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Chapter 6

Tools for Associative Writing

Chapter 4 explored the technical challenges of publishing integrated hypertexts in the World-Wide Web. This chapter introduces a further *user* challenge: supporting the writer in carrying out the various activities involved in Associative Writing. To help address this challenge, a model of Associative Writing is first derived from the correlations observed between a number of existing writing models, and then used as the basis of a critical evaluation of a number of existing hypertext tools designed specifically to support writing tasks.

6.1 Extracting a model of Associative Writing

Popular tools for writing new Web documents, such as Microsoft's *Frontpage* and *Word*, Netscape and Mozilla's *Composer*, Macromedia's *Dreamweaver*, and the World-Wide Web Consortium's *Amaya*, typically take the form of word processors with additional features allowing writers to anchor (associative) links in the written text, and perhaps manage a collection of documents forming a Web site. User interaction in each of these tools is usually similar; for example, to create a link the writer typically selects a link anchor and then chooses a "Create Link" action from a menu or toolbar — the URL of the target document may then be entered manually (Figure 6.1). In order to answer the question of whether these tools support Associative Writing, the Associative Writing process itself must first be explored in more detail.

Cognitive psychologists Hayes and Flower proposed a working model for the linear writing process in 1980, collecting together the growing body of research up to that point. Their model consisted of three interacting sub-process: *prewriting* (planning what to write and how to write it), *writing* (turning plans into written text), and *rewriting* (revising what has been written) (Hayes and Flower, 1980). Rather than occurring in any fixed or linear order, these sub-process are recursive, with one often interrupting the

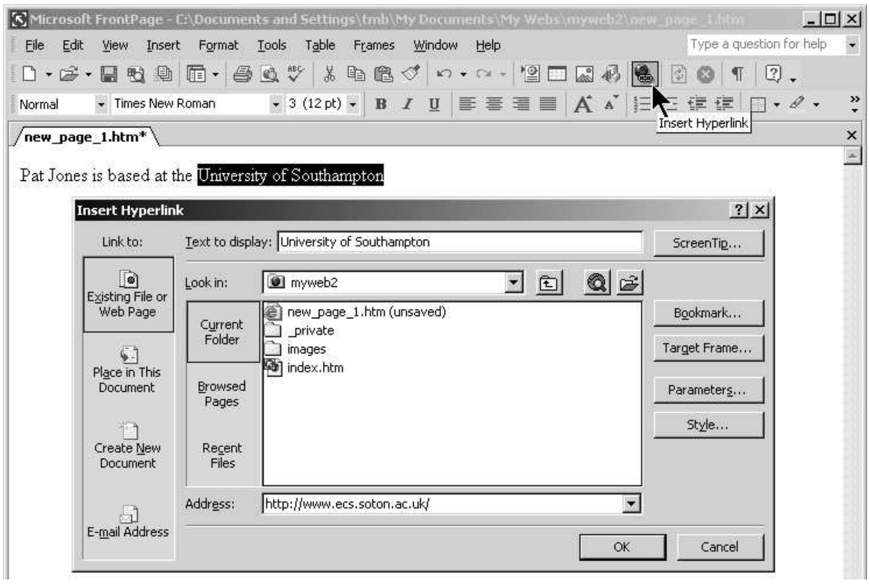


Figure 6.1: Creating an associative link in Microsoft Frontpage.

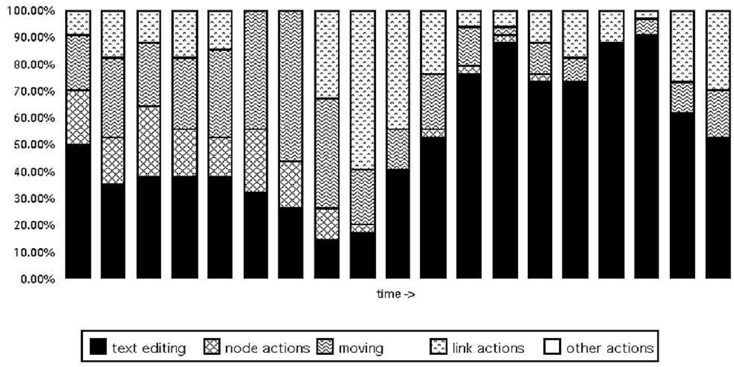


Figure 6.2: Timeframe analysis of hypertext writing (Pohl and Purgathofer, 2000).

other. Writers might be writing at one moment, moving their discourse forward; at the next they backtrack, reread and digest what has been written. A more recent study by (Pohl and Purgathofer, 2000) neatly illustrates this. The study analysed the kinds of activities authors of hypertext documents concentrate on, by analysing empirical data from student's use of a hypertext writing tool in the production of 96 hypertexts. Five classes of observed actions were reported: *text editing* (writing and deleting text), *node actions* (creating and deleting nodes), *moving* (positioning nodes in the hypertext), *link actions* (creating and deleting links), and *other* (any other activity). Visualisation of time spent on each of these activities during writing showed just how intertwined these activities are (Figure 6.2).

However, as later refinements showed, the writing process proved to be considerably more complex than Hayes and Flower's original model can capture (Hayes and Flower, 1986). (Smith et al., 1987) and (Streitz et al., 1989) describe hypertext systems which embody more complex writing models (with impressive theoretical grounding) to provide specific hypertext mechanisms for supporting the several kinds of thinking (or *cognitive modes*) involved in writing.

Smith *et al*'s system, *Writing Environment*, provided the writer with four main working areas corresponding to each of the major cognitive modes in the writing process, with operations available in each area reflecting the rules underlying each mode:

1. *Network mode* supports the early exploratory phases of writing, allowing the writer to build a hypertext structure by clustering related ideas into groups, interconnecting ideas using links, and arranging ideas into simple hierarchical structures.
2. Writers build a single, integrated hierarchical structure for the document in *tree mode*.
3. Text is attached to each node of the tree mode hierarchy in *edit mode*.
4. Writers view the final form of the document in *text mode*.

Streitz *et al*'s system, *Structured Elicitation and Processing of Ideas for Authoring* (SEPIA), also provides writers with four main working areas (activity spaces), but emphasises support for representing argumentation structures in writing:

1. Writers generate and structure ideas in the *content space*, grouping ideas according to topic-related clusters and creating relationships between ideas to form simple semantic networks.
2. The *argumentation space* allows writers to elaborate arguments by generating support or objections on different levels, and by formulating contradictions and argumentation chains.
3. The *rhetorical space* is where the writer creates the reader-oriented, final hypertext by imposing a document structure on the ideas and arguments created and elaborated in the content and argumentation spaces.
4. Writers create overall goal structures and plans for writing in the *planning space*, in order to co-ordinate the activities of the other spaces.

Hayes and Flower suggested that writing could be seen, above all, as a "goal-directed, problem-solving process" (Hayes and Flower, 1980, pg. 4), and both Writing Environment and SEPIA seem to embody this approach in supporting the writing process from conception through to final linear (Writing Environment) or hypertext (SEPIA) form. (Neuwirth and Kaufer, 1989), however, suggest that it is perhaps fruitful to consider writing as an "open-ended design task", where the primary intention of designers (writers) is not to produce an end-product, but some representation of it. Neuwirth and

Writing Environment	SEPIA	Neuwirth & Kaufer	Associative Writing
	planning space	goal tree†	planning
network mode	content space	selection & aggregation	context building
tree mode	argumentation space	hierarchy-building	structure building
edit & text modes	rhetorical space	generation	integrated writing

†Although not explicitly part of their writing model, Neuwirth & Kaufer describe a Goal Tree tool to help guide writers through a synthesis writing task.

Table 6.1: Correlating writing models to infer potential cognitive activities involved in the Associative Writing process.

Kaufer go on to describe their model of synthesis writing, based on observations of a number of writers' performances in writing tasks and supported by an extensive survey of the cognitive science literature:

1. A *selection* process identifies important information in individual source texts.
2. An *aggregation* process groups authors of source texts according to similarities/differences.
3. A *hierarchy-building* process organises authors according to degree of similarity/difference and provides an analysis of the causes of those differences.
4. A *generation* process produces a written synthesis.

Table 6.1 shows the correlations between the document-oriented writing models embodied by both Writing Environment and SEPIA and the task-oriented writing model proposed by Neuwirth and Kaufer. Similarities between the three models seem strongly apparent, so an attempt to extrapolate some of the cognitive activities involved in the Associative Writing process from these combined models seems reasonable.

Planning Both the SEPIA and Neuwirth and Kaufer writing models describe a planning activity in which writers construct goal structures to guide other activities. In terms of Associative Writing, we can deduce that such a planning activity may also guide the writing task.

Context building Each model describes a content generation activity, which may include selecting existing content from source texts (Neuwirth and Kaufer), brainstorming new ideas (Writing Environment, SEPIA), and exploring relationships (Writing Environment, SEPIA, Neuwirth and Kaufer). In terms of Associative Writing, we can deduce that this activity would involve the writer identifying and exploring the *global context* of the new hypertext (although the writer may not initially have a clear idea of the form the contribution will take).

The writer may identify existing Web content (ideas, concepts, data, examples, descriptions, experiences, claims, theories, suggestions, reports *etc.*) relevant to the task by browsing and reading, using any number of Information Retrieval applications (Brown, 2002), possibly retrieving specific knowledge from long term memory (for example, a theory) and searching the Web to identify the original source ("where has this theory been published in the Web?"). Such "information gathering" activities are often iterative (O'Day and Jeffries, 1993) — new information may change the expectations of what might be found in the future, or the understanding of the topic in hand, leading to searching or browsing with a new topic in mind. Writers may also generate new content, perhaps in response to existing materials (for example, interpretations, summaries, evaluations, "how can I build on existing work?"), or as an incentive for further browsing ("how can I show the reliability and innovation of this new idea?"). Relationships between content (both existing and new) would be identified by the writer as they are uncovered through careful and creative analysis of the texts (Figure 6.3a).

