Content Authoring in an XML-based and Author-Friendly Environment

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Abstract

Publishers are automating the publishing streets to facilitate Printing and Publishing on Demand (PPoD). Besides the traditional hard-copy publications, a wide variety of products are added to their product line, such as Web-sites, Portfolio, leaflets, e-books, DVD, video, audio, etc. To achieve this, content should be reusable for publication on different media and platforms.

Authoring content digitally already has become an integrated part of writing and a number of authoring environments are available to support the author in this process. However, to enable reusability of content in the context of a publishing street, content should be created in a medium neutral fashion. The eXtensible Markup Language (XML) allows for the separation of content and presentation, but also influences the authoring process radically.

This research discusses two process models for structured content creation that should be integrated in the authoring environment of a publishing street. The aim of these models is to ensure that authors are not restrained in their creativity while producing medium neutral (structured) content, i.e. to maintain both a high level of productivity and satisfaction.

The first method uses a wizard-based approach that guides the author through the content authoring process in a didactically approved manner. The second method supports the authoring of structured content without restricting the author to follow a certain procedure, such that the author can create content components in an arbitrary order.

The methods have been integrated into two experimental environments for content creation. To compare both environments with respect to effectiveness, efficiency and user satisfaction two experiments

are conducted. The experiments have been carried out with authors of ThiemeMeulenhoff, an educational publisher in the Netherlands.

The outcome of the experiments show that when using the guided approach structured content with predictable and equal quality is produced, with less dissatisfaction among the authors, i.e. especially among inexperienced authors. On the other hand, higher quality of content can be achieved with the second method, but also the risk of using this process model is higher, given that there were authors who experienced extreme dissatisfaction with the unguided environment.

1 Introduction

The world of educational publishing is changing rapidly. Publishers are automating the publishing streets to accommodate the increasing need of personalized content known as Printing and Publishing on Demand [9]. To achieve this, the content must be reusable and therefore designed in a medium-neutral fashion [7]. ThiemeMeulenhoff, one of the main educational publishers in the Netherlands, is facing these problems.

Reusability means that published content must be available and accessible for reprinting and reusing at any time. Content must therefore be stored in a flexible and platform independent format. This is also referred to as medium neutral [7]. To achieve this, content must be created, free of presentation or layout so that later use of (parts of) the content is possible for a variety of products [2, 9], such as books, DVD's and Web-sites.

Introducing XML, the eXtensible markup Language, as a standard for medium neutral data exchange into the publishing street is promising at first, but also complicates the content authoring process. The vast majority of the authors has no knowledge of XML and is solely interested in creating educational content. For this purpose they currently work with word processors that are based on the WYSIWYG (What You See Is What You Get) approach. This, of course, frustrates the condition of content being medium neutral and re-usable.

The challenge is to integrate XML into the authoring process, while simultaneously making sure that the authors can cope with the changes brought on by the implementation. Expecting the authors to create their content in 'raw' XML is highly unreasonable.

In this article two process models for structured content authoring are introduced. The first model uses a wizard-based approach, that guides the author through the initial process of creating educational content an a didactically approved methodology [14]. We will refer to this model as the

guided model. The second model allows the author to produce pieces of educational content in an arbitrary order. This is closer to the traditional writing process, and allows for more creative freedom. We refer to this model as the unguided model for structured content authoring.

Our expectation is that, despite a more limited creative freedom, the authors working with the guided model will produce better content in terms of quality and structuredness, while maintaining a high level of efficiency and satisfaction, when compared to the unguided model. Both process models have been implemented and integrated into an authoring environment for structured content. Such authoring environments are frequently used to accommodate authors in creating structured content without knowledge of the underlying technique [8].

To investigate the influence of the two process models on the creation of content, two usability experiments have been setup and conducted. The experiments measured the performance of authors working with both the guided- and the unguided model for structured content authoring in terms of effectiveness, efficiency, and satisfaction. Effectiveness refers to the quality of the re-usable content, while efficiency also takes into account how authors work within the environment.

We want to find answers to the following questions: Can authors produce higher quality content in shorter time? Do they need specific writing processes that support them in creating structured content? Authors must be able to create content of equal or even higher quality than the content they created prior to using the authoring environment. User satisfaction is concerned with issues such as: Do they feel creatively limited? Is it difficult to learn to use the environment?

