HYPERTEXT COMPOSITION: ANALYSIS OF THE STUDENTS' ACTIVITIES IN THE DESIGN PROCESS

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Abstract: Navigation in hypertexts, the design of hypertext systems and hypertext writing with a pedagogical purpose have all become important objects of investigation in the educational field as well as in computing field. This study aims at arriving at a better understanding of what activities of hypertext composition can be effective to enhance students' awareness of writing processes. The study examines how students constructed a hypertext and how they felt about the task. Twenty Computing Engineering students were invited to participate. During the process, the students were asked questions every 5 minutes. After that, they were interviewed. A systemic network was used to organize and give structure to the analytical categories. A model of the process was derived from the data in order to represent how the hypertext construction was undertaken by this group of students. It is concluded that it is important to rethink the impacts of planning, reading and testing activities in traditional writing process.

Keywords: Writing process. Hypertext design. Pedagogical tools.

1. INTRODUCTION

Although there have been many attempts to encourage the use of a wide range of technology for pedagogical purposes, there have still only been a few studies in higher education on how hypertext which involves innovative teaching practices can be employed to bring about effective learning.

In the context of universities, there have been a growing number of studies on how to integrate computer technology and writing. Several subjects require undergraduates to produce a certain amount of written material during their course. To meet this need, undergraduate courses in Brazil have introduced disciplines that include the teaching of writing for academic purposes and which generally focus on the production of reports, articles, critical reviews and essays.

Like many other students, the Computing Engineering students of the State University of Ponta Grossa[1] in Brazil have to undertake writing tasks throughout their time at university. However, since the Computing Engineering Course is largely concerned with software design and development, these students have little preparation in the skills needed for carrying out writing tasks of an academic standard. Moreover, they have to submit an essay in the last year of their course before they can obtain their degree. This has to be of a high academic standard and most students find the task of writing difficult for various reasons. These include factors such as knowledge of the audience, text structure, revision, lack of planning and so forth.

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[1] In Portuguese "Universidade Estadual de Ponta Grossa" – UEPG.

The aim of this research is to arrive at a better understanding of what activities of hypertext composition can be effective to enhance students' awareness of writing processes. The study examines how students constructed a hypertext and how they felt about the task. It also outlines a model for understanding the process of hypertext composition.

Survey of the literature

It is important to define the term hypertext to clarify its precise meaning in this study. Nelson (1981), who originally coined the term "hypertext", defined it in his self-published *Literary Machines* as "non-sequential writing" by which is meant a nonlinear form of conveying information. Moreover, hypertext can be regarded as an idea which has been waiting for technology to catch up with. If one wishes to implement the active links, it is necessary to use a dynamic display medium such as a computer screen.

Landow (1990) points out that "Hypertext emphasizes connections and relations, and in doing so changes the ways texts exist and the ways we read them. It also changes the roles of author and reader, teacher and student. Hypertext refers to nonsequentially read (and written) texts." (Landow, 1990, p. 134). In some cases, the term hypertext is used as a metaphor to refer to a way of thinking, that is, an associative way which ignores the media (paper or computer screen) that will support the final product – the text (Rada, Michailidis, and Wang, 1994; Ribeiro, 2005). Thus, "The network of nodes and links represents a model of the human memory." (Rada, Michailidis, and Wang, 1994, p. 24).

This study focuses on the process of composing a hypertext by means of computer technology (electronic implementation). Hence, for the purposes of this research, hypertext can be regarded as the presentation of information in a network of nodes that are interconnected by links and which readers are free to navigate in a nonlinear form. This can be done through whatever paths the network may allow and where the following definitions apply:

a) the information will be the content (in the form of written text for the purposes of this study) that is processed by the writer/reader;
b) the node is an integrated and self-sufficient unit of information, that is relatively small with regard to the complete document. In electronic instances, nodes are often thought of as being small enough to fit on to one computer screen. A node[2] can be either as small as a single word or so huge that it fills a number of pages.
c) a link is the transversal connection between two nodes. It is the connection between different nodes which is selected by the readers. An anchor is the visible region which must be selected to activate the link[3].
d) to navigate is the act of moving along paths within the hypertextual document.
e) paths refers to the set of links that are either selected by the reader or constructed by the author.

