2, again as compared with the data from the hypertext condition in experiment 1. As discussed earlier the comparisons with the hypertext condition are valid since the procedures and measures of experiments 1 and 2 are the same.

Total ownership scores out of 65 were calculated in the same way as in experiment 1. The questionnaire responses were also examined in terms of ratings for each factor, and averages were again calculated in the same was as in experiment 1. Kruskal-Wallis ANOVAs were then employed to assess the effects of the different navigation aids, and where appropriate non-parametric tests for post-hoc pair-wise comparisons according to the Siegal and Castellan (1988) method were also used. The results for parts A and B of experiment 2 are presented in tables 2 and 3 respectively. Graphs are only shown for significant results.

Table 2: Results of analyses performed on questionnaire ratings for the using map and creating map conditions in part A of experiment 2, including comparisons against the hypertext condition from experiment 1.

Analysis	Average for each condition	Kruskal-Wallis ANOVA	Significant post-hoc tests (p<0.05)
Total ownership scores (out of 65)	using map – 59.29; creating map – 46.33; hypertext – 49.14. (see figure 7).	Significant (H(2,20)=8.226,p<0.050).	using map vs. creating map; using map vs. hypertext.
Control factor (out of 5)	using map – 4.69; creating map – 3.70; hypertext – 3.54. (see figure 8)	Significant (H(2,100)=26.19,p<0.000)	using map vs. creating map; using map vs. hypertext.
Responsibility factor (out of 5)	using map – 4.51; creating map – 3.63; hypertext – 3.97. (see figure 8)	Significant (H(2,100)=16.70,p<0.000)	using map vs. creating map; using map vs. hypertext.
Value factor (out of 5)	using map – 4.43; creating map – 3.22; hypertext – 3.86. (see figure 8)	Significant (H(2,60)=9.64,p<0.01)	using map vs. creating map.

Table 3: Results of analyses performed on questionnaire ratings for the using A-Z and creating A-Z conditions in part B of experiment 2, including comparisons against the hypertext condition from experiment 1.

Analysis	Average for each condition	Kruskal-Wallis ANOVA	Significant post-hoc tests ($p<0.05$)
Total ownership scores (out of 65)	using A-Z – 52.00; creating A-Z – 49.43; hypertext – 49.14.	Non-significant.	N/A.
Control factor (out of 5)	using A-Z – 3.57; creating A-Z – 3.97; hypertext – 3.54.	Non-significant.	N/A.
Responsibility factor (out of 5)	using A-Z – 4.20; creating A-Z – 3.94; hypertext – 3.97.	Non-significant.	N/A.
Value factor (out of 5)	using A-Z – 4.39; creating A-Z – 3.90; hypertext – 3.86.	Non-significant.	N/A.

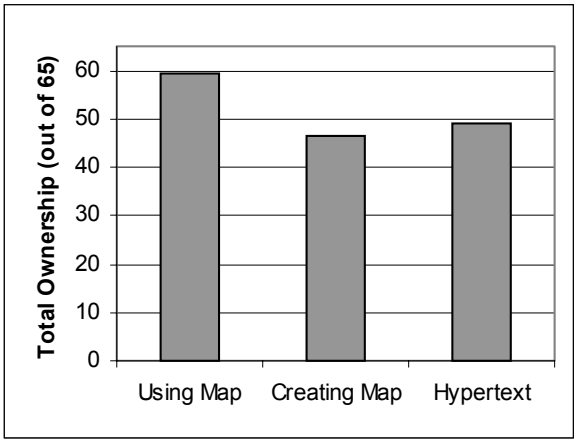

Figure 7: Average total ownership scores for analyses of part A in experiment 2.