Furthermore, the creation of content largely depends on the authors themselves. They may have to adapt or change their current writing processes in order to work with the provided authoring environment. Authors have various writing styles and strategies which must all be accommodated in one author friendly authoring environment.

These issues and problems are experienced by ThiemeMeulenhoff Publishing, Utrecht, the Netherlands, where this research is conducted. Having developed and implemented a few XML-based authoring environments of its own, ThiemeMeulenhoff has gained much knowledge and experience in this field. However, it is still searching for the one crucial answer. Is an XML-based and author friendly authoring environment a fact or fiction?

1.1 Organization

The remainder of this article is organized as follows. Section 2 discusses the available related work and forms the foundation of our theory and hypothesis for structured content authoring. The two process models are then discussed in detail in Section 3. Section 4 discusses the setup and results of the two usability experiments that are conducted to investigate our theories for structured content authoring. Finally, in Section 5 we will come to our conclusions and future work.

2 Towards a Theory for Creating Structured Content

Structured content authoring is a relatively new area of research. Many of the existing theories about content authoring apply only to a certain degree. The available XML editors on the other hand are more focussed on technology push and offer a limited customizability to enhance the usability. In this section we will discuss related work and come towards our own theory for structured content authoring at the end of this section.

Most authors are now used to create content using a text editor. Publishers must thus make the transition to working in an authoring environment as convenient as possible. To do that they must gain some insight to how authors write and what authoring tool suits their needs best. When it comes to creating structured content, we can identify three essential elements: the content, the author and the tool used by the author to create content.

2.1 The Content

[2] defines content as information that consists of several well-structured components which can be identified and retrieved, or reused, adapted, and personalized or formatted. [6] emphasizes more on the importance of the usage for the users.

Obviously these are not the only content definitions out there. They also have different contexts. But the message is clear: content is not merely information in text format with occasional images anymore. Content now consists of several components in different media formats, which together convey information to users in an effective way. To be able to do this, content must be:

1. **Reusable**.

(a) *Structured*. Structured (decomposable) content is the content aimed for in this research. Thus, whenever content is mentioned in the rest of this article, it actually refers to structured content. To make the structure of the content explicit, we make use of XML, the eXtensible Markup Language.

(b) *Medium-neutral*. Medium-neutral content is a controversial topic. Some argue that it is impossible to achieve because how one creates content depends on how the content will be used. Others find medium-neutrality essential if content creation is to be more efficient and effective. In this research, medium-neutrality is considered significant enough to be included in the content criteria.

2. **Tailored to user demand, preference and background**. Different users that are interested in the same topic can be interested in different facets of the content. Therefore content must be adaptable to suit the user's need.

2.2 The Author

Each author has a unique style of writing which is influenced by different approaches and perceptions. [13] describes three traditions that influence writing:

- **The Craft Tradition**. It defines itself by focusing mainly on writing techniques, grammatical correctness and proper usage.
- **The Romantic Tradition**. In this tradition, writing is successful when it expresses the inner vision of the writer. Writing is seen as unanalyzable and unteachable.
- **The Rhetoric Tradition**. This tradition believes that writing can be taught. It believes in heuristics to kindle the inventive processes and guide choices while writing.

An alternative categorization is defined by [3]. They surveyed authors and categorized their writing strategies into the following strategies:

- **Architectural strategy**. It is a very common plan-edit-write strategy.
- **Bricklaying strategy**. This strategy is a slow, linear and sequential strategy with little revision in the end.

- **Oil painting strategy**. A minimal planning and maximal revision strategy.
- **Water-color strategy**. It attempts to produce a complete version at the first attempt, with minimal revision.
- **Mixed strategies**. Which can be any combination of the above defined strategies.

By understanding how authors write and what influences them, we may be able to provide functionalities that can intuitively assist authors in the authoring environment. Albeit impossible to fully comply with each individual needs, we believe that this understanding will provide essential bricks for building a usable structured content authoring environment.

2.3 The Tool

Since most authors are used to write with word processors, they will inevitably tend to generalize authoring tools, if not comparing them. But unlike MS Word, for example, an structured authoring environment that implements XML will produce re-usable and medium-neutral content. Using an authoring environment with these capabilities will certainly change how the content is constructed and how authors construct it. One of the most important changes is the creative freedom of writers. [5] supports the idea that problems usually occurs during writing or realizing results of the creative processes. [7] adds that authoring not only involves creating the actual content but also encoding it. So the authoring tool must let authors maintain a degree of creative freedom if it were to be used.