Structure building Each model describes a process in which writers elaborate on the content and structures generated and identified in the context building process to apply an overall structure to the context. This structure may take the form of multiple levels of argument (SEPIA), a similarity/difference hierarchy (Neuwirth and Kaufer), or a simple tree (Writing Environment). In Associative Writing, we can therefore deduce that this activity would involve the writer applying a *local* context (or *coherence* (Moulthrop, 1992)) to the new contributions and interpretations, corresponding to the structure of the new hypertext (Figure 6.3b).

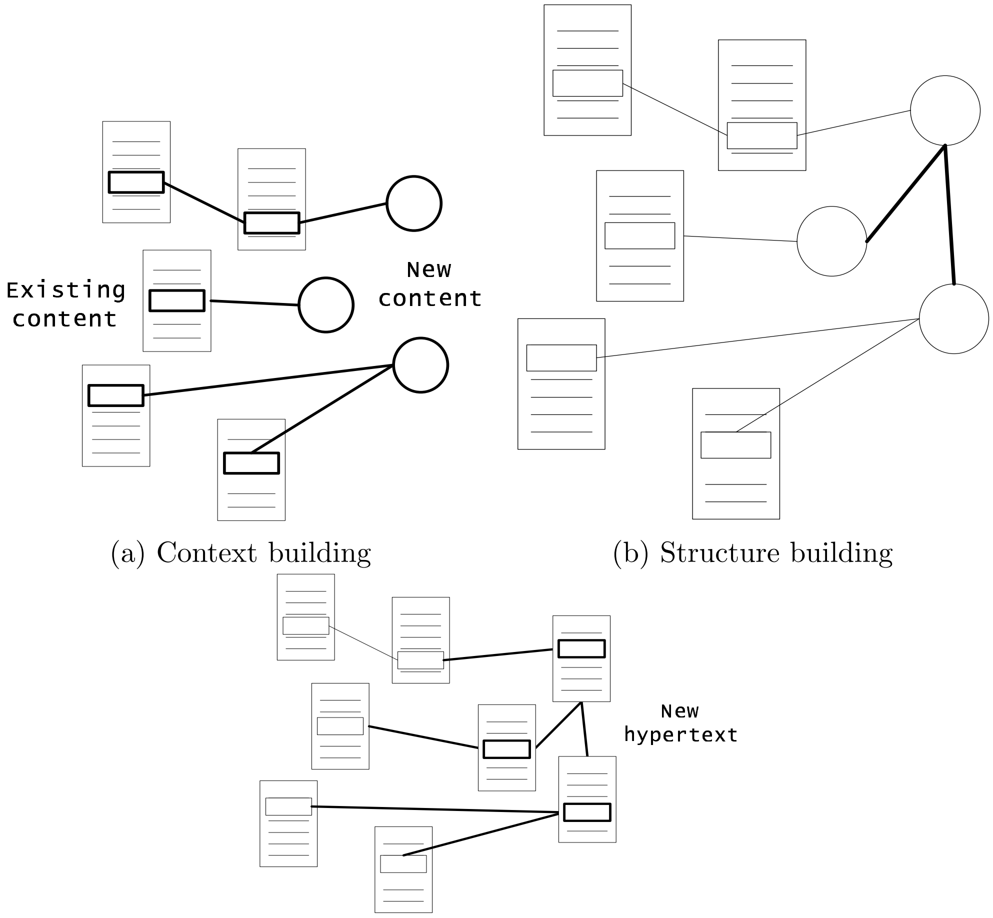
Integrated writing[1] Each model describes a process in which writers generate new content according to the organisation created in the structure building activity. In Associative Writing, we can deduce that this activity involves the writer's new contributions being elaborated into a coherent hypertext, which integrates with the underlying global context identified in the context building activity using associative links (Figure 6.3c).

As a simple example, Figure 6.4 illustrates how the Associative Writing strategy used by the authors of the *Astronomy Picture of the Day* Web site (reported in Chapter 3) could fit into the Associative Writing model.

6.1.1 The Challenge

Conventional word processing programs, and hence word-processor based tools for the Web, tend to support best Hayes and Flowers' original oversimplified and end-product oriented model of the writing process (*prewriting*, *writing*, *rewriting*), offering good composing and editing facilities but little support for the more complex cognitive activities involved in Associative Writing. In Section 3.2, it was suggested that Associative Writing may be sufficiently at odds with writer's normal practice of literacy as to explain why so

[1]Note on terminology: *Associative Writing* is the process of creating an *integrated hypertext*; *integrated writing* is a specific activity of the Associative Writing process.



(a) Context building (b) Structure building

(c) Integrated writing

FIGURE 6.3: Conceptual overview of Associative Writing activities.

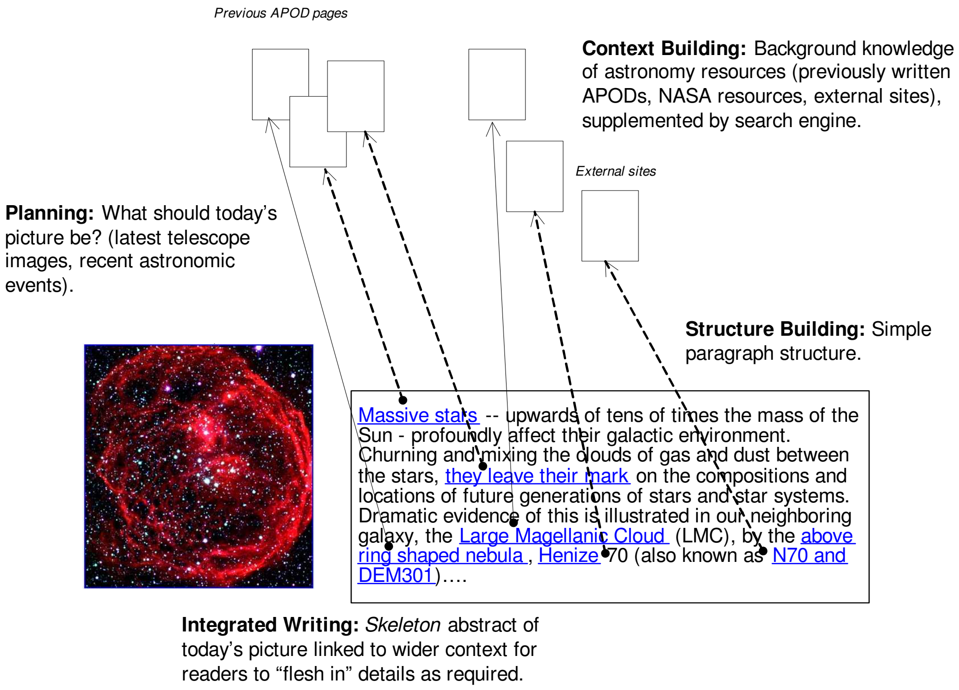


FIGURE 6.4: Fitting the *Astronomy Picture of the Day* writing strategy into the Associative Writing model.

Planning	Managing goals and plans for the writing task.
Context building	Identifying and exploring existing content relevant to the writing task, and the connections implicit between them.
Structure building	Applying a coherent overall structure to the context.
Integrated writing	Elaborating the structure into a coherent hypertext which integrates the underlying context.

Table 6.2: Summary of Associative Writing model.

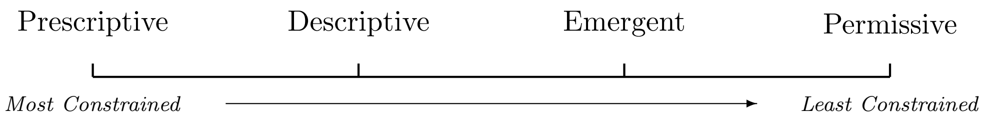
little evidence of integrated hypertext was found in the Web. However, in describing and correlating models of the writing process it has become apparent that the kind of "associative thinking" embodied by Writing Environment's *network mode*, SEPIA's *content space*, and Neuwirth and Kaufer's *selection* and *aggregation* processes) is an important aspect of writing. Perhaps then, Associative Writing is not so different from writer's "normal" (linear) experience of literacy, but current computer-based tools for writing in the Web do not support such exploratory activities well enough to help writers create integrated hypertexts.

The challenge then, seems to be to not only enrich the Web's hypertext model to support the publication of integrated hypertexts (as discussed in Chapter 4), but also to help the user carry out the various activities involved in Associative Writing. The next section describes the results of an investigation of a number of hypertext tools designed specifically to support writing tasks, with the purpose of critically reviewing each approach in terms of the Associative Writing model presented here (summarised in Table 6.2).

6.2 Tools for Hypertext Writing

Table 6.3 lists the hypertext writing tools investigated; the tools have been grouped according to a spectrum of approaches to constraining hypertext writing used by (Marshall et al., 1994), in order that tools embodying a similar approach may be discussed together. Each of the four main points on the spectrum is further divided into document-based tools (where the user interacts with the hypertext one document at a time) and map-based tools (where the user interacts with the hypertext through a visual network map).

Table 6.4 lists the set of significant hypertext writing approaches selected from the investigation to form the focus of this section, with each tool listed according to the Associative Writing activities which seem closest to the writing support the tool provides — these correlations will provide the context for a brief discussion of the features of each approach.



	Map-based	Document-based
Prescriptive	SEPIA, Writing Environment, Synthesis Writing Toolkit, gIBIS	PHIDIAS
Descriptive	Aquanet, MacWeb	Oval
Emergent	VIKI, Visual Knowledge Builder, ART, Web Squirrel, Tinderbox	Hyper-Object Substrate
Permissive	Storyspace	World-Wide Web, Wiki, Connection Muse, Hunter Gatherer, WebVise

Table 6.3: Spectrum of approaches to constraining hypertext authoring (Shipman and Marshall, 1999).