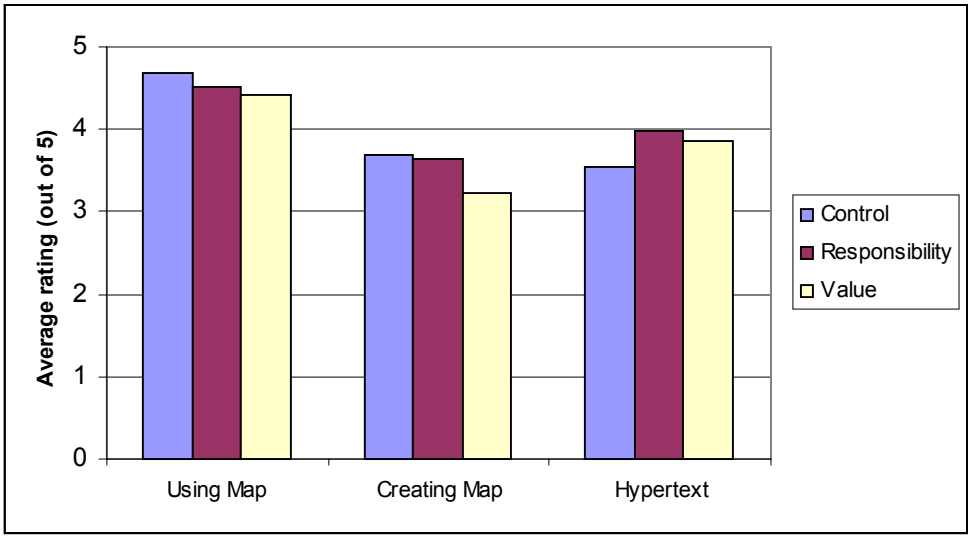

Figure 8: Average ratings on the control, responsibility and value factors for analyses of part A in experiment 2.

4. Discussion

The two experiments presented here aimed to assess the effects of navigational freedom and creating navigation aids on ownership for learning with electronic texts. Overall the results of these experiments indicate that navigation aids influence ownership for learning.

4.1 Summary and explanation for findings

4.1.1 Experiment 1

Experiment 1 examined the effects of the level of navigational freedom offered by a navigation aid, on feelings of ownership for learning. It was found that navigational freedom had significant impact upon feelings of control for learning with electronic texts, but did not affect overall ownership, or the component feelings of responsibility and value as measured by the questionnaire. In particular A-Zs and maps led to significantly higher feelings of control than paging buttons and hypertext. This suggests that the higher level of navigational freedom offered by the A-Z and map encourages higher feelings of control in the learner than the lower levels of navigational freedom offered by the paging buttons and hypertext. The learner control offered through higher navigational freedom has a positive influence on feelings of control, but findings indicate that it does not affect high feelings of responsibility or value in learning with electronic texts.

4.1.2 Experiment 2

Experiment 2 investigated the effects of creating navigation aids on ownership for learning with electronic texts. For part A, analyses showed that there were significant differences for overall feelings of ownership between the using map, creating map and hypertext conditions, but these results were not as predicted. It was found that participants who used maps reported significantly higher feelings of ownership than those that created their own maps. Furthermore, participants who used maps also reported significantly higher feelings of ownership on the questionnaire than participants that used hypertext. However, for part B there were no significant differences in the level of ownership reported by participants in the using A-Z, creating A-Z and hypertext conditions.

The results of experiment 2 were also examined in more detail by looking at participants' ratings on each factor of the questionnaire. The analyses of part A revealed that participants who used maps reported significantly higher feelings of control, responsibility and value for their learning than participants who created their own maps. In addition, the participants who used maps also reported significantly higher feelings of control and responsibility than participants who used hypertext. For the analyses of part B, there were no significant differences in the levels of control, responsibility and value reported by participants who used A-Zs, created A-Zs or used hypertext.

Our findings indicate that creating maps leads to lower feelings of overall ownership, and each of its component factors of control, responsibility and value, than using maps. However, the fact that no significant differences were found between using A-Zs, creating A-Zs and using plain hypertext for overall ownership, or the control, responsibility and value factors, suggests that it is not simply the act of creating a navigation aid that negatively leads to lower feelings of ownership. The effect is specific to differences between the using and creating map conditions in our experiment.

A potential explanation for this is that the activity of creating a map, in itself, requires certain skills that the user may not have unless they have used mind mapping software previously. In this experiment, although the participants were given functional training in map creation, they were not given any additional guidance about the best techniques to apply when creating maps. This was intentionally left open in this experiment so that participants could make their own decisions about creating the map.

4.2 Scope of findings

The type of electronic texts and the type of tasks employed in our experiments define the scope of our findings. The electronic texts used in these experiments were on the subject of usability evaluation, a topic that is central to HCI education, and has little pre-defined structure. As such, the findings presented here are of particular relevance to the use of educational electronic texts in topics with similar inexact structures such as those in Art and History. However, findings on ownership may differ for educational electronic texts with natural pre-defined structures, such as biological classification systems.

Our findings are also particularly relevant in short-term educational tasks, such as those used in a single tutorial session. However, findings on ownership may differ in long-term educational tasks or projects. This may be particularly relevant to the creation of navigation aids. Navigation aids that are created and refined over time may have different effects on ownership to the findings reported here.

The findings presented here focus on the effects of navigation aids on feelings of ownership for learning. We have not addressed other aspects of the learning process such as knowledge development.

4.3 Implications of findings

There are three major implications of our findings. Firstly, navigation aids affect feelings of ownership for learning with electronic texts. This indicates that designers of these texts should consider the employment of navigation aids carefully if they want to promote feelings of ownership.