In [12] a classification of presentation-oriented editors for structure documents is given:

- **Syntax-directed editors**. This classification of editors allows authors to directly work within the XML structure of the document. For our case, this is not a satisfying option, since most authors do not have the necessary background knowledge.
- **Syntax-recognizing editors**. This type of editors allows the user to edit the presentation in a WYSIWYG style, while underneath the editor tries to recognize the document structure by means of a parser.
- **Hybrid editors**. This classification of editors allows users to seamlessly switch between structure and presentation editing.

2.4 The Theory

Our models are based on the principles of a syntax-recognizing editor and a hybrid editor. The implementation of the guided model can be classified as a syntax-recognizing editor. The guided authoring environment completely hides the document structure, and like a wizard guides the author through the initial steps of creating the content. On the other hand, the implementation of the unguided model follows the principles of an hybrid editor. For beginners and novice authors, a WYSIWYG look and feel is offered, but advanced authors are given the option to switch to editing both the content and underlying structure. This allows the author more creative freedom. A concept often claimed to be highly valued by the authors.

In [4, 15, 10] the motivation for our guided model can be found. There, a number of advantages are given for using a wizard based approach:

- **Reduced workload**. A number of decision are already predefined, so the the cognitive workload for the author is reduced.
- **Structure tasks**. Structuring the tasks that need to be carried out will not only lead to better quality of content, but also increase the efficiency of the author.
- **Frequent tasks**. Frequent tasks are now formalised and uniform. This also increases the efficiency of the author.
- **Decomposition of complex tasks** A wizard is also a useful techniques for decomposing complicated tasks into linear series of steps.

[11] explains how beginners usually prefer a constrained path with guidance and fewer options, while experts want more flexibility, less guidance and faster access to more options. This illustrates one of the many dualities of the environment strived for in this research:

1. Offer adequate guidance for beginners yet also provide sufficient flexibility for expert users.
2. Provide enough creative freedom to accommodate authors and their various writing styles and strategies, while simultaneously enforcing a somewhat strict structure that may cause authors to adapt or change their writing processes.
3. Make sure that authors understand and not be distracted by the structure. Keeping it invisible proves to be very difficult. In addition, the auhtoring environment must always generate valid XML documents.

These dualities form the foundation for our two process models for structured content authoring. The guided model provides a high degree of guidance for structured content creation, such that highly structured and reusable content is easily devised in a didactically sound methodology. However the price paid for this is that of creative freedom. Authors are initially forced to follow the instructions of the wizard, which might lead to a lower satisfaction among the authors. The unguided model is based on the principle that creative freedom is of utmost importance and that authors should be allowed to write according to their writing tradition, while taking into account that the impact of writing in a structured content authoring environment should be reduced to a minimum.

Based on these two process models for structured content authoring, we want to test the following hypotheses:

Hypothesis 1
The use of a guided authoring environment will result in more correct and structured content as opposed to the unguided authoring environment. Therefore fewer revision steps are needed, ultimately leading to an increase in efficiency and user satisfaction.

However, to find a usable and definite solution, it is important to know what influences authors productivity. Thus follows the second hypothesis:

Hypothesis 2
Authors who work according to a didactically correct manner within the guided authoring environment make less iteration steps between creating, editing and restructuring the content, causing them to develop content more effectively and efficiently.

3 Two Models for Structured Content Authoring

In this section we discuss in detail the two process models that can be defined based on the criteria of Section 2.4. In this section both models are introduced and where applicable implementation details are discussed.