<table>
<tr><th>Planning</th><th>Context Building</th><th>Structure Building</th><th>Integrated Writing</th></tr>
<tr><td></td><td></td><td>Writing Environment</td><td></td></tr>
<tr><td colspan="4">SEPIA</td></tr>
<tr><td colspan="3">Synthesis Writing Toolkit</td><td></td></tr>
<tr><td></td><td></td><td>gIBIS</td><td></td></tr>
<tr><td></td><td></td><td>MacWeb</td><td></td></tr>
<tr><td></td><td></td><td>Aquanet</td><td></td></tr>
<tr><td></td><td colspan="2">VIKI</td><td></td></tr>
<tr><td></td><td colspan="3">VKB</td></tr>
<tr><td></td><td></td><td>ART</td><td></td></tr>
<tr><td></td><td colspan="3">Tinderbox</td></tr>
<tr><td></td><td></td><td></td><td>Wiki</td></tr>
<tr><td></td><td></td><td colspan="2">Storyspace</td></tr>
<tr><td></td><td></td><td>Connection Muse</td><td></td></tr>
<tr><td></td><td>Hunter Gatherer</td><td></td><td>Hunter Gatherer</td></tr>
</table>

Table 6.4: Summary of hypertext writing systems examined in this chapter.

6.2.1 Prescriptive Tools

Prescriptive tools impose constraints that embody a particular methodology or cognitive model of process; accordingly, the types of links and actions available to writers are the result of careful analysis and are embedded in the systems themselves. Writing Environment, SEPIA, and Neuwirth and Kaufer's tools for synthesis writing (subsequently referred to as the *Synthesis Writing Toolkit*) are examples of map-based prescriptive tools (note that although the cognitive models embodied by these systems have already been discussed, the specific tools provided by each system bear a brief examination in this context). gIBIS (Conklin and Begeman, 1988) is a map-based tool based on the prescriptive IBIS schema; PHIDIAS (McCall et al., 1990) provides equivalent document-based interaction. Table 6.5 summarises the potential contributions selected prescriptive tools make to the challenge of supporting Associative Writing in the Web, which are de-

	Planning	Context Building	Structure Building	Integrated Writing
WE	·	· closed	●	· linear
SEPIA	●	○ closed?	●	○ closed?
SWT	● Goal Tree	●	●	·
gIBIS	·	· closed	●	·

· Approach seems to provide no support for this activity

○ Approach could potentially provide some support for this activity, although with limitations/restrictions

● Approach could potentially support this activity well

Table 6.5: Correlation of prescriptive hypertext writing tools to Associative Writing activities.

scribed in the following sections.

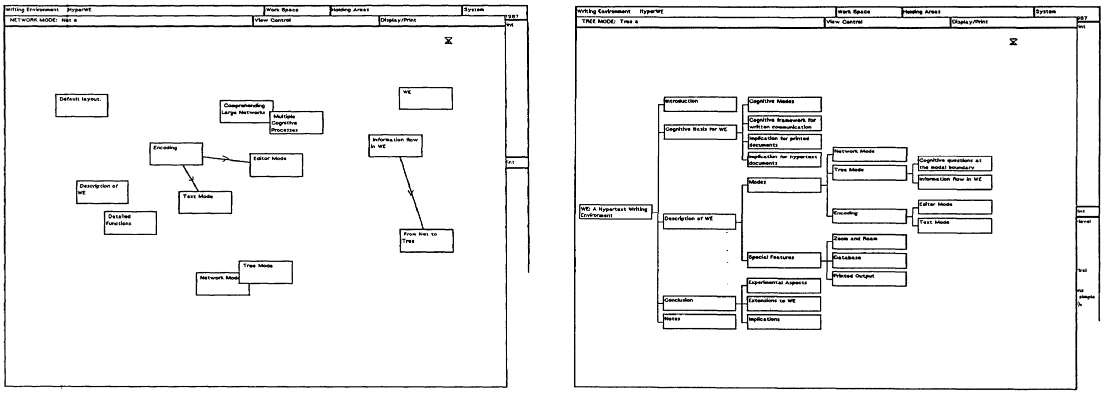
6.2.1.1 Writing Environment (Revisited)

Writing Environment uses hypertext structures to promote exploratory thinking in the early stages of writing (Smith et al., 1987), but targets a linear document so these networks are not preserved. The four working areas (modes) help the writer to create and structure ideas (*network mode*), define an overall document structure (*tree mode*), and create a linear representation of it (*edit & text modes*). These modes were used to help infer the context building, structure building, and integrated writing activities of Associative Writing (Table 6.1).

Network mode supports content generation and structuring (Figure 6.5a), but does not allow writers to integrate existing content with these exploratory hyperstructures. *Tree Mode* supports the building of a single hierarchical structure for the document (Figure 6.5b). *Edit mode* and *text mode* provide access to a standard text editor and a linear preview of the document (constructed by stepping through the tree mode hierarchy) respectively. Although the working areas are well integrated — for example, structures of ideas can be freely moved between network mode and tree mode (non-hierarchical networks will have hierarchical structures imposed on them and network cycles will be broken where links cross the hierarchy) — the 'closed' nature of network mode (note Writing Environment was pre-Web) and the linearisation of the tree structure in text mode preclude any potential support for the context building and integrated writing activities.

6.2.1.2 SEPIA (Revisited)

SEPIA was designed to support the writing of argumentative hypertexts (Streitz et al., 1989, 1992; Haake and Wilson, 1992), through four different "activity spaces". These activity spaces help the writer generate and structure ideas for the content domain (*content space*), for the style/procedure of argumentation (*argumentation space*), and



(a) (b)

FIGURE 6.5: Writing Environment network and tree modes (Smith et al., 1987)

for the type/structure of the target document (*rhetorical space*). A fourth activity space, the planning space, guides the overall creation of the hypertext. The designers use the theory of "cognitive compatibility" to map each of these activity spaces to a particular type of thinking that occurs during writing. As Table 6.1 shows, these activity spaces were used to help infer the context building, structure building, integrated writing, and planning activities of Associative Writing.

Although the content space supports the generation of new content and exploring of relationships between nodes, it is unclear whether writers can reference existing content in the SEPIA docuverse. Although the designers state that existing source materials *can* be brought into the content space, and that parts of these materials can be used as nodes in the activity spaces, it is not clear whether content is simply 'imported' (copied) or whether references to original source materials are maintained.

The argumentation space provides specific support for structuring content from the content space according to a multi-level argument structure (in contrast to Writing Environment's more generic tree mode). Nodes can be typed as either *positions*, *datum*, or *claims*, and can be connected using *support*, *object_to*, *justify*, and *negate* operations. *Generalise* and *specialise* operations allow micro argument structures to be connected to form multiple levels of argument structure: writers may start with a global argument and gradually refine it into specific instances, or start with several sub-arguments and draw a more general position by summarising their claims.

Two forms of hypertext that may emerge from the rhetorical space are a *guided tour* through the argumentation network or a *dual hypertext* containing both a "surface" presentation of the factual information about the argument and access to the author's argumentation structure for exploring the argument at a deeper level. Again it is not clear whether the new hypertext is integrated with existing material in the SEPIA docuverse.

As with Writing Environment, the designers of SEPIA also emphasise the importance

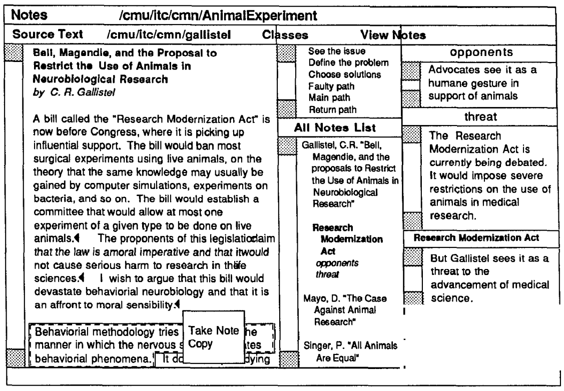


FIGURE 6.6: Taking notes on source texts with Notes (Neuwirth and Kaufer, 1989).

of smooth, ad-hoc transition between activity spaces. A typical example is the flow of information from the planning space to the other three spaces: issues created in the planning space set topics for brainstorming and exploration in the content space, direct structuring in the argumentation space, and are transformed into an outline in the rhetorical space. Operations in each of these spaces may then lead to information flow back to the planning space as new insights that arise necessitate the formulation of new goals.

6.2.1.3 Synthesis Writing Toolkit (Revisited)

Neuwirth and Kaufer (Neuwirth and Kaufer, 1989) describe a set of tools for supporting synthesis writing, developed in accordance with their model of the cognitive activities involved in a synthesis writing task: the *selection/aggregation*, *hierarchy-building*, and *generation* activities were respectively used to help infer the context building, structure building, and integrated writing activities of Associative Writing (Table 6.1).

The *Notes* tool supports the selection activity by allowing writers to take notes on source texts (Figure 6.6). The *Summary Graph* tool also supports the selection activity by helping writer summarise the arguments presented in each source text using a predefined network structure (Figure 6.7). The main path of the graph represents the position of the author of the source text; faulty paths represent the positions they oppose, and return paths represent the reasons for rejecting the opposed positions. Notes made on the source text can be routed into the nodes of the summary graph for that text.