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[2] Other synonyms for node include frame (KMS), work space (StorySpace), card (HyperCard), and lexia (by Landow (1990)). On the World Wide Web, a node is simply termed a Web Page.

[3] These may vary in size from one word to the entire contents of the node. In a conventional book, a link is the predefined sequence that is provided to the reader. The reader can have only one way of reading which is to start from the beginning of the book and go on till the end.

In general terms, there is an overlapping between traditional writing activities and hypertext composition activities. As a social artefact, writing involves communication and also representation which according to Hayes (1996) can be a "representation of the topic", "representation of the writer's persona" and "representation of the text as a spatial display". Writing also includes the act of thinking about what and how to write and whom to write to. For example, some people write in a different way to a familiar audience from the way they address an audience of strangers. Another feature of writing is that it involves cognitive processes. Although the product constitutes an important part of any construction process, these cognitive processes in writing may be better examined when researchers shift their view from the product to the process. According to Hayes (1996):

> (…) writing depends on an appropriate combination of cognitive, affective, social and physical conditions if it is to happen at all. Writing is a communicative act that requires a social context and a medium. It is a generative activity requiring motivation, and it is an intellectual activity requiring cognitive processes and memory. (Hayes, 1996, p. 5)

From a different perspective, writing can be viewed as a design process. Writing as a design can be considered as an open-ended process and mediated by tools and resources. In examining how designers work Lowson (1990) described the following kinds of design problems and processes which are pointed out by Sharples (1996):

- Design problem are open-ended and cannot be fully specified. The number of actions that a designer might take at any stage is uncountably large.
- The design process is endless. A designer is faced with an inexhaustible number of possible solutions and the end of the design is a matter of judgement.
- There is no infallibly correct process of design. There are many different and equally successful approaches, and good designers are able to control and vary their strategies according to the task.
- The process involves finding as well as solving problems. The design process does not consist of a neat sequence of stages leading up to a finished product, and much of a designer's time is spent in identifying and refining the problem.
- Design inevitably involves subjective value judgment.
- Design is a prescriptive activity. Design is concerned with what might, could and should be.
- Designers work in the context of a need for action. Design is a process that will result in some change to the environment. (Sharples, 1996, p. 136).
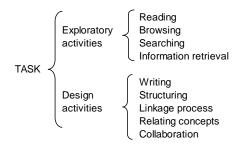
These aspects of design can enable one to understand how people write and also how people produce software in so far as they (the text and software) can also be considered as a design process.
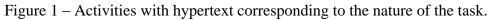
By recognizing that writing can be regarded as a design task, Dillon (2002) is able to offer a perspective in which hypertext writing (as a design activity) relies on combining content, structure and presentation into a coherent whole. Moreover, he argues that the focus of hypertext writing should not be on feature-based analysis of hypermedia interfaces, but on the provision of content, which is the role of the author and has traditionally been treated as a distinct form of 'design'. There are interesting parallels between these activities (traditional and hypertext writing) such as the fact that both are poorly structured and give a central role of iteration and their reliance on drafts

or prototypes to generate the finished products (Dillon, 2002). From this point of view, Dillon's view has a direct bearing on the teaching of writing and hypertext design.

Why production rather than consumption

The 1990s were characterised by a good deal of research on hypertext writing. Apart from allowing rapid access to large amounts of information, hypertext offers users the opportunity to construct their own hypertexts and thus meet their own particular requirements. Yet, why does one construct a hypertext? An active and goal-oriented task within an educational context is required to bring about learning outcomes. It has also been argued that hypertext writing might allow students involved in producing hypertext to acquire more significant learning than those performing exploratory tasks.