3.1 Guided Model

The guided model for structured content authoring is based on the principle of using a wizard to guide the author through the initial phase of creating

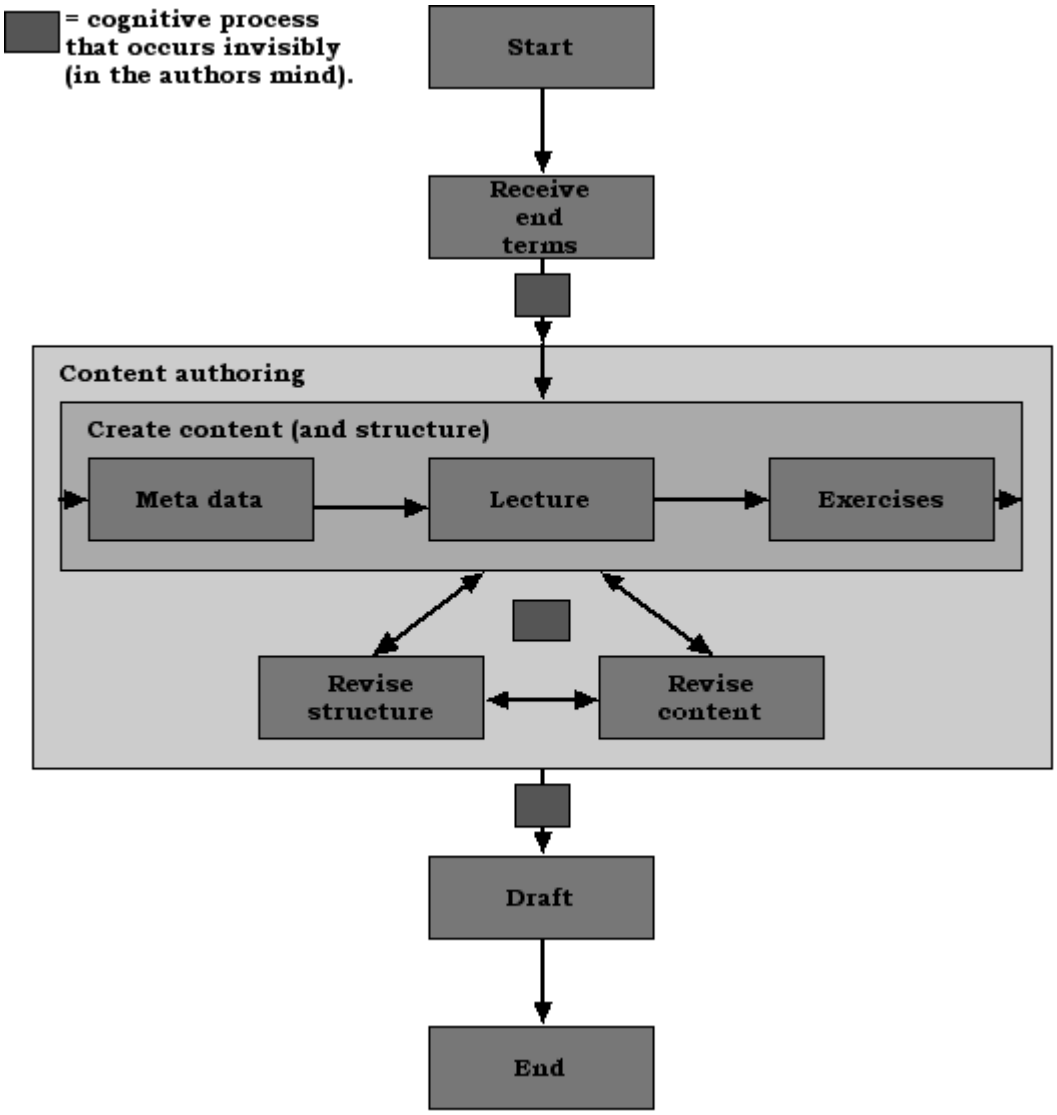

Figure 1: Guided model for structured content authoring

structured content. A didactically correct methodology is used to create the content in a linear series of steps. Figure 1 shows the guided model.

The model is initiated with the author receiving the end-terms of the educational material that they have to devise. A cognitive process is then started, where the author prepares the actual task that is carried out within the authoring environment. The author then starts creating the structured content: Initially the author has to *specify the meta data information*, e.g. name of the course for which content is written, information about the concepts used, target audience, etc. Next the author is asked to write the *initial pieces of content that form a lecture*, and finally the author is asked to *write a number of exercises*, associated with pieces of the educational material.

After this step, the author can choose to *create additional content*, to *revise the structure*, or to *revise the initial content*. After a number of iteration steps the author is satisfied with his version and ready to submit a *Draft* to the editor in charge.

The implementation of this model is realized through a Web-based authoring environment. Only a WYSIWYG view was available, thus the complete underlying XML structure was hidden from the authors.