The *Synthesis Grid* tool supports the aggregation activity by helping the writer group authors of source texts according to similarities/differences (Figure 6.8a). The first column of the grid lists the names of the authors of the source texts, and the remaining columns represent each author's response to positions — discovering these dimensions is the goal of the writer in building a synthesis grid. Summary graph nodes can automatically be routed into the nodes of the grid, and then decomposed into more specific

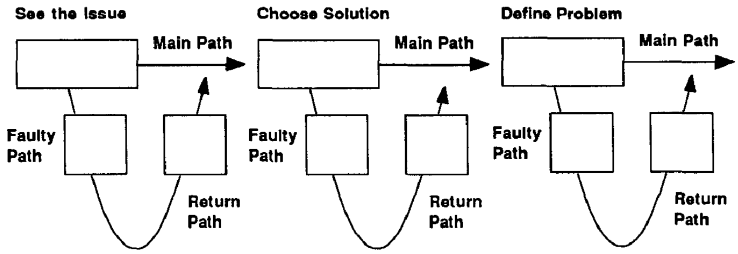
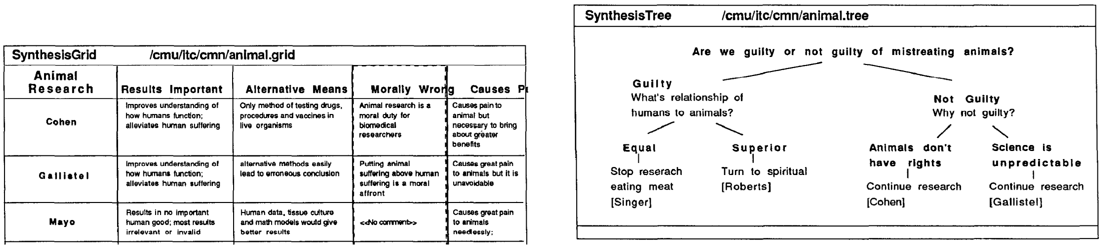


FIGURE 6.7: Summarising source texts with the Summary Graph (Neuwirth and Kaufer, 1989).



(a) (b)

FIGURE 6.8: Exploring similarities and differences between source texts with the Synthesis Grid and Synthesis Tree (Neuwirth and Kaufer, 1989).

issues.

In terms of the context building activity of Associative Writing, the Notes, Summary Graph, and Synthesis Grid approaches could help the writer identify existing relevant content in the docuverse (Notes), support the generation of new content to some extent (writer's notes could be interpretative or summary comments), and allow a (perhaps restricted) exploration of the relationships surrounding the selected content (*Summary Graph*, *Synthesis Grid*).

Support for Neuwirth & Kaufer's hierarchy-building activity is provided by the *Synthesis Tree* tool, which helps the writer index the authors of source texts within a structure that represents hierarchies of overall agreement and disagreement (Figure 6.8b). Nodes of the Synthesis grid can be used to construct the tree.

Whenever the writer makes a note on a source text, the Notes tool creates a link between the passage in the source text and the note. As the information in the note is routed to and altered in the Summary Graph, Synthesis Grid, and Synthesis Tree, the toolkit maintains links between the different states; therefore the writer can request at any time to see the representation of a particular node as it appears in other tools. Although the recording and management of links to specific passages in source texts suggests the possibility of integrated writing, Neuwirth & Kaufer do not go on to propose a tool to support the generation process (actual text editing), choosing instead to focus on open-ended writing tasks.

Node Type (Source)	Allowable Link Types	Node Type (Destination)
issue	replaces, questions, is_suggested_by	issue
issue	is_suggested_by, questions	position
issue	is_suggested_by, questions	argument
position	responds_to	issue
argument	objects_to, supports	position

TABLE 6.6: Enforced node and link structure in IBIS (Kunz and Rittel, 1970).

6.2.1.4 gIBIS

Issue Based Information Systems (IBIS) (Kunz and Rittel, 1970) was a framework for collaborative understanding of the major issues and implications surrounding difficult problems (problems lacking a definitive formulation). Similar to the SEPIA's *argumentation space* approach, the gIBIS (graphical IBIS) tool (Conklin and Begeman, 1988) helped writers achieve understanding by using hypertext components to create multi-level arguments surrounding the problem issues.

The hypertext model of IBIS consists of three node types — *issues*, *positions* and *arguments* — with link types representing the allowable connections between nodes (Table 6.6). gIBIS extended the model to allow an *other* type for nodes and links (to allow writers to 'escape' the constraints of the IBIS framework), an *external* type for nodes containing external material (in the form of copied content rather than references to existing content), and *generalise/specialise* types for creating multi-level arguments. More recent evolutions of the gIBIS approach include Questmap and Compendium[2] (Conklin et al., 2001). The gIBIS approach seems most suited to the structure building activity of Associative Writing.

6.2.2 Descriptive Tools

In descriptive tools, writers characterise their domains of interest, and use (or re-use) these abstractions to constrain and structure the writing process. MacWeb (Nanard and Nanard, 1991) and Aquanet (Marshall et al., 1991) are examples of descriptive, map-based tools. In MacWeb, writers built a "web of types" which constrained the construction of the hypertext. Aquanet allowed authors to construct type schemas, which formed the basis for representation. Oval (Malone et al., 1995), a document-based descriptive tool, provided a sophisticated rule-based knowledge representation facility for structuring hypertext nodes according to their textual content. Malone *et al* have demonstrated how Oval can be used to define and build templates of documents and links based on the IBIS schema. Table 6.7 summarises the potential contributions

[2] `http://www.compendiuminstitute.org/`

	Planning	Context Building	Structure Building	Integrated Writing
MacWeb	·	· closed	○ semantic network	·
Aquanet	·	· closed	●	·

Table 6.7: Correlation of descriptive hypertext writing tools to Associative Writing activities.

MacWeb and Aquanet make to the challenge of supporting Associative Writing in the Web.

6.2.2.1 MacWeb

Hypertext writing in MacWeb (Nanard and Nanard, 1991) relied on a two-layered organisation: the first layer, a "web of types", defined the hypertext data model as a semantic network of nodes and links. The second layer, the "main web", contains instances built according to the data model.

The formalisation of knowledge structures before construction of the main web suggests that the MacWeb approach is best suited to the structure building activity of Associative Writing, although the structure takes the form of a single-layered semantic network rather than multi-layered argumentation (SEPIA, Synthesis Writing Toolkit, gIBIS) or hierarchical (Writing Environment) structure. The MacWeb approach seems unsuitable to supporting the context building and integrated writing activities, since the tool is closed (although a user-configurable document generation facility can traverse the network and create a "virtual" linear document).

Figure 6.9 shows a typical MacWeb workspace. Most of the workspace is taken up with the specification of the web of types, which includes the use of multiple inheritance (*Painter and Scientist* inherits from both *Painter* and *Scientist*) and inheritance rules for link types (*Has Carved* and *Has Painted* both inherit from *Has Produced*). The main web (to the left of the workspace) describes the relationships surrounding *Leonardo Da Vinci* using semantics defined in the web of types.

6.2.2.2 Aquanet

The development of Aquanet (Marshall et al., 1991) was influenced by observations of the use of NoteCards (Halasz et al., 1987). Although the "Browser" notecard was regarded by many writers as clumsy and slow, they frequently chose to use it when faced with large information structuring tasks. In addition, a drawback with systems like NoteCards and MacWeb was the difficulty in building coherent composite structures using links alone. Aquanet was designed to provide a richer linking model to allow more complex relations to be expressed. Users also had to be able to modify and extend these

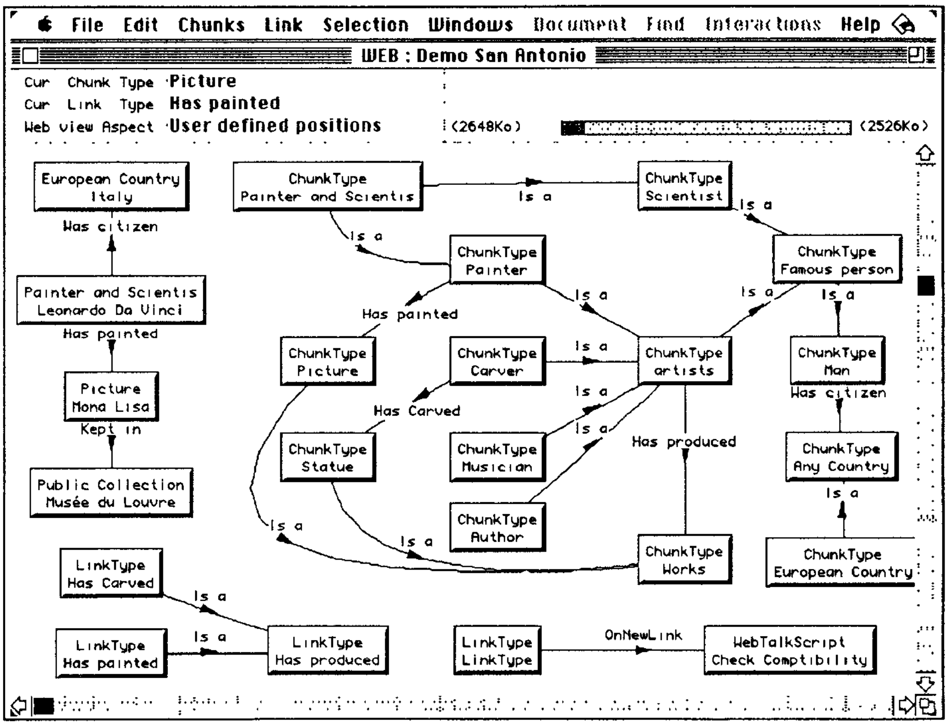


FIGURE 6.9: MacWeb workspace (Nanard and Nanard, 1991).

linking models as their understanding of the task developed (Newman and Marshall, 1991).

Every node in Aquanet is an instance of some type. A type's definition specifies the named content (slots) that a node may have, the type of each slot (e.g. text, images, numbers, strings, dates), and the graphical appearance of the object. Figure 6.10 shows the editing of a composite "Argument" type. The graphical appearance of the Argument type will display the values of three slots - *Grounds*, *Rationale*, and *Conclusion*. In the workspace, composite structures can be chained (for example, the *Conclusion* of one Argument is the *Grounds* of another) or connected using links (Figure 6.11). Schemas define the available types for a specific task.

