Semantic PowerPoint: Content and Semantic Technology for Educational Added-Value Services in MS PowerPoint

Andrea Kohlhase
DiMeB (Digital Media in Education) / KWARC (Knowledge Adaptation and Reasoning for Content)
Dept. of Math. and CS, University Bremen / School of Eng. and CS, Jacobs University Bremen
Germany
kohlhase@informatik.uni-bremen.de

Abstract: Contrary to popular perception, MS PowerPoint (PPT) is not so much a tool for presentation optimization but rather a tool for optimization of presentation production. This difference has been neglected so far, but from a pedagogical standpoint it is crucial: in the former, the emphasis lies on the effect of the document (educational value for students) and on the usability of the environment (expressional value for educator) in the latter. PPT is often used in educational contexts like lectures, so we ask whether (and if so, how) PPT might be extended so that students become beneficiaries. In this paper we will argue that PPT documents enhanced by content features are pedagogically valuable for authors and readers, as both can benefit from added-value services afforded by the semantics. We support the argument with our implementation of such content features in the CPoint system (esp. CPointStudent) which extends PPT to a "Semantic PowerPoint".

1 Introduction

In scientific circles the use of MS PowerPoint (PPT) as a paradigmatic example for presentational software is fervently debated. Sceptics like Tufte accuse PPT of impressing a linear and simplified "cognitive style" on the user (2006) whereas advocates like Sanders-Bustle point to the advantages of visualization (2003). But who is the user in these arguments? The author of the presentational document or its recipients? Both are dealing with the PPT presentation and are affected by it. If we take a closer look at the PPT system itself, we realize that it is primarily a work environment for the production of such presentation documents. Probably everyone has already had some encounter with a PPT presentation where the lecture seemed to "fight" with PPT features which didn't work as expected. If PPT were optimized for presentation, we would expect that such bugs were completely resolved by now. If we understand PPT as geared towards creation of a presentation, then the creator is the beneficiary of the system, but if we view PPT as geared towards presentation, the audience benefits more.

From a design standpoint this difference means that the process of creation is greatly supported whereas the outcome, the presentational document, is considered a ready-to-use product. In particular, interaction design isn't necessitated for the latter. The underlying assumption is that if a lecturer has given her best to develop the lecture, then the product has to be good enough to be complete as a product. Now, if we look at a PPT document from a pedagogical perspective, then it definitely has some value when the talk is given, but afterwards (e.g. if provided as a handout or posted to the web) it seems almost worthless except being a "cheat sheet" or "memory board" for the elapsed show. In particular, all the potential of Digital Media is gone, and as the context of its intended use is different, the carefully designed presentation is far less valuable than a paper designed with similar care.

The growing number of people using PPT in educational scenarios show that they like to work within and with PPT. We may safely assume that they believe in advantages of presentational support. In Section 2 we analyze the advantages and drawbacks of presentation software (independent of the brand) in educational scenarios from a pedagogical perspective. We will see that presentation systems lack flexibility and often miss implicit content.

One approach of remediation consists in enhancing the presentational documents semantically, i.e. using semantic technology together with additional content markup. In Section 3 we present a PPT extension, the CPoint system developed by the author, that transforms PPT into a "Semantic PowerPoint". In particular, it allows to semantically annotate PPT documents, so that they become living documents, that can be used by students in the PPT work environment, e.g. to perform follow-up course work and exam preparation.

2 A Pedagogical View on Presentational Documents

For a pedagogical analysis we need to take three kinds of actors into account, the educator, the student, and the "world" (society, peers, parents, local context). We will focus in the following on the facets "society", "educator", and "student" one by one.
• Society

In today's "knowledge society", the World Wide Web increasingly dominates our perceptions of "education" since the Internet delivers an overwhelming information abundance that now makes e.g. learning a life-long necessity. Most documents on the Web can be considered as "living documents", i.e. that they are not completed like a hanged painting, but rather constantly updated and never finished (e.g. Berners-Lee 1997, Krutz et al. 2006). Moreover, they may contain "living" references to other such documents via hyperlinks and last, but not least: they can interactively respond to events.

