

Application of Grounded Theory to Exploring Multimedia Design Practices

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Abstract

This paper describes the application of Grounded Theory to an exploration of multimedia design practices. It discusses the opinions of multimedia developers, as elicited from interviews, on the selected design tasks and the processes employed in their completion. Our findings, which emerge from the analysis of the collected data, indicate that the currently available multimedia models do not address some of the important concerns of practitioners. We believe that closing the methodological gaps in these models would provide better support for the multimedia development process.

Keywords

Multimedia design, Grounded Theory, design context

Introduction

Multimedia products can be very complex; they may consist of many components, have a sophisticated structure and interdependencies that necessitate the use of software tools and large repositories of components. To deal with the complexity of multimedia products, special design methods and software to support them have been developed (Balasubramanian, Ma, & Yoo, 1995; Boll & Klas, 1999; Garzotto, Mainetti, & Paolini, 1995; German & Cowan, 1999; Hardman, Bulterman, & Rossum, 1994; Isakowitz, Stohr, & Balasubramanian, 1995; Lange, 1996). Nevertheless, multimedia design guidelines and design tools are still in the focus of multimedia research and practitioners are still in need of effective methodologies and tools. For example, Johnson and Nemetz (1998) evaluated several classes of multimedia systems, e.g. Web sites and CD-ROMs, and showed that indeed there is a great need for new design principles and methods.

The goal of this research is to investigate several aspects of multimedia development. In doing so, we aim at gaining in-depth understanding of the ways multimedia designers work, their practices and concerns. On the completion of our study we hope to propose a methodological framework for multimedia development that will result in improved multimedia development tools and ultimately, in the construction of better quality multimedia products.

Our research to-date points to the area of multimedia design that seems neglected by the existing software tools and design methods but which we believe remains in the centre of designers' concerns, i.e. the effective utilisation of the design context to support design decisions in multimedia authoring. We consider the design context to be a set of issues that influence design decisions in multimedia development.

The following research questions lie at the centre of our pursuits:

- What issues form part of the design context surrounding typical multimedia design tasks?
- How can designers utilise the design context to effectively support a decision-making process in multimedia development?

To better understand multimedia design decisions, we sought the opinions and collective experience of multimedia practitioners. In the process, we collected several cases, observations and demonstrations of multimedia products and their developmental history. We aimed to explore real design situations and to focus specifically on multimedia designers and their decision-making processes. We decided to proceed with an in-depth study of the observed phenomena and we therefore took an interpretive research approach. Since our findings can only be drawn directly from the collected data, we found grounded theory (Glaser & Strauss, 1967) to be eminently suited to our research project.

Overview of the Grounded Theory

Grounded theory is a research method that prescribes systematic guidelines for data collection and analysis with the purpose of inductively building a framework explaining the collected data (Charmaz, 2000). Grounded theory strategies suggest the collection and analysis of large amounts of unstructured textual material from various sources, such as formal and informal interviews and observations, then developing a theory on the basis of the data material. Although grounded theory methods do not dictate data collection rules, the rigor of the analytic process helps to build a strict explanatory framework. Some researchers emphasize that the strength of grounded theory lies in the fact that concepts and theories developed on the basis of data material are more “empirically grounded” (Glaser & Strauss, 1967, p.3f).

One of the strategies of grounded theory is an iterative collection and analysis of data which allows a focus on further data collection.

Since the majority of collected data is unstructured, a researcher needs to break the material up into more manageable chunks. This is done with the help of categories or codes, which are “derived either from common sense concepts or from abstract theoretical concepts” (Kelle, 1997, para 5.2). Depending on the approach taken, the codes may be developed before data collection and coding or while the material is being coded.

To draw concepts from the collected material, coded text passages are compared. Since a theory can be regarded as a network of categories, derived interconnected codes form the building blocks of an emerging theory (Kelle, 1997).