3.2 Unguided Model

The unguided model for structured content authoring is based on the principle that creative freedom of the authors is essential for the writting process, and that issues regarding the document structure are inherent to this process. Figure 2 shows the process model of the unguided authoring environment.

In general, the same steps are defined as for the guided model, with the exception of the step where the *initial content is created*. For the unguided model it is up to the user what content is created first. If the author desires so, he can start with the exercises, then create the meta data information and revise the structure and content of the exercises, before creating pieces of content for the lecture. As such, the process is uncontrolled allowing the author to devise content according to the writing style that best fits his working method.

For the implementation of this model, we used XMetal [1] a highly customizable XML editor that allows different views on the document structure, varying from a plain XML view to a WYSIWYG presentation. However not all structural issues can be hidden from the author. Especially manipulation of the structure and cursor placement within the document structure prove difficult issues, for which no foolproof solutions are yet available.

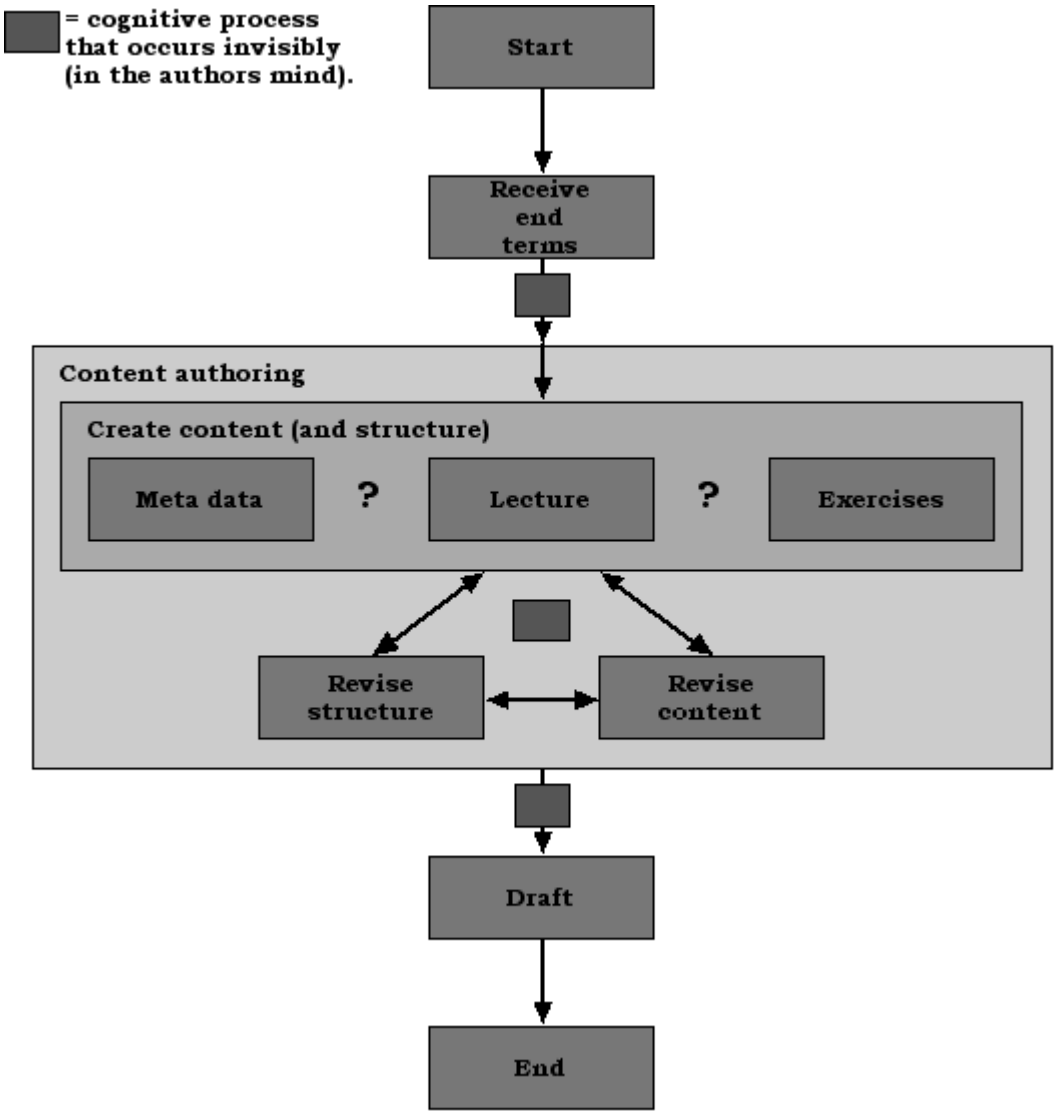

Figure 2: Unguided model for structured content authoring

4 Usability Experiments

To test our hypotheses (see Section 2.4) we have setup and conducted two small scale usability experiments. The aim of the first experiment is to compare the usability of the guided model versus the unguided model in terms of effectiveness, efficiency and usability. The aim of the second experiment is to investigate what steps in particular are responsible for the differences found between the two models.

4.1 Pre-testing

Before both experiments were conducted, several logical predictions can be made based on the literature study and previous implementations. Pre- and post-experiment questionnaires are used to prove or reject these predictions. This was done as a pre-test to show whether the results of the experiments would also support the commonly believed predictions. All predictions are statistically analyzed using the Pearsons r.

The results of this pre-test are:

1. How does previous experience influence the performance for the experiments:

   (a) There is no correlation between experience in using authoring environments and the ability to learn using the guided authoring environment ($r = 0.267$, $p = 0.456$)

   (b) There is a positive correlation between experience in using authoring environments and the ability to learn using the unguided authoring environment ($r = 0.689$, $p = 0.028$)

   These results make sense, since most authors a used to write educational content in word processors.

2. There is no correlation between difficulties in working with predefined document structure and the ability to learn using both environments (guided: $r = -0.444$, $p = 0.198$. unguided: $r = 0.371$, $p = 0.291$).