As with MacWeb, the formalisation of knowledge structures before the construction of the hypertext suggests that the Aquanet approach is best suited to the structure building activity of Associative Writing. The Aquanet approach is also closed; providing no opportunities for context building or integrated writing.

6.2.3 Emergent Tools

As the representational capabilities of prescriptive and descriptive systems become increasingly rich — for example, typed anchors in MacWeb (Nanard and Nanard, 1993) — they become more difficult to use (Marshall et al., 1994). Aquanet users did not rely

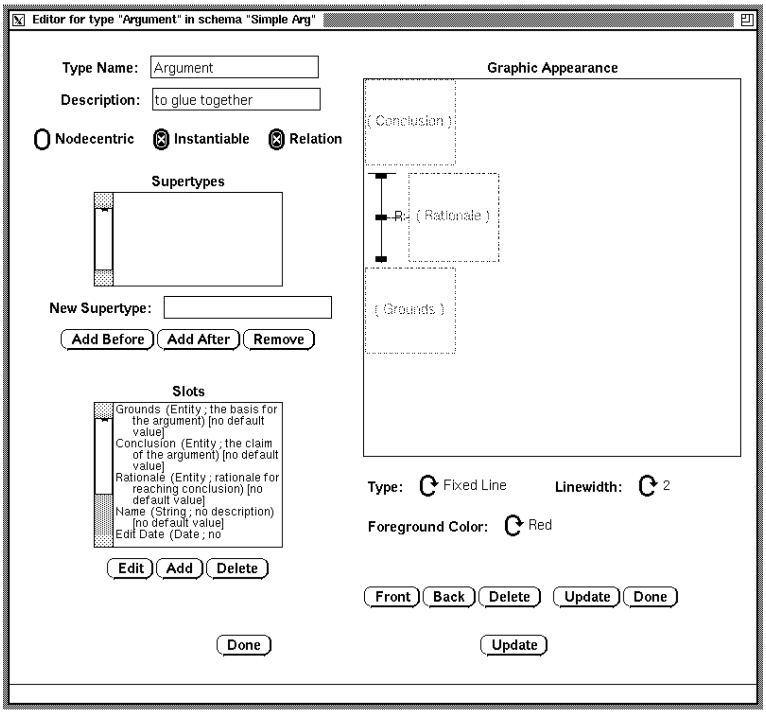


FIGURE 6.10: Aquanet type editor (Marshall et al., 1991).

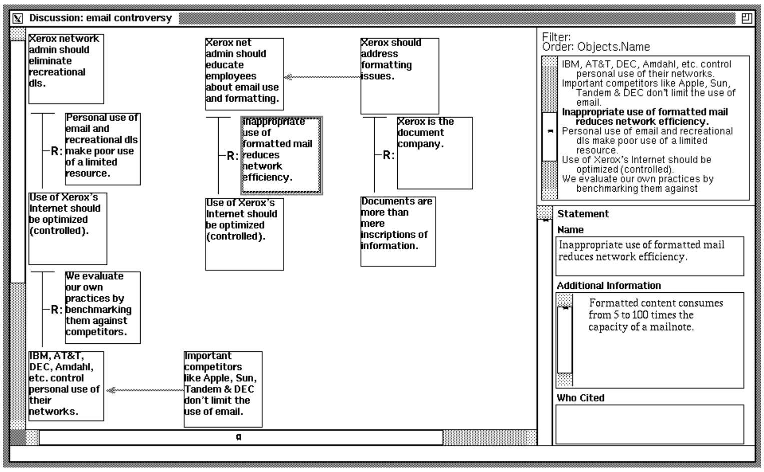


FIGURE 6.11: Aquanet workspace (Marshall et al., 1991).

on the predefined library of network structures; instead they tried to define their own schemas for hypertext structures, and were consequently frustrated by a system unable to support flexible schema modification (Marshall et al., 1994). Similarly, (Isenmann and Reuter, 1997) reported frustrations with the structures and methodology enforced by IBIS-based systems like gIBIS.

Aquanet users got around this problem by using the main workspace as a "drawing board", in which developing relationships between nodes were expressed spatially by placing similar objects in piles (Marshall and Rogers, 1992). The use of spatial and visual cues to imply relationships has since been shown to apply not only to map-

	Planning	Context Building	Structure Building	Integrated Writing
VIKI	·	○ URL slots	•	·
VKB	·	○ URL slots	•	○ global links
ART	·	·	○ linear	·
Tinderbox	·	○ URL attributes	•	○ Web site builder

Table 6.8: Correlation of emergent hypertext writing tools to Associative Writing activities.

based hypertext systems, but also to traditional hypertext systems and in the physical arrangement of paper and notecards (Marshall and Shipman, III, 1993), leading to the introduction of emergent tools which support free-form expression and the gradual emergence of structure.

SEPIA's content space and Writing Environment's network mode are early examples of emergent tools, since they allowed writers to express relationships between ideas by placing them in piles. More recent tools have more sophisticated features. Map-based "spatial hypertext" tools such as VIKI (Marshall et al., 1994) and the Visual Knowledge Builder (VKB) (Shipman III et al., 2001) allow authors to represent and explore relationships by colouring, shaping and arranging visual objects in the workspace, widening the conventional node-link hypertext model by taking advantage of spatial proximity and visual cues. Spatial hypertext tools allow writers to take advantage of visual and spatial recognition (remembering the location of a node in a visual workspace as opposed to remembering the navigational path leading to it) and construct ambiguous links (node placement can imply some indecision or potential for a relationship) (Shipman and Marshall, 1999). Visual languages (for example, colour-coded nodes) emerge or evolve as the writer's understanding of a task evolves (Marshall and Shipman, III, 1997a), indicating that users adapt their solution strategies as they gain more insight into their task. Systems with predefined link types and relations make the overhead for making such changes mid-task overwhelming; spatial hypertext therefore lowers the writer's effort of expression (Shipman III et al., 2001). Indeed, spatial hypertext tools such as Web Squirrel (Simpson, 2001) and Tinderbox (Eastgate Systems Inc., 2002) have become popular for Web foraging and personal information management.

ART (Yamamoto et al., 2002) uses spatial positioning to support the early stages of linear information authoring. The Hyper-Object Substrate (HOS) (Shipman, III and McCall, 1994) was a document-based system that used textual analysis to support emergent structures by suggesting new formalisations for addition to the writer's information space. While the writer created pages with text and graphics, HOS looked for textual cross-references between information chunks, making suggestions for attributes and relations based on these cross-references. Table 6.8 summarises the potential contributions selected emergent tools make to the challenge of supporting Associative Writing in the Web.

6.2.3.1 VIKI

VIKI (Marshall et al., 1994) was designed to support the new interface requirements arising from observations of the use of Aquanet (Marshall and Rogers, 1992) in supporting "information triage" (Marshall and Shipman, III, 1997b) — the process of sorting through materials and organising them to meet the needs of a particular task.

VIKI's hypertext data model provided three kinds of elements for representing emergent structure: objects, collections, and composites. Objects held content, and were represented by one or more visual symbols in the workspace, each of which could have different size, shape, colour, line thickness, and font characteristics. New objects could be created quickly — Aquanet users were frustrated by the need to specify what type of node they were creating before entering any text. Like Aquanet, VIKI objects held content in a number of slots, but these slots could be created in an ad-hoc fashion. Collections contained spatial arrangements of objects (and other nested collections). Composites were lightweight structures that consist of particular visual/spatial configurations of a combination of two or more objects or collections. In order to express relationships or categories in VIKI, symbols are simply placed near one another in piles or lists, or placed in a collection.

As with Aquanet, VIKI also had a typing mechanism. However, VIKI type specifications were not rigid, and only intended to combine semantic information about objects (for example, default slot values) and visual information about the symbols (for example, default colour and shape). An integrated spatial parser assists writers in a variety of ways by recognising implicit structure in the spatial and visual attributes of the symbols and suggesting collections and composites.

The VIKI approach seems particularly suitable to the context building and structure building activities of Associative Writing. However, although VIKI objects could refer to existing Web pages — URLs could be manually entered in content slots, enabling externally referenced material to be viewed by activating a Web browser (Shipman, III et al., 1997) — specific content from pages must be copied into a separate content slot and (unlike Synthesis Writing Toolkit) the location of the content in the source document is not recorded. Structure building could be supported through VIKI's nested collections.

6.2.3.2 Visual Knowledge Builder

The Visual Knowledge Builder (VKB) system built on the successes of VIKI — for example, the "Suggestion Manager" extends VIKI's spatial parser (Shipman et al., 2002) — and attempted to address its issues and limitations (Shipman III et al., 2001). In particular, VIKI's information triage is not meant as a publication, but as a continual work in progress for an individual or small group (and hence the VIKI approach does not support integrated writing in the Web). Typically, the readers and writers of the hypertext are the same group of people, so there is less emphasis on the presentation of information and little support provided to allow others to understand the hypertext. This limited the applicability of such spatial hypertext systems. VKB attempted to enable the more general use of spatial hypertext by addressing four major problems:

1. *Interpreting changing visualisations* — as visual languages evolve, prior encodings may become ambiguous. A navigable history mechanism enables the construction of the hypertext to be witnessed by moving through the prior states of the workspace, thus helping users to understand and interpret a writer's work practices and disambiguate specific actions.

2. *Interference between visualisation and visual materials* — VIKI could only display text in the workspace. Although (Robertson et al., 1998) have demonstrated that the display of images, video, and 3D renderings in a spatial workspace is technically possible, the challenge is to display visual materials in such a way that they can be also be visually interpreted as part of the spatial hypertext. In VKB image objects retain borders and backgrounds so the same methods and visual languages can be used for interpreting images as for interpreting text.