Coding and analysis processes can be manual, computerised, or a combination of both. In qualitative data analysis a combination of both methods is beneficial since it allows a combination of the best features of both approaches, “providing an audit of the data analysis process as a whole” (Welsh, 2002, abstract) It has been noted that information retrieval software assist in performing accurate searches on large data sets, which also adds to the rigor of the qualitative research process (Callan, Croft, & Harding, 1992; Richards & Richards,

1991). However, to obtain more reliable results computerised approaches need to be combined with manual techniques to ensure that multiple instances of concepts can be found.

Method

The choice of the research method was influenced by the following needs:

- the need to investigate practitioners' perceptions of design situations and to understand the decision-making process in a "real-world" environment; and
- the need to determine whether some of the issues are interpreted differently by practitioners with a different work scope, e.g. by graphic designers, Web developers, educational designers.

Due to the richness of the information, the interviews were not rigidly structured and the questions used to elicit practitioners' opinions were asked in an open fashion. The collected data were based primarily on the subjects' recollection of events, and as such were influenced by their perception of the situations; therefore the existence of some bias had to be taken into consideration during analysis. By using a multi-method triangulation approach the possibility of bias was reduced, and the rigor of the conducted study was therefore assured (Miles & Huberman, 1994).

The collected interview data was triangulated with observations of design assignments. The interviews provided the researchers with a recollection of the design processes, whereas observations resulted in concurrent verbal reports. As noted by Adler and Adler (1994), interviews are "constructions of subjects' recollection and (sometimes self-serving) perceptions", however, when combined with researchers' observations of subjects in real settings in the process of work, the collected data can be accepted as hard evidence.

The selected data collection methods were also motivated by the findings reported by Ericsson and Simon (1993), who showed that both forms of verbal reports adopted in our study, i.e. concurrent verbal reports ("talk aloud" and "think aloud") and retrospective reports, have little impact on the subjects' cognitive processes. The collected reports were particularly well suited for our study for the following reasons:

- Protocol analysis gave some access to practitioners' cognitive processes during the multimedia design process.
- Collected data were relatively accurate and closely reflected the course or structure of the thought processes (Ericsson & Simon, 1993).
- Protocol analysis supported theory building. Verbal protocols are accurate sources of data that provide a rich foundation for hypothesis construction and in-depth investigation.

Data Collection

Pilot Study

Our data collection started with a number of semi-structured interviews to probe the scope of the area of our investigation. While the initial direction of our research was focused on the design decisions associated with multimedia reuse, it was soon discovered that multimedia

practitioners have little regard for the explicit re-use of artefacts, and that a major part of their design process is in construing the context for decision making across the entire spectrum of design issues. This realization refocused and widened our study to the investigation of multimedia design practices and more specifically decision making in visual multimedia development. This later led to the formulation of a concept of design context, and of understanding of its impact on the decision-making.

Interviews and Observations

The subsequent data collection consisted of several mini project-oriented case studies. Each case involved a single interview and for some selected cases, observations of multimedia practitioners followed. The interviews were conducted primarily by one researcher. In these interviews, multimedia designers were asked to talk about a project of their choice and in the process explain the design process, discuss different drafts, explain decisions made and reflect on their best practices.

In the first five interviews run on these principles the researcher did not ask any additional questions since the purpose was to collect the preliminary data to focus further data collection. These unstructured open-ended interviews were later replaced with more focused interviews aimed at collecting an interviewee's design story, which was then supplemented with a range of additional questions.

Interview data were used to understand the subjects' working environment and to further focus the interviewing process. In selected cases interviews were followed up with observations to verify findings that were emerging from the collected data.

The data were collected mainly in the form of audio and video recordings, hard copy notes made by the researcher, and screenshots used to illustrate transcriptions.

Field procedures

The main goal of the case study sessions (both interviews and observations) was to identify design events and reuse occurrences (often transparent to practitioners), determine multimedia objects and situations these events apply to, and capture the developer's reasons for making design decisions.

The interviewees were selected based on their area of expertise in multimedia production, i.e. the researcher approached graphic designers, multimedia developers, multimedia programmers and Web developers. Eight (8) subjects were interviewed of whom three (3) were observed in the process of working on a commercial multimedia project.