The following brief account of the implications of the exploratory and design tasks and the interrelationship between them, suggests that the task of writing hypertext is active rather than exploratory. Writing hypertext might bring about more significant learning benefits for the students involved in producing a hypertext than for those performing exploratory tasks such as browsing, searching or retrieving information. Figure 1 shows a summary of the learning activities provided by hypertext in two areas – reading as an exploratory activity and composing as a design activity. This should clarify views about the task which can be carried out with hypertext.

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                      ┌ Reading
           ┌ Exploratory  ┤ Browsing
           │ activities   │ Searching
           │              └ Information retrieval
TASK  ┤
           │              ┌ Writing
           │ Design       │ Structuring
           └ activities   ┤ Linkage process
                          │ Relating concepts
                          └ Collaboration
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Figure 1 – Activities with hypertext corresponding to the nature of the task.

While earlier accounts have raised high expectations regarding learning activities with hypertext, these exploratory tasks do not generally foster learning. This view is supported by Bromme and Stahl (2002) who explain that the opportunity to explore a hypertext environment more freely "is only an advantage for those learners who possess sufficient prior knowledge and a suitable learning style to structure their work." (Bromme and Stahl, 2002, p. 2). For this reason, an attempt should be made to identify what kind of prior knowledge or learning styles students can employ in the learning activity. Discovering this is particularly relevant to the task because much better learning outcomes can be anticipated if the task corresponds to individual differences.

In studies about exploratory activities, the learning constraints and opportunities involved in hypertext were analyzed by taking the exploratory activities together with the learning materials as a point of departure. However, there are some other tasks which are associated with the design of hypertext (sometimes called writing tasks). When the task is writing a hypertext, the decisions involved in the process are likely to be more complex. For example, the choice of words employed to link chunks of text can affect the readers' decisions and might not live up to their expectations. The structure of the content also involves making decisions about the relationships between the concepts.

Constructivist approach sheds light on the discussion about cognitive tools and teaching and learning. The focus of teaching, within the constructivist approach, should be on the way that students interact with their world and how they learn through this interaction (Duffy and Cunningham, 1996). To illustrate this view, Bosch and Bolluyt's (2001) study focuses on the collaborative writing of hypertext. If the emphasis is laid on collaborative writing of hypertext, it can help one understand many important aspects of hypertext production. For example, during the editing process, the students negotiated the structure of the hypertext. Further research might clarify how this negotiation takes place and what the strategies used by students to construct a hypertext in a collaborative way are. Bosch and Bolluyt's (2001) study helps understand some of the aspects of the process (by drawing on the four interrelated working processes) and shows how the teacher plays a central role. It seems that in the hypertext writing task, the artifact by itself is not enough to bring about learning.

An examination of the claims of authors reveals that the task of hypertext writing provides students with two aspects of learning:

- **The writing process**: this refers to how students perceive their own process of writing and their strategies for dealing with situations such as content structuring, planning, analysis, constructing an argument and so forth. Some studies might include analyzing the writing process for both hypertext writing and linear (traditional) text writing;
- **Content retention**: this refers to how much knowledge students acquire from the process of writing hypertext.

Apart from this study, there has still been very little research on the effects of hypertext writing on traditional writing. Currently, the technical constraints that have hampered the use of hypertext writing in teaching and learning, are being overcome by the facilities offered by the HTML editors. In the opinion of Bromme and Stahl (2002) "The production of hypertext is one way of enabling learners to deal with information actively and thereby encourage learning and comprehension of their contents." (Bromme and Stahl, 2002, p. 3). When an author decides how the content and concepts should be spread across the various nodes, it might lead to an understanding of concepts and the borderlines between them. Moreover, planning appropriate links can also lead to a deeper understanding of the semantic relations between the concepts which are covered in the individual nodes.

METHODOLOGY

Twenty Computing Engineering students (in different years of their course but with a previous knowledge of hypertext composition) were invited to compose an electronic hypertext from a given text. Although the focus of the study was on the process of composition, the students had to concentrate on both the process of construction and the product and were thus provided with a text to be processed into a hypertext.