3. *Cross-space relationships* — to express relationships between objects in a spatial hypertext, they must either have related visual attributes or placement. However, an object may have different relationships in different contexts. VIKI allowed each object to have multiple visual symbols, but this proved unintuitive for many users. VKB reintroduces explicit links to allow the expression of relationships between objects that are placed far away from each other. *Local links* connect objects in the same workspace, and may also transport the user "through time" to previous states of the hypertext. By linking to prior states, a hypertext can discuss its own evolution, promote the exploration of prior states, and direct readers to important periods of the hypertext's emergence.

4. *Publishing Spatial Hypertexts on the Web* VIKI allowed content objects to point to Web pages, but external documents cannot link to the spatial hypertexts. VKB's *global links* are pointers to objects in other spatial hypertexts on the Web.

As would be expected from a tool that builds on VIKI, the VKB approach also seems suitable for the context building and structure building activities of Associative Writing. Integration in context building is still limited in the VKB approach however; although drag-drop capabilities have been added (writers can drag URLs, content, and documents into the workspace to create new nodes) references to original sources are still not recorded. Like VIKI, the structure building activity could be supported through nested collections (Figure 6.12). VKB's global links may support integrated writing within the confines of the spatial hypertext system (integrating spatial hypertexts published on

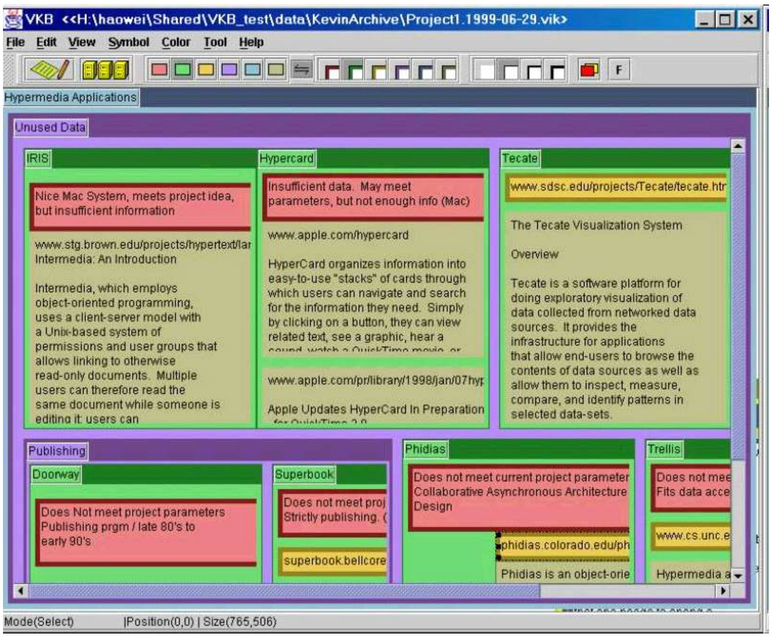


Figure 6.12: Nested collections provide an overall structure to a Visual Knowledge Builder workspace (Shipman et al., 1999).

the Web), but the workspace is not closed to other tools — the representation can be exported in different encodings, including HTML and XML (Shipman et al., 1999).

6.2.3.3 ART

(Yamamoto et al., 2002) described a series of spatial hypertext systems that support the early stages of linear information authoring, such as writing and movie editing. The ART (Amplifying Representational Talkback) series used spatial positioning of objects as a means to interact with linear information being composed. Users generate a "part", and then specify where to put it in the linear composition by arranging the part in 2D space. Positioned parts are serialised (from left to right or top to bottom) to construct the linear composition. The user does not interact directly with the linear information being authored, but composes it by interacting with the spatial representation.

Figure 6.13 shows an ART tool for writing. The writer generates chunks of text in the Element Editor (EE), which appear as nodes in the Element Space (ES). The writer then specifies where to insert the nodes in the linear document by positioning the node in the Element Space — the corresponding view in the Document Viewer (DV) is updated accordingly. In the context of Associative Writing, the ART approach only really supports the structure building activity, albeit limited to a linear document structure.

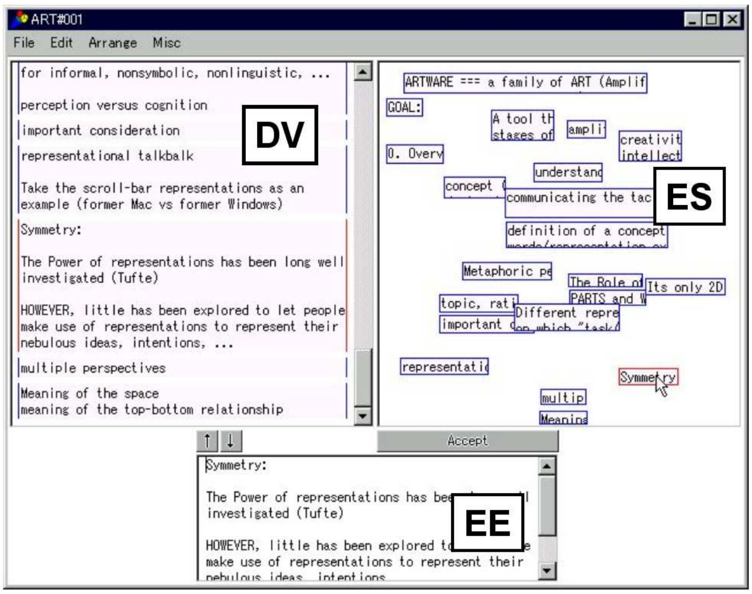


FIGURE 6.13: ART#001 workspace (Yamamoto et al., 2002).

6.2.3.4 Tinderbox

Tinderbox (Eastgate Systems Inc., 2002) combined elements of StorySpace, VIKI, Visual Knowledge Builder, and ART into a lightweight tool chiefly aimed at personal content management and organisation. Tinderbox provided a number of different *views* of the nodes in the workspace. Map view, most similar to VIKI and VKB's workspace, showed content nodes (*notes*) as visual symbols, each of which could have different visual characteristics. In Map view, as with VIKI, VKB, and ART, developing relationships between notes in the Tinderbox workspace could be expressed spatially by placing similar notes in clusters or piles. Tinderbox also allowed explicit links (with arbitrary types) between notes to be created (displayed using StorySpace style arrows — Figure 6.14). Other views of the information space include Outline, Chart and Treemap, which showed the hierarchical structure of notes, but not links, as an indented outline, tree chart, and as boxes within boxes (similar to VIKI and VKB's 'collections'). Although VIKI's mechanism for allowing each note to have multiple visual symbols proved unintuitive, and was later replaced by cross-space relationships in VKB (Shipman III et al., 2001), Tinderbox retains this mechanism in the form of *aliases*.

The Tinderbox approach seems best suited to the context building (Map view) and structure building (Outline, Chart, and Treemap views) activities of Associative Writing. However, integration with source documents still remains limited — although content can be dragged and dropped to form new nodes in the workspace, URLs of source documents must be manually specified using note 'attributes' (analogous to VIKI and VKB's "slot" mechanisms — Figure 6.15).

Other features of Tinderbox include prototypes (analogous to type specifications in VIKI

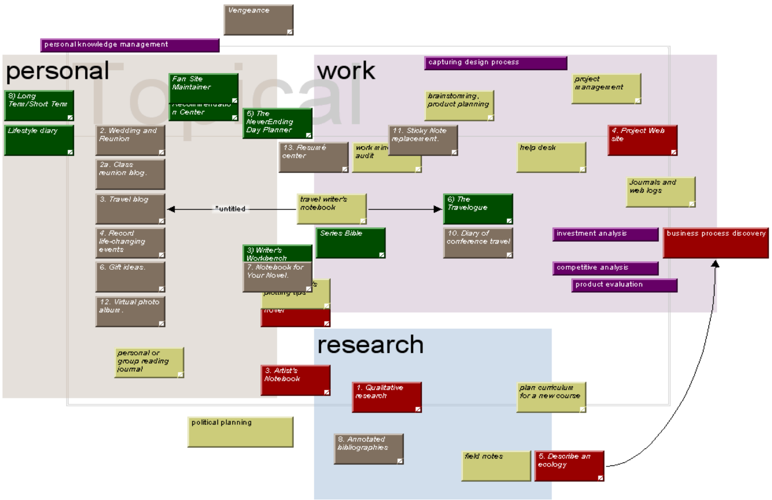


FIGURE 6.14: Tinderbox workspace (Eastgate Systems Inc., 2002).

FIGURE 6.15: Setting a URL attribute in a Tinderbox note (Eastgate Systems Inc., 2002).

and VKB), AutoFetch notes (notes in which the content is periodically fetched from a specified URL, for example a "today's headlines" note) and programmable agents. Tinderbox also provided some sophisticated mechanisms for turning notes into a Web site, including specifying layout and design, and selecting what will be published and what will be kept private. Notes are combined with XML or HTML based export templates which describe which parts (attributes) of the note to share, and how they should appear on the Web page (for example making URL attributes into HTML links). Compound pages can be built from the combined content of several notes, including those created by user-programmed agents, for example, a researcher's home page which lists interests (extracted from a note), and links to publications (built by gathering the titles of all the publication notes and sorting them by date). Tinderbox workspaces may also be exported as XML and processed by other applications.

	Planning	Context Building	Structure Building	Integrated Writing
Wiki	·	·	·	○ WikiWords
StorySpace	·	· closed	●	· closed
Connection Muse	·	·	○ text components	·
Hunter Gatherer	·	○ select/collect	·	○ Collection View

TABLE 6.9: Correlation of permissive hypertext writing tools to Associative Writing activities.

6.2.4 Permissive Tools

In permissive tools, connections are unconstrained and intimately tied to the writer's perceptions of relationships between nodes. The Web hypertext model (Berners-Lee et al., 1992) supports simple, unconstrained linking; the popular Web editing tools listed at the beginning of this chapter (Microsoft Frontpage, Mozilla/Netscape Composer, Amaya *etc.*) are therefore examples of document-based permissive writing tools. Other hypertext writing tools in this space include Wiki (Leuf and Cunningham, 2001), a document-based Web page writing environment and Hunter Gatherer (schraefel et al., 2002), a document-based tool for harvesting information from the Web. Although this work focuses on integrated non-fictional hypertexts, the (permissive) hypertext fiction tools StorySpace (Bernstein, 2002) and Connection Muse (Kendall and Réty, 2000) bear some examination in this context. Table 6.9 summarises the potential contributions these tools make to the challenge of supporting Associative Writing in the Web.