The data collection processes of each case included:

1. Initiating contact with the potential subjects via telephone and/or e-mail.
2. Interviewing subjects with the aim of gaining understanding of the multimedia development process used. During the interviews the computer screen was videotaped and the voice of the interviewee was recorded not only on video tape but also using a digital voice recorder.
3. Transcribing interviews from audio file and verifying the results using video recording. Transcribed interviews were verified by the interviewees via telephone and/or e-mail

when needed. The practitioners were also asked to provide screenshots of evolving multimedia products in different stages of their development (e.g. early draft, intermediate version(s) and final version), which were subsequently inserted in the appropriate places in the transcribed verbal protocols.

4. Organising a repository of transcriptions.
5. Observing and videotaping selected subjects in action at their workplace. Each subject was observed during a design activity using a video camera placed on a tripod stand capturing data from the computer monitor on a videocassette. Again additional audio recording was done to supplement the recording of sound on videotape. During observations subjects were asked to “think aloud” to reveal their thoughts on performing design tasks and the reasoning behind their decision. “Think aloud” is a form of verbal report that “can claim to being the closest reflection of the cognitive processes” (Ericsson and Simon 1993, p.16).
6. Transcribing observations from videotape, noting all paralinguistic features and points at which external information (such as requirements documents, navigational charts, etc) was used. Verifying information in follow-up interviews.
7. Adding transcriptions to the repository.
8. Analysing transcribed data using a coding system. Data were analysed for multimedia design tasks and issues associated with them.

Collected Data

Interviewees talked about the issues they felt were most important in their work and in multimedia product development in general. The range of topics covered in our interviews was very broad; however, we found numerous similarities of concerns and opinions. For example (see Figure 1), several interviewees signalled the importance of colour-related issues in the World Wide Web design.

Graphic Designer 1: “I also asked the client for the exact colours of the logo because as a graphic designer one of my jobs is to keep colours as accurate as possible, even though on a web site you are a little bit limited.”
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Web Developer 2: “The colours came from their corporate colours, the blue and the red and we kept with that.”

Figure 1 - Collected interview data

The similarity of concepts found across interview transcripts allowed us to generalise and classify issues related to common design tasks. This will be illustrated in the following sections.

Data Coding and Analysis

The coding of data started when the data gathering process was in progress. It was conducted primarily by the researcher who had previously collected the data. The coding system evolved during the process and helped further focus the subsequent data collection (Charmaz, 2000).

Data maintenance was done using the qualitative data analysis package NVivo. There were several reasons for choosing this package:

- Several colleagues' recommendations.
- Easy import of transcriptions from the Word for Windows that was used to produce transcriptions.
- RTF format that supports different font styles and colours to call attention to certain parts of the text.
- Visibility of coding stripes.
- Codes maintenance system.
- Possibilities of creating various working sets of documents and categories (nodes).
- Sophisticated search facilities.

Although NVivo was not specifically designed to support grounded theory methods, it is widely used in qualitative data analysis and theory building from the analysed data, and as such it is well equipped to support grounded theory approaches (Welsh, 2002).

While the initial coding was very fine-grain with unique codes developed for each interesting design issue (see Figure 1 and Figure 2), the process of re-reading the transcripts and generating the codes helped the researcher understand what developers were doing, and what approaches to product development were taken. This understanding allowed a comparison of different practitioners' views, actions and experiences – a major technique in grounded theory (Charmaz, 2000).