During the process, the students were asked questions every 5 minutes. After that, they were interviewed. Although the hypertext documents were collected, the raw data for this research was not the product itself but rather, the students' accounts of the process of hypertext composition. Transcripts of verbal protocols were analysed and

both qualitative and quantitative approaches were adopted by means of a systemic network (Bliss et al., 1983) to organize and give structure to the analytical categories. Following this, the interview data were analysed and a new set of categories was defined so that an analysis could be carried out.

The initial version of the network was designed to contain most of the design activities undertaken by the students and took into account the fact that they had a pre-prepared text when composing their hypertexts.

A notation system drawn from Bliss et al. (1983) was used to construct the systemic network and the notations provide the readers with support in helping them to understand the way in which the network is to be read. The notations are as follows:

General idea	Technical term	Notation
Category name	term	e. g. Reading
Choice: difference in context of alternatives	system	BAR
Parallel aspects: simultaneous choices	co-selection	BRA
Repeated possibilities	recursion	REC
Greater fineness of distinction	delicacy	tree structure

Cerutti and Mellar (2005) suggest that the systemic network has a degree of refinement. Then, the systemic network was undertaken through a process of refinement that focused on three features: a combination of theoretical reflection and empirical data analysis; the notational aspects of the network (i.e. if the bars and brackets were where the researcher intended them to be); the organisation of the activities themselves (i.e. if the activities were related to each other and the degree of recursion applied).

In this way, the analysis of the data collection of students' activities has showed four main categories which are: "reading", "planning", "linking" and "improving interface". An example of this set of categories is provided in Figure 2.
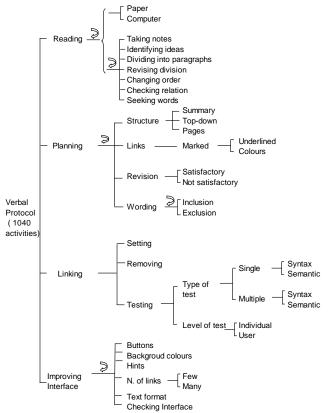
Figure 2 – systemic Network for the students' activities.

RESULTS AND DISCUSSION

A model of the process represents how the hypertext construction was undertaken by this group of students. The model is grounded in two sources of evidence: first, the data collected during the construction task and interview sessions, and second the evidence supplied in some other studies about hypertext writing. Figure 3 shows the structure of the model.
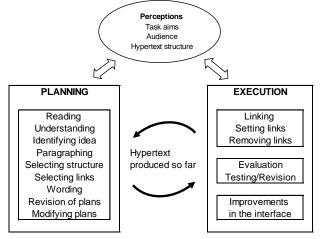

Figure 3 – The general organization of the model

The model comprises three major components: planning, execution and perceptions. The planning and execution components represent the composition activities, and the perceptions component represents the influence that the students' perceptions of the task aims, audience, and hypertext structure had on these activities.

The process of hypertext composition is a recursive process in which the sub-activities are also recursive processes.

The following points should be taken into account:

There is only one box in the planning component because of the difficulty of distinguishing planning activities. Some of them can be classified as internal (e.g. reading, comprehending and identifying ideas) whereas other can be seen as external (e. g. paragraphing and wording) and involve strategies to choose linking words.

The planning activities were not necessarily undertaken in the same order in which they are represented in the diagram. For example, one can start the process by reading and then select a structure; after that, one can read the text again and then select linking words (perhaps using some kind of strategy for the selected words). This might be followed by dividing the text into paragraphs or just revising what was done in advance.

There are three boxes in the execution component. Linking, evaluation and improvements are represented as distinct activities within the execution process, though they are not regarded as being sequential.

The component "Perception" comprises three focal points which were observed during the process of hypertext construction and expressed by students during the individual interviews. This component has two "two-direction" arrows connecting it with the planning and execution components. This suggests that perceptions can influence the planning and execution, and can also be influenced by these processes. The expression ´task aims´ refers to the perceptions students have of the aim of constructing a hypertext (such as making it available on the internet) as well as the aims of the hypertext itself (such as being a navigable document for the reader). The term ´audience´ refers to the readers/users of the documents as perceived by the students. The 'hypertext structure' refers to the students' perceptions of what the hypertext structure should be like.