Secondly, higher navigational freedom leads to higher feelings of control, but not higher overall ownership or the component feelings of responsibility and value. Consequently, we suggest that the designer of educational electronic texts should not simply look at navigational freedom to encourage feelings of ownership for learning. They should also address issues related to encouraging the user's feelings of responsibility and value in their learning. We can speculate that aspects of the learning environment that might influence these feelings include the relevancy of the task to the learner and the learner's involvement in decision making about the task.

The third implication of our experiments is that creating navigation aids has little or negative effects on feelings of ownership for learning, but that using maps to navigate is particularly beneficial to ownership. As such, if they want to promote ownership designers of educational electronic texts should be careful in the way that they employ tools that allow users to create their own navigation aids.

4.4 Conclusions and future research

Overall, our findings suggest that designers of educational electronic texts should not assume that by increasing navigational freedom, or offering learners the ability to create their own navigation aids, they will increase the learner's feelings of ownership. Results presented here indicate that the effects of these types of navigation aids are not clear-cut in terms of ownership, and further investigation is needed.

Three key areas for future research have been identified. Firstly, the results presented here only examine the consequences of navigational freedom, and using and creating navigation aids in terms of feelings of ownership for learning. In order to get a complete picture of the effects of these activities further investigation will look at how they influence users' understandings of the text content as well as how efficient they are to use. Secondly, since it was thought that potential difficulties could have arisen with the creation of maps due to learners' inexperience in mind mapping skills, another area for future investigation is to examine the effects of additional training in mind-mapping skills and specific training in the use of creating-map software, on feelings of ownership for learning. Finally, this research should be extended by looking at the effects of navigation aids on ownership for learning in the context of different types of electronic texts and educational tasks.

References

Biggs, J. (1999) *Teaching for Quality Learning at University*, Open University Press, Buckingham, UK, pp61.

Conklin, J. (1987). "Hypertext an Introduction and Survey", *IEEE Computer,* Vol.20, No.9, pp17-41.

Cunningham, D. J., Duffy, T. M., and Knuth, R. A. (1993) "The Textbook of the Future" in *Hypertext: A Psychological Perspective*, C. McNight, A. Dillon and J. Richardson (Eds), Ellis Horwood, pp19-49.

Dillon, A. and Gabbard, R. (1998) "Hypermedia as an Educational Technology: A Review of Quantitative Research Literature on Learner Comprehension, Control and Style", *Review of Educational Research*, Vol.68, No.3, pp322-349.

Duffy, T. and Cunningham, D. J. (1996) "Constructivism: Implications for the Design and Delivery of Instruction", in D. Jonassen (Ed), Macmillan Library Reference USA, NY, pp170-198.

Eveland, W. P. and Dunwoody, S. (2001). "User Control and Structural Isomorphism or Disorientation and Cognitive Load?" *Communication Research*, Vol. 28, No. 1, pp48-78.

Gross, P. A. (1997) *Joint Curriculum Design: Facilitating Learner Ownership and Active Participation in Secondary Classrooms*, Lawrence Erlbaum Associates, NJ.

Honebein, P. C. (1996) "Seven Goals for the Design of Constructivist Learning Environments", in *Constructivist Learning Environments: Case Studies in Instructional Design*, B. G. Wilson (Ed), Educational Technology Publications, NJ, pp11-24.

Lunts, E. (2002) "What Does the Literature Say about the Effectiveness of Learner Control in Computer Assisted Instruction?" *Electronic Journal for the Integration of Technology in Education*, Vol.1, No.2, pp59-75. Available online: http://ejite.isu.edu/Volume1No2/Lunts.pdf

McDonald, S. and Stevenson, R. (1999) "Spatial Versus Conceptual Maps as Learning Tools in Hypertext", *Journal of Educational Multimedia and Hypermedia*, Vol.8, No.1, pp43-64.

Milner-Bolotin, M. (2001) *The Effects of Topic Choice in Project-Based Instruction on Undergraduate Physical Science Students' Interest, Ownership, and Motivation*, PhD. Thesis, University of Texas at Austin.

Siegel, S. and Castellan, N.J. (1988) *Nonparametric Statistics for the Behavioural Sciences,* 2nd ed., McGraw-Hill, NY.

Zeiliger, R., Reggers, T., Baldewyns, L., Jans, V. (1997). "Facilitating Web Navigation: Integrated Tools for Active and Cooperative Learners", in proceedings of the 5th International Conference on Computers in Education, *ICCE '97*, Malaysia. Available online: http://www.gate.cnrs.fr/~zeiliger/artWN97.doc

Zeiliger, R., Belisle, C., Cerratto, T., (1999), Implementing a Constructivist Approach to Web Navigation Support, in proceedings of *ED-MEDIA'99 Conference*, AACE, Seattle,Wa., USA. Available online : http://www.gate.cnrs.fr/~zeiliger/artem99.htm