The prominent Web2.0 paradigm strongly builds on this notion of a document: its governance is bottom-up instead of top-down, the control is not with publishers but with users or content authors, pages are replaced with tagged objects, users are consumers as well as producers instead just the former. Most importantly, the read-only access has changed into read-write access. Under a pedagogical perspective we note that such a paradigm fits very well with constructivism as a learning theory which emerged as dominant learning theory in recent years. In particular, it starts to be embedded into learning software as the semiotic quality of living documents enable various construction processes (Schmidt, 2005).

These new digital qualities build the background for the vast potential which is associated with the use of Digital Media in educational scenarios (and E-Learning systems in particular) from a pedagogical standpoint. Thus presentational documents that are treated like regular paper documents can no longer be considered "state-of-the-art".

• Educator

For an educator the presentation she creates is not only a tool for conveying information to the audience, but also one that supports a talk by adding visual components as well as visualization of structural components. In a good lecture, the PPT presentation and the lecturer's one share a "flow", i.e. they fit well together and create a holistic experience for the recipients, engaging the listeners and by that supporting learning.

In order to achieve this flow, an educator has to make her knowledge explicit by producing a presentational document. Her task is to contextualize content using the presentational work environment while producing the document. Typically, educators enjoy this creation process as it becomes more than anticipated information transfer. It represents the knowledge of the educator, her ability to reflexively integrate it into a holistic document. In particular, the reconstruction that happens when generating the presentational product presents a reflection scenario for the educator and reinforces her notion of self-efficacy (Miltiadou & Saveyne, 2003).

All in all, we note that the presentational document is not considered as a final document until the actual lecture. In effect, educators consider presentational documents as living documents. Even the possibility of reusing it in a later course reinforces this notion. During the lecture this living document congeals into a static, linear entity, losing all the flexibility it had before, and that is called for by all acclaimed pedagogical theories. In (Kohlhase 2006) it was pointed out that this application flexibility is more relevant at school-level than on college-level. The underlying argument is that the instructional style sometimes glossed as "sage on the stage" is still accepted in the latter for contextual reasons. The linearity of the congealed presentation prohibits deviations, indirections, and excursions - all of which are pedagogical tools of an educator. Hence, from a pedagogical perspective, a presentational document should not be allowed to be a "show", but an aggregation of supportive information.

• Student

As pointed out above the student "receives" the information in form of a linear show. The visual preparation of learning content in a regular presentational document addresses an additional learning channel, that enhances a student's learning experience at that very moment (see e.g. Sanders-Bustle, 2003). But when the show is over, all what is left is a static document, that at best is printed out in form of a hand-out and serves as a "cheat sheet" with memory triggers. Not only are they "just" paper documents, they often do not even contain enough content to function as a learning guide.

The intrinsic problem is that "knowledge" is a complex network of knowledge bits which cannot be sequentialized without simplification and reduction. The presentational form forces an educator to linearize her knowledge, but this can be accounted for in her accompanying narration and interaction with students. Without these, the presentational document resembles an empty hull.

The pedagogical analysis indicates clearly that presentational documents haven't employed their potential yet. In particular, this potential shrinks dramatically once the presentational document is treated like paper. What we need
is a work environment for students where the same processes which enabled the educator can be reconstructed by the student, centering around the course material as a living document.

In order to achieve this, we have to enrich the presentational document so that it stays being a living document. Note that the user changes by the act of "handing out" the presentational document. After this act students are its consumers, thus the requirements for the work environment change and have to be accounted for.

Our approach consists in enabling authors to add content to presentational documents and employing semantic added-value services for enabling students to re-enliven them. In particular, the underlying implicit knowledge has to be made explicit by the educator and reestablishes the complex network of knowledge bits for a student.

In the following section, we showcase this approach with our implementation of an invasive, semantic work environment for MS PowerPoint called "CPoint: Content for PowerPoint".

3 The CPoint System for Educators and Students

Development of the Cpoint system was started 2002 in the Course Capsules Project at Carnegie Mellon University, USA with the aim of recovering the "treasure" of about 2000 MS PowerPoint slides (painstakingly collected over the years covering various computer science lectures) and convert them into reusable and web-sharable content units whose hidden content was made explicit and machine-understandable, so that semantic value-added services could be built for them.