The two arrows (in opposite directions) in the middle of the diagram show that the process of hypertext composition as a whole is recursive. Students do not follow neatly from planning to execution once, but, make continuous shifts between planning and execution.

The students' ideas about their learning

Analysis of the students' ideas revealed that they learned about content, hypertext structure and revision processes. Their ideas were grouped into four analytical categories. The categories consisted of the following:

Text comprehension/interpretation and content retention - The analysis carried out revealed that text comprehension and content retention are closely linked to reading activities. The students said that by reading the text several times (dividing the text into paragraphs, finding linking words, revising the division and so forth), they were able to understand the content and also to remember parts of the text. This fact in itself is not new and has been referred to before. However, the students' awareness of its effects when dealing with hypertext construction allows us to argue that reading activities have a relevant role in hypertext composition from a given text.

Relations between content and form - In this category three aspects of students' learning were observed: *Linking ideas* (students mentioned cohesion, coherence, simplicity, objectivity and organization of content/ideas); *Structure of the text* (this includes both the organization of ideas in the mind, planning, and on the computer screen, execution of plans. *Outlines* (the students thought that they could incorporate outlines in their text as a way of structuring their composition).

Knowledge of the audience - The analysis of the interviews about students' perceptions of the user revealed that these perceptions influenced the students' choices of linking words, nodes and relations, and aspects of the hypertext interface. However, the students did not actually say that "thinking about the audience" was a lesson which they had derived from the task. The identification of words such as "person", "you", the reader" or "the user", shows that the students think the audience (reader/user) has an influence on the students' hypertext composition.

Revision - Three students regarded 'revision' as being something which they learnt from hypertext composition. The revision process was observed in each part of the process of writing a composition, for instance, checking relations (reading), revision (planning), testing (linking) and checking interface (improving the interface). However, it is believed that in hypertext composition, the revision process involves not only reading but also particularly testing activities, especially among this group of students.

CONCLUSION

In rethinking the activities involved in the process of hypertext composition, it is possible to say that:

Planning. An analysis of this activity revealed that there were different ways of planning the hypertext. Moreover, to some degree planning in hypertext composition can be compared with planning in traditional writing. The fact that hypertext composition requires more planning than traditional writing is not a new discovery (Braaksma et al., 2002). Before one can deconstruct the organization of the linear text and then construct a hypertext document, it is necessary to think about the nature of both structures. Shifts between linear text and hypertext structures can allow students to compare both processes of construction. Moreover, it is likely that the lessons learnt from the tasks described by the students which include linking of ideas, text structure and outlines, depend on the planning of the hypertext structure (and its frequency). It can be concluded that it is not only changes in the media that influence the way students regard the relationship between content and form but also changes in the way the content is represented.

Reading. Reading plays an important role in the process of hypertext composition. The activity of reading was carried out in an intensive way by this group of students. It can be concluded that the text without paragraphs, which was given to the students entailed a lot of reading and intensive planning of the hypertext structure. While discussing the need for repeated readings to construct a network of ideas, it was shown that these readings not only improve the students' retention and understanding of the content but also their understanding of the structure of the text, as well as their conception of the act of reading itself. Thus, it can be concluded that the reading activity

in the hypertext composition is effective in enhancing students' reading skills and attitudes particularly because the students' concept of reading is constantly changing.

Testing. The fact that students were involved in the activity of testing and that three types of testing could be identified were unexpected findings in their statements. There is no reference in the literature to rates as high as this or to the testing of interface as a particular type of testing. Evidence suggests that the students' perceptions of the audience had a great influence on these three types of testing activity, especially the interface tests. However, there is not enough evidence in this study to support an explanation as to why this group of participants undertook so many tests in their hypertext documents.

Finally, the electronic implementation of the hypertext gives students the opportunity to make changes in their network of ideas (the way they arrange and re-arrange concepts and ideas). As well as this, hypertext composition can also show how difficult the writing process is and it may help students to gain a better understanding of their own style of writing.

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