3. There is no correlation between difficulties in working with predefined document structure and the creative limitations experienced by authors in using both environments (guided: $r = 0.049$, $p = 0.893$. unguided: $r = 0.542$, $p = 0.106$)

4. There is no correlation between always writing in the same structure and the creative limitations experienced by authors in using both environments (guided: r = 0.08, p = 0.826. guided: r = 0.147, p = 0.684)

5. When analyzed using cross tabulation, it seems that authors with previous experience with an authoring environment prefer the guided environment above authors without previous experience. This is surprising, since related work on the use of wizards [11] claims that especially beginners will profit from such an approach.

4.2 Experiment 1

The first experiment aims at testing Hypothesis 1 by measuring and comparing efficiency, effectiveness and user satisfaction of both authoring environments.

4.2.1 Experimental Setup

The experiment is conducted using a pool of ten authors, who all participated in two sessions. One session for each authoring environment. The authors were asked to create educational content for two different topics: (1) the Gulf War in Iraq and (2) the use of DNA in criminal justice. Five authors started with the first topic, the others with the second topic. Furthermore we have spread the authors equally over the different authoring environments. For the second session, we gave the authors the other topic and let them work with the other environment.

All authors were presented with background articles taken from A4-newspaper (`http://www.stepnet.nl/`) but were given the freedom to decide whether to use this information or to create/add their own. The writing assignments, instructions on how to use the environment, a list of the metadata and their meaning, along with a framework were given before each task. Once the author was ready to start, we timed how long the authors needed to finish a first draft of the topic.

Each author must also fill in pre- and post-experiment questionnaires. The pre-experiment questionnaire is used to gain insight to their background, writing influences and style, and ICT knowledge. The post-experiment questionnaires, filled in after each task, are used to measure their satisfaction.

4.2.2 Results from the First Experiment

All drafts created by the authors were judged by editors anonymously. The editors were asked to score the drafts on a number of aspects:

1. Correctness: spelling and grammar
2. Structuredness: structure of the document
3. Completeness: exhaustiveness of the topic, etc.
4. Quality of information: the quality of the written information with respect to the target group
5. Quality of questions: the quality of the given questions/assignments with respect to the topic and the target group
6. Overall quality: the score of the whole draft based on previous points.

All scores are given in a Likert-scale from 1 to 5 (1 = very bad, 2 = bad, 3 = adequate/average, 4 = good/above average, 5 = excellent). Scores with two or more decimals are rounded up when higher than 0.5 decimal and rounded down when lower than 0.5 decimal.