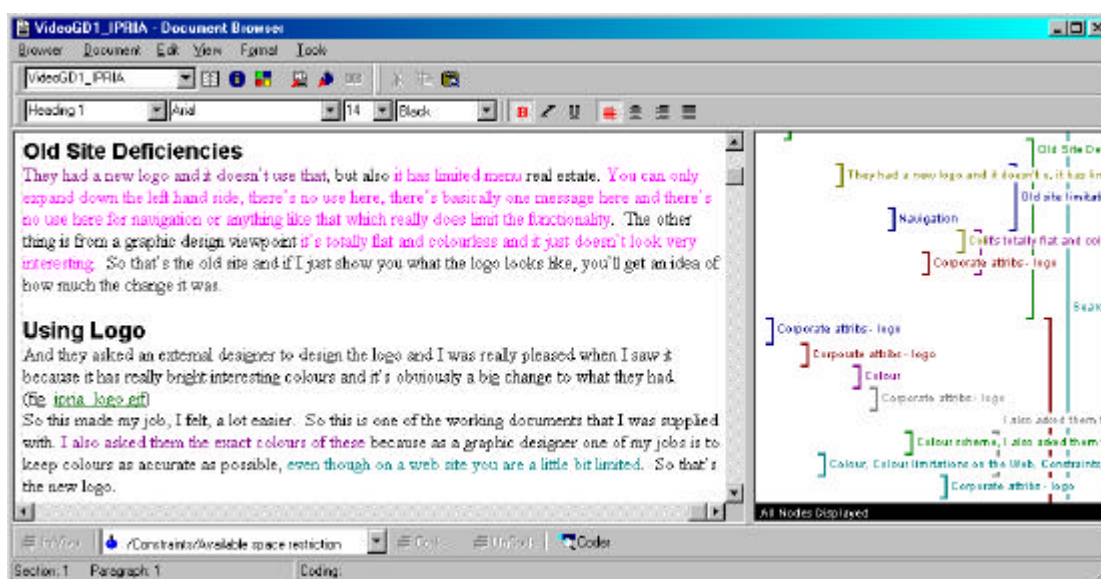


Figure 2 - Fine grain coding of interview data

The researcher quickly discovered that there were frequent commonalities between procedures, issues and concerns addressed by practitioners, and thus a more generalised coding system was developed. This approach allowed the identification of common tasks performed by practitioners and the task-related classification of concerns mentioned (Figure 3). For example, in one of the early video interviews the graphic designer described the issue of the colour scheme selection for the Web site (see Figure 2). As the researcher was collecting and transcribing more data (see Figure 3), the data were further scanned for additional references to colour related issues, some of which reflected a pre-existing context, such as corporate colour schemes and logos (identifiable in Figure 3 as an overarching “Views on Colour Scheme” code), and others linked with technical aspects, such as the colour depth, colour saturations, the selection of web safe colours, etc.

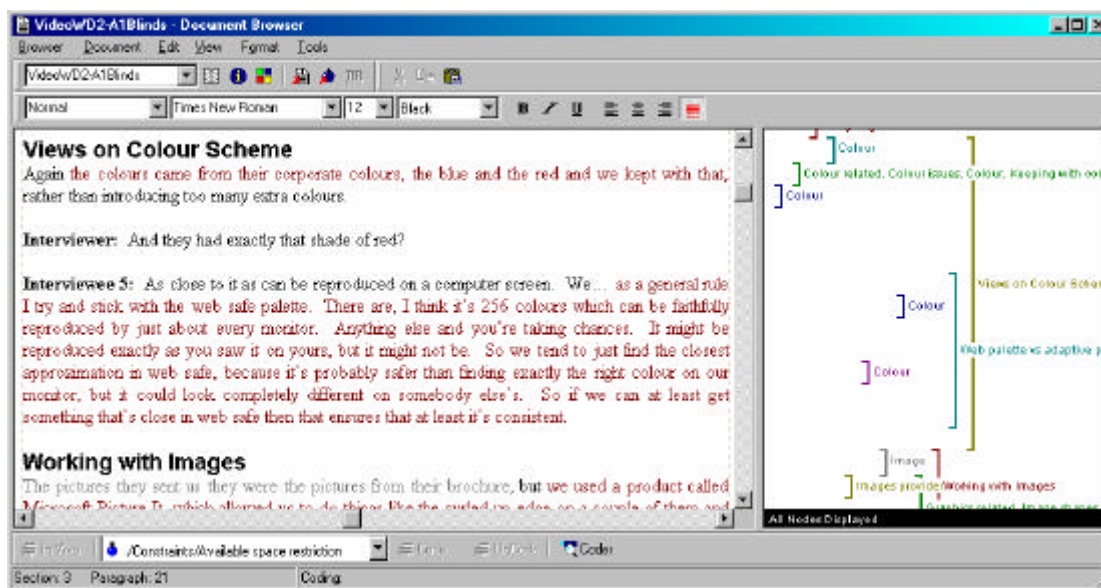


Figure 3 - Fine grain and generalised coding of data

The results of the analysis led to the merging of fine grain codes into more general themes, reflecting the various design tasks, e.g. the pre-existing (business) context, human-computer interaction (HCI) issues, designing menus, etc. Within each design task more fine-grain issues were identified. For example (see Figure 4), in the “pre-existing context” theme we identified a number of aspects, which now include:

- Use of the colour scheme reflecting the industry (e.g. Yoga recognises energy points of the body with different colours and these colours were used through the Web site in relevant sections);
- Colour compatibility across the web site. Interviewees reflected on their experiences with the use of various colour combinations (such as light blue on white) making an impression of a professional finish, the combination of well-matched colours (e.g. navy blue and warm colours), need for a neutral area to offset bright colours, the legibility of text set against other colours, etc.
- Use of corporate colours from logos and business cards. Issues mentioned included the selection of Web safe colours to match corporate colours and complementing corporate colours with some neutral colours for backgrounds.

Similarly, in the “designing menu” theme (explored in the next section) the following aspects were included:

- The look of the navigational tool. Interviewed practitioners talked about menu buttons, drop-down menus, rollovers, Flash animated menu, palm-pilot look, etc.
- Creating rollovers. Practitioners had a preference for different tools here and identified advantages and disadvantages of using those tools, e.g. Fireworks, Flash, Photoshop with ImageReady.
- Text substitute for image based menu to address accessibility issues and W3C compliance.

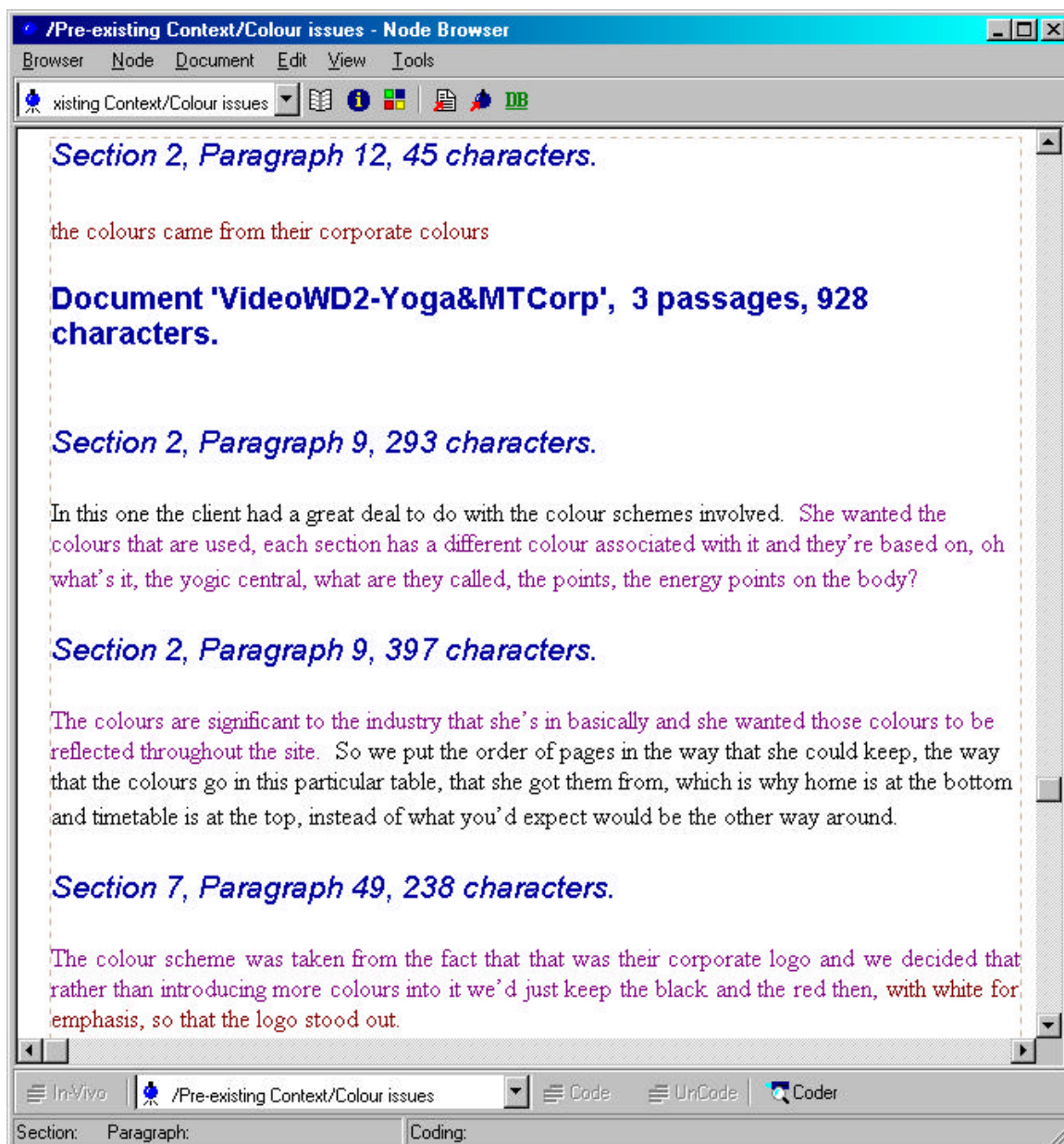


Figure 4 - Formation of general themes

Findings and Discussion

In the process of data coding the concept of "design context" emerged.

When talking about a task performed in the process of multimedia product development, interviewed practitioners remarked on various aspects of their work that had to be considered in support of design decisions necessary to complete the task. These aspects were usually derived from client requirements, the pre-existing business and technological context, the designer's experience, and the availability of multimedia authoring tools. During data analysis, all task-related aspects were generalized and clustered into design issues. The collections of such issues, with all their associated aspects, as relevant to a particular design task we call "design context". For example, for the "menu design" task a design context includes issues related to the design of the menu look, its structure, behaviour, buttons, rollovers, and drop-downs (see Table 1 for a synopsis of design issues and aspects relevant to the design context of the "menu design").