CPoint ("Content for PowerPoint") was designed as PPT add-in that's interface provided the same feel and touch as PPT itself to lower usage barriers for semantic markup as much as possible. The system was conceptualized as open-source software (see LGPL) that "invaded" the proprietary MS PowerPoint to allow users free usage and participation in a software development community. This "invasive technology" based on the notion of taking educator's reality into account; here the acceptance of their use of PPT instead of e.g. OpenOffice Impress. We didn't want to enforce yet another authoring tool on the user, but wanted to take advantage of her already existent knowledge about the presentational work environment.

Figure 1: The CPOINT Menu Bar

Therefore, we started out by extending PPT with a semantic editor module written in Visual Basic for Applications (which comes with the MS PowerPoint work environment). CPoint makes its functionality available through a toolbar in the PPT menu (see Figure 1) where it is at a user's disposal whenever the PPT editor is running.

Figure 2: An Example for a Semantic Visualization with CPointGraphs
PPT objects like images, lists, or textboxes can be tagged with a name (as in systems like flickr or del.icio.us), and moreover can be categorized by their semiotic/functional role e.g. "theory" or "example". Each categorization enables the user to input more category-dependent information, characterizing the underlying relationships between the individual PPT objects. Additionally, extra information (in form of a text string) can be provided. The semantic information "hides" behind the objects, i.e. it is not visible in the presentation, but it is attached to the object itself. This way the presentational character of the document is not disturbed. If a user is in the process of enhancing the presentation semantically, she can make use of the "visualization mode" that adds small semantic labels with name and category information at each annotated PPT object (see Figure 5) to see what was done so far. Returning to "hide mode" restores the presentational document.

The authoring process of this semantic information is geared towards the semantic XML standard OMDoc (Open Mathematical Documents, see OMDoc, 2006) which attempts the tightrope dance between a formal representation format that can be exploited by machines but is tedious to read by humans and an informal format that can be understood by humans but not machines. The integration with the open source world is realized by CPoint's conversion function. Here, the enhanced PPT presentation can be converted into other formats, specifically OMDoc. These generated OMDOC documents can be fed to e-Learning systems like ActiveMath - enabling students to make additional use of a teacher's presentation by using available software packages. Moreover, users may aggregate new presentations by picking content from available OMDOC documents - enabling e.g. teachers to reuse and share their knowledge.

This system design turned out to be too idealized, therefore we started focusing on motivational issues. A first result was the recognition of the need of semantic added-value services that have to be offered to users for short-term expectations in return for their investment of time and energy to annotate the PPT objects semantically.

Here, we developed the CPointGraphs module which visualizes various aspects of the semantic information (contained in one or more PPT documents) in graphs. The network-like structure of the educator's implicit knowledge made explicit with the help of the CPoint editor has several pedagogically valuable effects. First, the educator realizes logical mistakes in the sequence of introduced items by looking at the semantic visualization. For instance, in Figure 2 you can see a graph with theories as nodes and the "imports"- relation as edges. The different colors encode their location in different presentational documents. Unconnected nodes or a dark blue node within a set of light blue nodes hint at a rather awkward sequentialization in the PPT presentations.

In our experience the process of semantic markup by an educator has a strong influence on her future presentation creation as the graph is mentally laid out in advance and hence, there is a much more cognizant exposure to individual PPT objects. Educators experienced this as a positive effect and as helpful for building coherent lectures. Moreover, if this graph generation is done by a student, then the knowledge bits within a lecture can be put into a bigger picture, triggering a deeper reflection process. If a student does not agree with the educator's semantic markup, she can change it in her copy of the presentational document and get a feeling of the differences which this change cause with the semantic visualization via CPointGraphs. If it makes more sense that way for her, then she will be in a much better position to learn the content. The active handling of content allows a better understanding according to constructivist and even constructionist learning theories (see Reichel et al, 2006).