Effectiveness

The effectiveness of the drafts is measured on all aspects mentioned above.

From the descriptive statistics alone, we can conclude that the drafts produced by the guided authoring environment are more structured than the drafts produced with the unguided authoring environment (mean difference of 0.6). The standard deviation indicates that drafts created using the guided environment will have less spreading or variety in structuredness. Although drafts from both environments are generally of the same structuredness, more drafts from the guided environment are graded as excellent and none as less than average. This is in accordance to the expectation that enforcing a certain structure is likely to result in a more structured draft. The overall quality of the drafts produced with the guided environment is also slightly higher (0.3) and there are more drafts with higher quality when created using the guided environment.

There is no significant difference between the correctness and quality of drafts produce by both environtments. However, the scores of the

drafts produced with the unguided authoring environment are more widely spread. It seems that authors tend to make more grammar and/or spelling mistakes when given more freedom. Note that some authors indicated that they require a spelling checker in the environments. Both environments also barely differ in the matter of quality of questions and completeness. From these results, we can conclude that although the guided authoring environment is limiting and forcing authors to follow a predefined writing style the drafts produced are of equal or better quality.

A paired sample T-test is then performed to check whether the mean differences are significant and not based on coincidence. The result is that only differences are found in the structuredness of content (avg=0.6, p=0.08) and the overall quality of content (a=0.3, p=0.08). Both differences are marginally significant (i.e $0.05 < p < 0.10$) in favor of the guided authoring environment.

Efficiency

Efficiency is defined as the effectiveness over time needed to finish a writing task. The effectiveness is represented by the overall quality score. We found that the means of both efficiencies only differ for about 0.01 as do the standard deviations. The paired sample T-test further indicates that the differences are indeed not significant. However, there are more extreme values, both positive and negative, in the distribution of scores for the drafts produced by the unguided authoring environment. From this one can conclude that experts are capable to work more efficiently with the unguided model, while at the same time inexperience authors feel more lost, when working with the unguided model.

User Satisfaction

The hypothesis assumed that user satisfaction for the guided environment will be higher then for the unguided environment.

In the matter of physical characteristics, authors are generally satisfied with the appearance of both environments. There is also little difference in expressing the importance of help files in both environments. Furthermore, there are more authors who find that there is less indistinctiveness in the guided environment.

Most authors mention that they feel the need to make changes to their usual way of working. Most of those who make adjustments do this to

conform to the document structure presented to them or because of the limitations of the environment. The authors also differ in what they experienced regarding the creative limitations in both environments. Thus the perception of authors does influence their feeling of being creatively limited.

In the matter of efficiency, most indicate no difference with their usual efficiency. Their complaints are mainly targeted to the functionalities and layout limitations of the environment. Last but not least, there were more authors who are not satisfied with their work in the unguided environment.

4.2.3 Discussion

Results clearly show that in spite of the small differences in the effectiveness, efficiency and user satisfaction, the use of the unguided environment obviously has a higher risk of extreme user dissatisfaction and lower quality of drafts. The guided environment is therefore more suited for producing drafts of somewhat stable and predictable quality.

4.3 Experiment 2

The second hypothesis used in this experiment aims at explaining results of the first experiment. To do this we have analysed the videos for five of the authors who participated in the experiment. Based on the models presented in Section 3 the observed activities are tagged and timed. The result is a list of activities based on the steps on the process model, with their start and end time. In addition one activity is added to the original models: *miscellaneous*. This step is used to tag all activities that did not correspond with one of the steps in the process model, such as considering the help function, or searching for information on the Internet.

The writing processes of the authors can also indicate their writing strategies. Apparently most of them used an architectural approach, planning – writing – editing their work. Some authors definitely showed usage of other strategies. One author, for example, indicates that he usually revises his work five times after writing it.

Due to the limited availability of the authors we did not observe many iteration steps, e.g create content – edit content – create content. Most authors did not revise their content or only revised it at the end of the writing process. We observed that authors using the unguided environment

made more iterations, revising the content or structure, than for the guided environment.

The time taken by authors to finish their task in the guided environment is longer than the time needed to finish the task with the guided environment. This implies that working in the guided environment is more efficient. Unfortunately, this is not always the case. One author, for example, finished the task in the guided environment much faster yet ends up with lower efficiency than the task done with the freely structured environment.