Design issues	Aspects of design tasks to be considered
Menu Look	<ul style="list-style-type: none"> • Menu layout • Non-ortho linear vs. tabular menu items layout • Visual representation of menu items • Menu context indication • Menu persistence during navigation • Temporal effects
Menu Structure	<ul style="list-style-type: none"> • Consistency between menu and site/information structure
Menu Buttons	<ul style="list-style-type: none"> • Tool-specific menu design facilities • Creating reusable menu styles • Menu image representation (vector vs. bitmap) • Editing ability of menu components • Inter-tool communication and compatibility
Menu Behaviour	<ul style="list-style-type: none"> • Visual effects (transitions) • Navigation behaviour • Mouse-click effects
Menu Rollovers	<ul style="list-style-type: none"> • Mouse-over effects • Inclusion of rollovers in menu design • Duality of rollover visual and behavioural design • Time required for uploading rollover scripts • Visualisation of rollover behaviour in text readers • Representation and initialisation of menu states • Export and slicing of images used in menus • Script compatibility between different browsers • Use of images to indicate mouse over effects • Selection of a highlight colour in mouse over effects • Use of animation for rollovers • Keeping track of menu components
Menu Drop-Downs	<ul style="list-style-type: none"> • Use of scripts and style sheets to design fly out menus.

Table 1 - Abbreviated design context for a "menu design" task

Emerging from our study, the design context captures the cumulative experience of multimedia practitioners as applicable to a particular task. It embodies their knowledge of useful design artefacts and successful practices in multimedia development, e.g. classes of

multimedia components and design processes associated with their creation, methods of components design and integration, selection of features, etc. All such artefacts and practices are commonly the focus of some well-known multimedia (and hypermedia) design models, such as Dexter (Halasz & Schwartz, 1994), AHM (Hardman et al., 1994), MPDM (Shimizu, 1995), HDM (Garzotto, Paolini, & Schwabe, 1993), RMDM (Isakowitz et al., 1995), OOHDM (Schwabe & Rossi, 1995), ZyX (Boll & Klas, 1999), and Visual Composition Models (Gibbs, Breiteneder, & Tschritzis, 1994; Mey, Breiteneder, Dami, Gibbs, & Tschritzis, 1992; Mey & Gibbs, 1993).