6.2.4.1 Wiki

A wiki is a Web-based tool for collaborative idea exchange and writing in the Web, designed to be informal, quick and accessible (Leuf and Cunningham, 2001)[3]. Wikis are freely expandable collections of interlinked pages which are easily editable by any user with a forms-capable Web browser. Indeed, wikis are not carefully crafted sites for casual visitors; instead they seek to involve the visitor in an ongoing process of creation and collaboration that constantly changes the landscape of the site. Each wiki invites *all* users to edit *any* page or to create new pages within the site, and does so on a democratic basis — every user has exactly the same capabilities as any other user and accounts and passwords are not required. Writing takes place in a text environment using simple markup conventions (Figure 6.16). Hypertext links in wikis are designed to be as simple to create as possible: every page has a title consisting of joined capitalised words (for example "WikiWikiWeb"), called "WikiWords". To create a link in edit mode, the author just types a WikiWord. The WikiWord approach seems applicable to the integrated writing activity of Associative Writing, since it helps writers to easily integrate a number of existing resources (provided they exist on the same wiki site).

[3] `http://c2.com/cgi/wiki` — original WikiWikiWeb site.

(a)

(b)

FIGURE 6.16: Browsing and editing a page from the WikiWikiWeb.

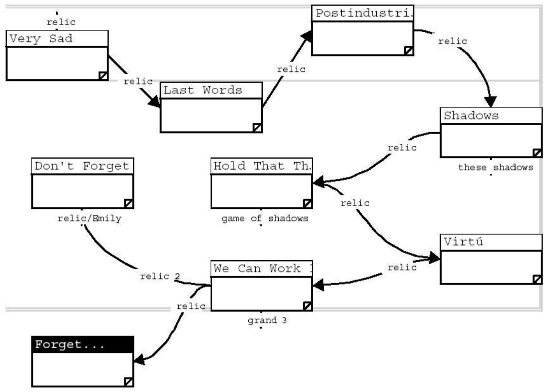


FIGURE 6.17: Part of the Storyspace map from Victory Garden (Moulthrop, 1991).

6.2.4.2 Storyspace

The main interaction with the StorySpace tool (Bernstein et al., 1991; Bernstein, 2002) is through a graphical workspace, in which small rectangular symbols (*writing spaces*) representing nodes are visually connected by link arrows (Figure 6.17), although note symbols may also be arranged spatially and coloured. Each writing space has two roles: it contains text (including images) and it occupies a place in the evolving structure of the hypertext; each writing space therefore contains a textual component (the content of which is edited and viewed through an integrated document viewer), and a structural component in which further writing spaces may be nested.

As with other map-based writing tools such as gIBIS, MacWeb, and Aquanet, users manipulate the structure of the hypertext directly by arranging, opening, and closing writing spaces — links between spaces are not disrupted by reorganisation. However, StorySpace differs from these tools (and hence is distinguished as a permissive tool) in that links can be assigned semantic types by the addition of an arbitrary text label; link behaviour can also be specified to change during the course of reading (for example, becoming visible only when the user has visited a particular node). Many influential works of hypertext fiction have been produced (and are subsequently read) in Storyspace, including *afternoon, a story* (Joyce, 1990) and *Victory Garden* (Moulthrop, 1991). Being designed with hypertext fiction in mind, StorySpace provides no mechanism for identifying or 'importing' existing content, and therefore the StorySpace approach is not well suited to supporting the context building activity of Associative Writing. However, as we have seen with VIKI and VKB, nested collections provide writers with a mechanism for imposing an overall structure on the hypertext. Although StorySpace hypertexts may be exported as a set of interconnected Web pages, the otherwise closed nature of the system means that this approach is unsuitable for supporting the integrated writing activity.

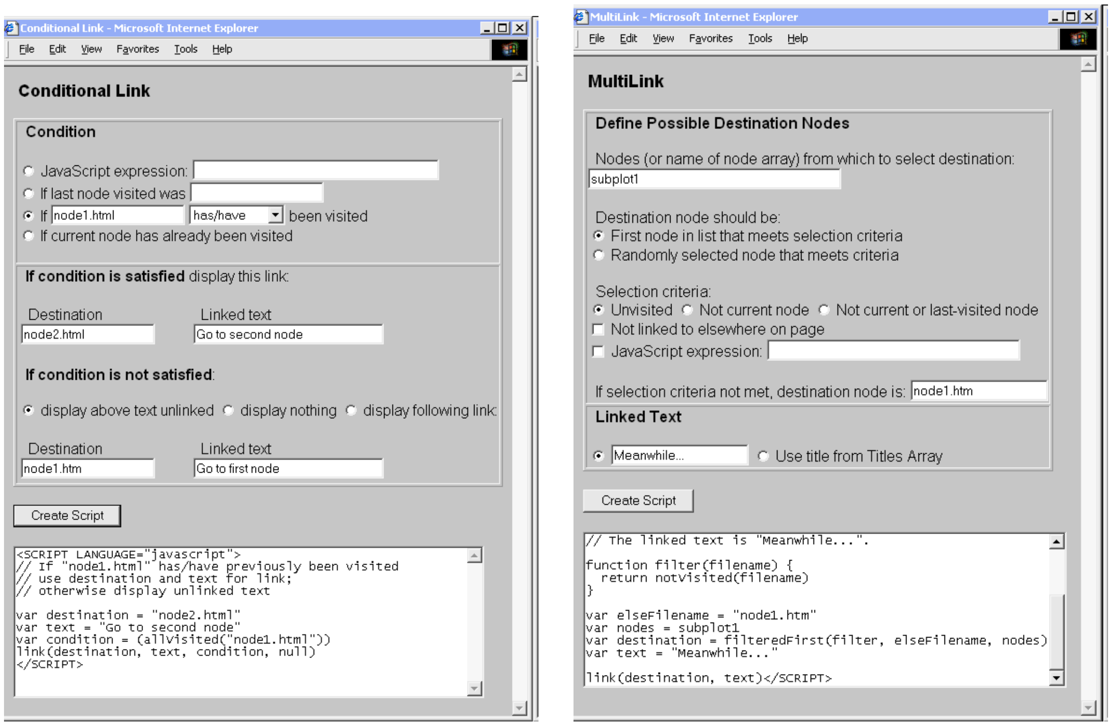
6.2.4.3 Connection Muse

Connection Muse is a toolkit for writing adaptive hypertext poetry and fiction for the Web (Kendall and Réty, 2000). In creating such hypertexts, the writer is faced with the challenge of creating opportunities for structural growth which successfully guide the readers understanding of the text. Only the writer knows the text intimately, and understands the long-range implications of different structural possibilities: Connection Muse is therefore designed to help the writer to capture this knowledge and define how structure should emerge from the reading of the hypertext.

Similar to StorySpace, writers can specify links which only become available when some prerequisite criteria has been fulfilled (*conditional links*), and also links which have a dynamically selected destination (*multilinks*). Nodes can also grouped into ordered or unordered sets called *text components*. Nodes in an ordered text component have a progressive relationship to one another, such as a narrative thread. Nodes in an unordered text component have an associative relationship to one another, such as a particular character, locale, object or event.

Large-scale structural relationships within the hypertext can be expressed by using text components as link destinations. Entry behaviours can be specified for destination text components, including the random selection of a node from an unordered text component, or the selection of the first unvisited node in an ordered text component. As examples, Figure 6.18a specifies a conditional link which targets `node1.htm` unless it has already been visited, in which case it targets `node2.htm`; Figure 6.18b specifies a multilink that targets the first unvisited node in the ordered text component `subplot1`. In terms of Associative Writing, therefore, the Connection Muse approach seems best suited to the structure building activity.

During subsequent reading, Connection Muse models the reader's growing knowledge of the structural components of the hypertext, and adapts the navigational elements of the hypertext according to the writer-defined behaviours. For example, the hypertext poem *Penetration* (Kendall, 2000) uses different coloured links to denote knowledge values:



(a) (b)

FIGURE 6.18: Creating a conditional link (a) and multilink (b) in Connection Muse (Kendall and Réty, 2000).

dark green for unvisited nodes, light green for nodes previously visited in a different context, and white for nodes previously visited in a similar context.

6.2.4.4 Hunter Gatherer

Hunter Gatherer (schraefel et al., 2002) allows writers to harvest information from within Web pages into editable collections. Collecting information from the Web with Hunter Gatherer is straightforward: users select the required information, and then press a key to add it to their collection. The system automatically gives the information component a title, adds the URL as a link back to the source document, and renders the location of the selected information as an XPointer (part of the XML Linking standard — Section 4.3). This approach seems to map best to the context building activity of Associative Writing, in that it allows writers to gather relevant existing content into a series of named collections (although relationships cannot be captured explicitly, gathering related material into the same collection could imply the relationship). The browser integration and subsequent transparency of the select/add process means that users can focus their main attention on the information gathering task rather than continually shift that focus to other applications, for example Compendium or Visual Knowledge Builder. Hunter Gatherer therefore minimises the "forced divided attention" introduced by shifting between information triage and management (schraefel et al., 2002).

	Planning	Context Building	Structure Building	Integrated Writing
WE	·	·	•	·
SEPIA	•	◦	•	◦
SWT	•	•	•	·
gIBIS	·	·	•	·
ScholOnto	·	◦	·	·
MacWeb	·	·	◦	·
Aquanet	·	·	•	·
VIKI	·	◦	•	·
VKB	·	◦	•	◦
ART	·	·	◦	·
Tinderbox	·	◦	•	◦
Wiki	·	·	·	◦
StorySpace	·	·	•	·
Conn. Muse	·	·	◦	·
H. Gatherer	·	◦	·	◦
WebVise	·	•	·	·
Frontpage	◦	·	◦	◦

•	Strength
◦	↕
·	Potential weakness

TABLE 6.10: Correlation of all hypertext writing tools to Associative Writing activities.