Correlation analysis between iterations and efficiency shows no significant relation between these variables in both environments (guided: $r = -0.296$, $p = 0.628$; unguided: $r = 0.447$, $p = 0.451$). Correlation analysis is also performed to look for relations between iterations and effectiveness (guided: $r = 0.535$, $p = 0.353$; unguided: $r = 0.746$, $p = 0.148$). Thus iterations do not affect the authors efficiency and effectiveness.

Another factor that may influence the efficiency and effectiveness of the authoring environment is the number of miscellaneous activities (not including the thinking processes) they undertake during writing. Some were clearly engaged in more miscellaneous activities while creating content than others; switching constantly between re-reading the instructions and articles, making notes, consulting the framework and trying to figure out the environment. This again supports what has been mentioned earlier, that a step representing the miscellaneous activities should be added to the original models.

At a glance, this seems to be another possible explanation because apparently, the more miscellaneous activities authors performed, the more inefficient they work. However, one author conducted more miscellaneous activities while working with the unguided environment yet managed to gain higher efficiency and effectiveness scores compared to the unguided environment.

Correlation analyses are once again used to confirm these efficiency assumptions. Surprisingly, none of the correlations are negative and the only significant correlation is the one between miscellaneous activities and effectiveness in the strictly structured environment. Apparently, the effectiveness of this environment can be increased when an author is engaged in a lot of miscellaneous activities. So working in a restricted environment requires authors to somehow compensate this restriction by conducting other (relevant) activities outside the environment in order to increase the quality of their work. This is logical, considering that most authors stated that they had to make significant changes in their usual way of working to be able to work in the guided environment.

Most authors complained about the limitations of the prototypes. We must also keep in mind that both experiments are conducted in the authors learning phase. Therefore, it is understandable that authors are having problems with functionalities within the environments. They also had problems with the structure of the document used in the unguided environment. The correct placing of the cursor was also a major obstacle in order to generate a valid document. Although this problem is easily solved when authors follow the instructions to the point and use the appropriate buttons, they still had to adjust to the authoring environment. We feel that a considerable amount of time and practice is needed to solve the presented problems.

4.3.1 Discussion

Each author has his/her own way of working which makes it quite impossible to reach 100 percent user satisfaction in any environment. An authors efficiency and effectiveness are not always determined by the number of iterations and miscellaneous activities. However, all authors make less iteration steps when working with the guided environment. Unfortunately, due to the restrictiveness, most authors tend to conduct more miscellaneous activities in this environment.

5 Conclusions and Future Work

The need to produce reusable content drives publishers to revise their publishing street. This also has its impact on the way content is created by authors. In this article we have introduced two process models for structured content authoring. Using a wizard based approach, a guided model is designed and implemented, that guides the author through the writing process in a didactically approved methodology, while hiding all structural aspects of the content from the author. On the other hand we have defined an unguided model, that respects the creative writing process of the author. The implementation of this model in XMetal allowed both a structural view on the content and a WYSIWYG approach that is often used for the well known word processors.

Our hypothesis was that the use of a guided authoring environment will result in higher quality and structured content as opposed to the unguided authoring environment. Therefore fewer revision steps are needed, ultimately leading to an increase in efficiency and user satisfaction.

From the experiments we can conclude that the use of a guided model for structured content authoring produces drafts of predictable and equal

quality with less dissatisfaction, despite lesser flexibility and freedom, especially among beginners when compared to the unguided model. The use of a unguided environment, on the other hand, can ultimately provide publishers with drafts of higher quality of information. However, the risk of using this environment is higher, considering there are authors who experienced extreme dissatisfaction with the unguided model. A considerable amount of training may be needed, before author can actually produce their content in such an environment.

The results from the experiments show that authors performance when using both environments does not depend on his writing strategies or how he perceives writing. Furthermore, the number of iterations and miscellaneous activities do not influence the efficiency and effectiveness of an author. Instead, the experiments show that the most important factors in determining whether an environment can be implemented and used efficiently and effectively by authors, are the flexibility and freedom it provides authors with.

For future experiments, a larger pool of authors is needed for the experiments to validate the outcome of our small scale experiments. At current we can consider the outcome to provide interesting trends. Participating authors should also be given a considerate amount of time to practice, to reduce trivial yet costly mistakes.

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