We compared our findings against the major features of these multimedia design approaches. Table 2 lists a subset of design aspects drawn from the examples presented in this paper to illustrate the emerging gaps between multimedia design models and the observed practice. For example, while the multimedia models have an excellent coverage of design issues related to spatial, temporal, interactive, structural, user interface, and navigational aspects of multimedia products, they have been unable to capture designers' concerns in relation to technology compatibility, tool support for the design (and later implementation) process, the pre-existing business context and visual aspects (as discussed in the previous section). Such gaps identify the areas of possible extension to the models, leading to better methodological support of multimedia design processes.

Design Model	Dexter	AHM	MPDM	HDM	RMDM	OOHDM	ZyX	VCM	Observed Practice
Spatial design	N	Y	Y	N	Y	Y	Y	P	Y
Temporal design	N	Y	Y	N	N	Y	Y	Y	Y
Interaction design	Y	Y	Y	Y	Y	Y	Y	Y	Y
Structure design	Y	Y	Y	Y	Y	Y	Y	Y	Y
User interface design	P	P	Y	N	Y	Y	Y	N	Y
Navigation design	Y	Y	Y	Y	Y	Y	Y	Y	Y
Technology compatibility	Gaps								Y
Tools support									Y
Contextual issues									Y
Visual aspects									Y

(Y - supported, N - not supported, P - partially supported)

Table 2 - Comparison of design models with observed practice

We believe that the identified gaps could be explained by a number of factors (which need to be further investigated), such as:

- Prototypical nature of multimedia development, which calls for the use of specialised authoring and design tools;

Graphic Designer 1: "Image Ready does actually simplify the process a fair bit, because you can actually preview the rollovers."

Web Developer 2: "I use Fireworks for all of my buttons, because for a start I like the fact that it's vector and not bitmap. It makes it a lot easier to edit individual components. So you know, you can do a mass select, like, you can select all of the boxes and change the colour across all of them with one click, which you can't do very easily with bitmap."

- User-centric design approach which heavily depends on the external context and which focuses closely on the usability and accessibility issues of the resulting products;

Graphic Designer 2: "I think people's eyes do tend to stay towards the top of the page."

Graphic Designer 1: "They also are very text heavy documents so I need to have a lot of white space."

- Potentially non-homogenous community of multimedia (especially web) users, thus forcing designers to anticipate non-uniform technology to facilitate delivery and use of multimedia products.

Web Developer 1: "And the reason why we needed a different version for Netscape and for Internet Explorer was because... lets launch site in the page... is that Internet Explorer allows you to show the movie at 100% of its width and the height which creates a much nicer movie type effect I guess, whereas in the, if you use the same settings in Netscape, the movie would appear as one single line because it just doesn't understand what 100% width means. So we need to detect the browser."

Web Developer 1: "And the reason why we detected screen resolution was because on an 800 by 600 screen which we were using as the lowest common denominator in this case, the bottom part of the movie would not be visible on browsers that had all of the available menu bars and things fully open up at the top."

Web Developer 2: "For general text I always use something like Verdana or Arial or something like that as opposed to Times, because Times works best on printers."

Graphic Designer 1: "... and every extra pixel adds to the size of the file, so I'll cut that off."

Multimedia designers seem to be "obsessed" with visual aspects of the developed product, such as layouts, colour schemes, use of fonts and white space, balance between text and images, etc. As one graphic designer put it, "I want it to be visually interesting", which we found to be an attitude shared among a wide range of multimedia developers.

Evaluation

To establish the validity, integrity and quality of this research we applied the Klein and Myers' (1999) framework for evaluation of interpretive field studies. The undertaken research activities were examined against the seven principles of the Klein and Myers' framework.