A separate List/Edit window displays a list of the collected information. Users can rename, sort and delete components, and give the collection a title. The user can also select a "Collection View", where the content of each component is retrieved (there is no copying of content, only referencing of content addresses via an XPointer) and displayed in the browser as a linear list. Each component appears in the list with the source page URL as a link. In an Associative Writing context, the Collection View approach may help the writer create a hypertext which integrates the collected material.

6.3 Discussion: Introducing a More Specific Focus

Table 6.10 collates each of the hypertext writing approaches reviewed in this chapter according to the potential contributions each approach makes to the challenge of supporting Associative Writing in the Web. The table also attempts to position work discussed in previous chapters in relation to the hypertext writing approaches discussed here.

WebVise (Grønbæk et al., 1999), introduced in the survey of "augmented Web" work reported in Chapter 4, is a document-based permissive tool (although note that the extensions to WebVise to provide user-defined link types (Hansen et al., 1999) are *descriptive*). In the context of Associative Writing, the WebVise approach seems particularly suitable to the context building activity: writers can apply annotations to Web pages, and connect related ideas in pages using *anchored links.*

ScholOnto (Buckingham-Shum et al., 2000), introduced as a Semantic Web initiative in Chapter 5, is a prescriptive tool (links are constrained according to an ontology) which facilitates both document-based (Web based forms for creating *concepts* and *claims*) and map-based (Questmap-based interface for creating *concepts* and *claims*, generated visualisations) interactions. The ScholOnto approach (which focuses supporting human understanding using Semantic Web technologies, rather than explicitly on supporting writing) seems closest to the context building activity of associative writing: users describe source documents using one or more *concepts*, and then contribute to an understanding of how these concepts relate to the literature by expressing their individual interpretations using *claim* links).

The permissive word-processor based Microsoft Frontpage Web composition tool is also included in the summary, since it offers some features beyond a the straightforward text-editing environment typical of other popular tools. Frontpage's 'Task' view approach (Figure 6.19a) for example, although perhaps less complex than the SEPIA's planning space and Neuwirth & Kaufer's Goal Tree, could provide some support for the planning activity. The 'Navigation' view (Figure 6.19b) helps the writer define an overall structure — or local coherence (Moulthrop, 1992) — for a set of Web pages. The text-editing environment itself allows writers to anchor links to existing material (although these links are subject to the limitations of the Web's hypertext model, and are less easy to specify than WikiWords), and thus create the kind of integrated hypertexts uncovered in Chapter 3.

Overall, this chapter has seen a trend away from early 'complete' solutions for supporting the writing process such as Writing Environment, SEPIA, and the Synthesis Writing Toolkit (1980s), towards tools more specific and specialised to a particular writing task or activity where an end product may not necessarily be in traditional written hypertext form (for example, spatial hypertext for information triage in the 1990s) — cf. Neuwirth and Kaufer's early indications that writing should be considered as an "open-ended design task" (Neuwirth and Kaufer, 1989). As a result there seems to be no 'complete solution' to the challenge of supporting Associative Writing in the Web (the SEPIA approach seems to come closest, but this early system is not Web-based). Addressing the challenge will therefore require a combination of elements from more recent approaches.

A number of approaches which could support the structure building activity provide a good foundation for extension. These approaches help the writer create a hierarchical (Writing Environment, VIKI, Visual Knowledge Builder, Tinderbox, StorySpace) or argument-based (SEPIA, Synthesis Writing Toolkit, gIBIS, Aquanet) document structure (note that although the descriptive tool Aquanet is used to create an argument-based structure in the example given above, the tool could equally well support the

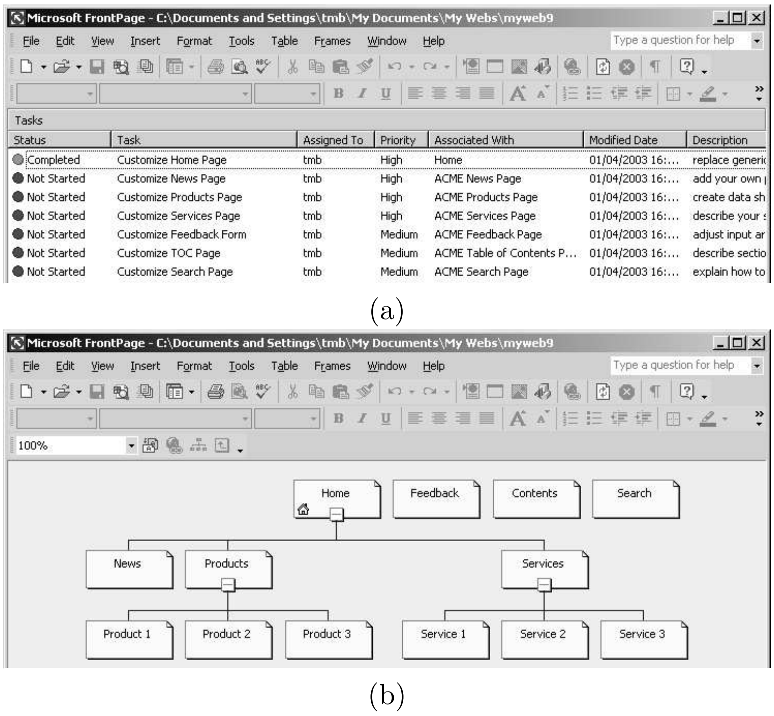


FIGURE 6.19: Task and Navigation views in Microsoft Frontpage.

creation of a hierarchy or other more specialised structure). Some of these tools already have impressive features, for example VKB's navigable history mechanism and Suggestion Manager, and Tinderbox's Web site building mechanisms.

Foundations for supporting the context building and integrated writing activities, however, are less stable. These activities are closely tied; in order to produce a written hypertext which integrates existing Web content (integrated writing), writers must be supported in selecting (or otherwise identifying) and exploring that content in the context building activity. Table 6.10 shows that the SEPIA, Visual Knowledge Builder, Tinderbox, and Hunter Gatherer approaches (highlighted) could come close to supporting both activities: SEPIA's content space may include existing materials, which are then integrated into the final hypertext form (although it is not clear whether existing material is referenced or copied); Visual Knowledge Builder offers some Web integration through URL slots, and *global links* provide opportunities for creating integrated *spatial* hypertexts; Tinderbox also offers some integration though URL attributes, which can be used to create links to other Web pages using Tinderbox's Web site builder tools; Hunter Gatherer allows users to select existing content from Web pages directly, and then generate an integrated "Collection View", but lacks many other features (such as allowing the writer to contribute new content and to explore the relationships between collected content).

Clues as to how to build on these systems may be obtained from other approaches which could support context building well (but not integrated writing). WebVise and Synthesis Writing Toolkit both provide mechanisms for the writer to interact directly with existing content (using the map-based Notes tool in the latter case). In contrast, each tool which has been flagged as potentially supporting structure building well is map-based. However, the Synthesis Writing Toolkit demonstrates how document- and map-based systems could be bridged by maintaining links to notes made on source documents from other (map-based) tools (Summary Graph, Synthesis Tree, Synthesis Grid); allowing writers to explore and assert structure over existing content in the docuverse without losing the original locations of the content in source texts.

Due to the weaknesses of current approaches in supporting the context building and integrated writing activities, it seems appropriate to narrow the focus of this challenge to these activities, with the anticipation that support for other activities could later be integrated into a chosen solution. Those approaches which seem to provide the strongest support for context building (WebVise, Synthesis Writing Toolkit, and Hunter Gatherer) are based around direct document-based interactions, integrating the writer directly with existing work in the Web. Such interactions are also well supported by a number of hypertext annotation systems (Heck et al., 1999); this focus on context building and integrated writing is therefore explored further in the next chapter in the context of such systems.

6.4 Summary

Whereas the previous chapter concluded that a technical challenge of Associative Writing in the Web is to enrich the hypertext model of the Web to better support the publication of integrated hypertexts, this chapter introduced a *user* challenge: popular Web composition tools do not support Associative Writing well.

By comparing and correlating models of the writing process described by Streitz *et al* (Streitz et al., 1989), Smith *et al* (Smith et al., 1987), and Neuwirth & Kaufer (Neuwirth and Kaufer, 1989), activities involved in the Associative Writing process could be extrapolated:

Planning Constructing overall goal structures and plans for associative writing.

Context building Identifying and interconnecting existing Web content and new contributions.

Structure building Elaborating on the content and structures created in the *context building* process to create an overall structure for the writing.

Integrated writing Arranging new contributions into a coherent hypertext (according to structure elaborated in *structure building* activity) which integrates with the global context identified in the *context building* activity.

It was concluded that popular writing tools for the Web, based on end-product oriented word processing programs, tend to support best text editing and composing, and hence provide little support for the more complex activities of Associative Writing. The challenge then, is to help the user carry out the various activities involved in Associative Writing. The results of an investigation of a number of hypertext tools designed specifically to support writing tasks was reported in response to this challenge, with the purpose of critically reviewing the potential support provided by each approach for supporting Associative Writing.

The chapter concluded that although a number of approaches could help support the structure building activity of Associative Writing (hence providing numerous extension possibilities), foundations for supporting the planning, context building, and integrated writing activities are less stable. It was therefore decided to narrow the scope of this challenge to consider only the context building and integrated writing activities, with the anticipation that existing support for other activities could later be integrated into a chosen solution. This focus is explored in the next chapter, which investigates the possibility of using existing work and technology in hypertext annotation to support context building in the Web.