We also realized at some point, that our "users" have quite different tasks depending on the role they are occupying at the time of using the CPoint system. In order to alleviate these tasks, we developed two different interfaces for the roles "author" and "student" (financially supported since 2005 by the KWARC group at the International University Bremen, Germany, and since 2006 the European Project ONCE-CS "The Open Network of Centres of Excellence in Complex Systems").

We started out with the CPointAuthor module. Here, the interface is not given by single forms that open on demand, but it is realized as a panel that is constantly visible (see Figure 3). As soon as a user selects (i.e. clicks) a PPT object, the basic underlying semantic information (e.g. the categorization as "Symbol" and its name "ourPlus") is shown and can be edited. An author-specific task consists in the creation of PPT objects. With CPointAuthor pre-
categorized objects can be generated. Their layout can be individually determined by category-dependent information in an adjoining (local) Cascading Style Sheets-File (CSS). This doesn't just alleviate the task of semantic markup, it unifies the layout throughout a course (and beyond). Its customization effect triggers a visual decoding and recognition process not only by the lecturer giving the talk, but also by experienced students. This added-value also helps the navigation process within the presentational document for follow-up work by students.

We also integrated a CPoint math editor called CMath that allows LATEX-like input for math symbols (based on Necula's previously freely available Texpoint) and OpenMath-like definition with LATEX-like input of math symbols. Moreover, we extended Texpoint to updatable inline math.

Recently, we added a CPointStudent module. Again, we chose the interface type to be a panel that shows available basic semantic information by selecting a PPT object. From within the panel the student now has direct access to the CPointGraphs functionalities. Moreover, CPoint's search or navigation form "GoTo" is made directly available (see Figure 4). Here, we can make use of the machine-understandable data that users put in and let CPoint search for the object the user is looking for. She can specify a string like "tree" and can ask CPoint to look for this word in the names of objects or in all semantic information. She can decide whether she is searching just examples and she can determine which presentation or group of presentations (called collections) is scoured. On the right hand side the PPT objects are listed that fulfill the criteria that are given on the left hand side. Once the user selects an object, CPoint navigates to that exact object. A "GoBack" option is provided as well. The visualization mode was also extended, as we realized that the extra information for each PPT object can contain pedagogically valuable hints for a student. But one has to know of its existence, so we introduced special notes-like labels (="notes") which are attached on the left hand side of the PPT object (see Figure 5). In this example, we see a (German) list of references that are to be used in this special part of the course. As extra information their relevance and some explanations are given.

Another feature of CPointStudent consists in its multilinguality or locale. The default language is English, but if the add-in is loaded when a German PPT document (that is, if the language parameter of the document's properties is set to "de") is open, then the form with German names, tooltips, etc. will appear. The library could easily be extended to other languages as well.

4 Conclusion and Outlook

In today's knowledge society we can expect that presentational documents like PPT files represent living documents and that the added-value of having semiotic documents instead of paper ones can be employed by users: educators and students. We show that the advantages of digital presentational documents are realized in e.g. the PPT work environment for educators but not for students arguing that PPT against common conviction is not optimized towards presentation but rather towards presentation production. Once a lecture is delivered, the presentational document doesn't have much of a pedagogical value left.

We try to overcome this gap of overt potential by enriching the presentational document so that it remains a living document which in turn can be made pedagogical use of for students. We describe CPoint as a semantic PPT extension that allows to enrich PPT documents by semantic annotation and that mines this information with added-value services for educators and students.

In the future we want to augment the semantic services offered to students even more, for instance by introducing homework exercises that can be solved within the PPT environment. A student gets a "bag of content" and is assigned the task of finding an underlying semantic structure. Another possibility is to offer a logic analogon to spell aids: if a student is looking for the implicit knowledge structure and creates relationships between PPT objects.
objects, these could be compared with the one that the educator proposed and suggestions could be deduced from there.

Moreover, we envision for the near future an integration of this semantic PowerPoint with a semantic Word, so that semantic information between the two systems and the two kinds of documents can be shared. The first version of CWord ("Content for Word") has been implemented by the author.

All in all, we believe that traditional, digital work environments like MS PowerPoint need to take into account semantic opportunities so that the educational hopes in Digital Media can finally be bear real fruit.

Figure 5: Visualization Mode with Notes and Category Labels

References