1. The Fundamental Principle of the Hermeneutic Circle

Transcriptions of interview data were repeatedly searched for themes and ideas explaining the multimedia design process. Interviewees were contacted with the purpose of clarification of events observed or described in the interviews. The study iterated between the fragments of interviews as parts and the global context to determine the full meaning of individual product development discussions. The researchers then applied concepts from the existing literature on software and multimedia design to explain the observed design phenomena.

2. The Principle of Contextualization

Interviews and observations were conducted in real settings where practitioners had access to their projects, documentation and software tools used in development. Individual experiences had a strong impact on the way the projects were described and what issues were emphasized as the most important.

3. The Principle of Interaction Between the Researchers and the Subjects

Interviewees were encouraged to talk freely on the issues they felt important in the development process. The researchers ensured the understanding of the observed multimedia development processes and decision-making by videotaping the computer screen, while asking for additional explanations where necessary. The researcher encouraged the interviewees' to share their opinions on the design options considered and the design decisions made.

4. The Principle of Abstraction and Generalization

The collected data were coded and analysed for commonalities and similarities which were fundamental in forming general multimedia design concepts. The system of codes, which enabled later interpretation of observed phenomena, evolved iteratively to provide an abstract framework of design tasks, issues related to these tasks, design decisions resolving various design issues, and inter-related design aspects which supported the decision-making process.

5. The Principle of Dialogical Reasoning

The initial understanding of multimedia design process was based on the well-known design models described in the literature. However, the researchers discovered deviations of accepted methodological approaches from practice. The collected data show that observed practitioners are not only concerned with the product function, form and contents, but also with the issues related to tool and business contexts of the product design and use environments. The initial preconceptions had to be revised and the notion of design context evolved during the analysis.

6. The Principle of Multiple Interpretations

Our interviews revealed that practitioners from a variety of backgrounds encounter common problems in multimedia product development. However, designers presented us with their particular insight on the use of different techniques, tools and approaches to

dealing with these similar situations. In our analysis, through the use of code generalisation, we integrated and reconciled the partial interpretations of the observed phenomena into a generic framework for understanding the multimedia design process.

7. The Principle of Suspicion

The researchers understand that opinions shared by the interviewed subjects were infused with some degree of bias. This was countered by triangulating interviews with observations to verify our findings. At the same time researchers' coding and interpretations of transcripts could also be biased. Iterative data collection and analysis was therefore applied to allow any such misinterpretations to be identified and subsequently minimized in the process.

We believe that the conducted research complies with the criteria set by Klein and Myers (1999) and thus our findings are based on a sound research process. It should be noted, however, that the collected data are very rich and may still be subject to a different interpretation. As suggested by Corbitt and Thanasankit, "what we have to do is recognise what it is we create and suggest that others test our generalisations and our conclusions based on their own sense of meaning." (Corbitt & Thanasankit, 2000, p.9)

Summary and Conclusions

In this paper we have described the grounded theory approach to exploring multimedia design. The aim of the research was to identify the design context surrounding a typical design task.

Large amounts of unstructured textual material were collected in the form of interview and observation data. The data were organised using a qualitative analysis package - NVivo. In the process of data analysis the researchers identified common design tasks and aspects of design issues associated with them. Such issues represented the practitioners' cumulative experience in dealing with the design task, and were recognised as supporting designers' decision-making processes, which ultimately lead to the completion of the task. A collection of task-related design issues is considered by the authors to be the task's design context.

We have compared our findings consisting of issues concerning multimedia designers engaged in various design tasks, with well-known multimedia and hypermedia design models. We have identified several gaps between the design tasks and issues supported by these models and the observed design practices, namely, that multimedia practitioners are concerned not only with the product function, form and information contents - which are currently supported by multimedia methods - but they are also guided by issues of technology compatibility, tool availability, and user contextual factors and their perceptions. We believe that extending the existing multimedia models to bridge these gaps would improve the methodological, and possibly tool, support for multimedia developers.

Our future work will focus on producing a more complete framework of multimedia development practice, which could be readily incorporated into the selected methods of multimedia design.

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