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Wiki as a Tool for Web-based Collaborative Story Telling in Primary School: a Case Study

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Abstract : Wikis are simple to use collaborative hypertext authoring systems. In recent years, these systems have caught the attention of the education community, because they embody many aspects of personal empowerment and communication between learners. To date, most work on Wiki in education has focused on use for **information creation and sharing** by students at the **post-primary level**. In this paper, we present a case study where **primary level** students (Grade 4-6) used a Wiki for collaborative **storytelling**. The paper reports on our experience with this activity in the course of 5 semesters since 2002, each semester comprising 9 hours of class time. The paper reports observations on the collaborative process that took place during the activity. It also describes the activity in sufficient detail to allow a technically sophisticated teacher to use it in the classroom, and makes recommendations on how Wiki could be improved to better support collaborative storytelling by young children.

1. Introduction

Wikis are simple to use, asynchronous, Web-based collaborative hypertext authoring systems. The original concept is due to programmer Ward Cunningham (Leuf and Cunningham, 2001), whose prototype implementation has inspired many variants (Mattison, 2003). While a precise definition of Wiki does not exist (Lamb, 2004), the general consensus is that a Wiki is *a collective website where any participant is allowed to modify any page or create a new page using her Web browser*. To edit a page on a Wiki site, all a user needs to do is to click on the **Edit** button that appears on that page, modify the text that is then displayed in an editable field, and click on a **Save** button. In a Wiki system, authors do not use a WYSIWYG ("What You See Is What You Get") editor to modify the content of a page. Instead, they use a non-WYSIWYG editor to modify text that is marked up using a very simple syntax (called Wiki markup).

Wikis took off in recent years as a new way to conduct discussions and collaboratively edit documents on the World Wide Web. Several different Wiki systems have been set up, some public, some private, and have been put to several different uses. One of the most high-profile Wiki projects is **Wikipedia** (http://Wikipedia.org/), which aims at creating a free, hyperlinked encyclopedia, and reached the respectable size of one million articles a little before its fourth anniversary in September 2004. Another example of a successful public Wiki is the Swedish general reference site **susning.nu** (Aronsson, 2002).

As awareness of Wikis has grown, people in the education sector have become increasingly interested in using them for computer-supported collaborative learning (CSCL). Because they embody in many respects the paradigm of personal empowerment and communication between learners, they have been characterized as enablers of socio-constructivist learning (Schneider et al., 2002). Because they constitute an environment where, as users, students and teachers have the same power and flexibility, there is a shift in agency which has been found to boost student engagement (Guzdial, 1999). Examples of use in educational settings include using Wikis to store storyboards, scripts, code and drafts in a course on digital video special effects, and to collaboratively critique poems and essays in English composition classes at the Georgia Institute of Technology (Mattison, 2003; Rick et al., 2002). Wikis have also been used to break the ice and facilitate interaction between members of new online learning groups by enabling them to build personal profile pages (Augar, 2004). A number of other uses in education have been inventoried by Georgia Tech's Collaborative Software Lab (2000).

To date, most work related to Wiki in education has focused on use for **information creation and sharing** by students at the **post-primary level**. Although the collaborative, web-based nature of Wikis and their simplicity make them a good candidate tool for supporting story writing by younger children, little attention has been paid to that type of use. The thousands of stories found on sites like kidpub.com and fanfiction.net attest to the fact that the opportunity to write stories and make them available to the general public gives children a powerful incentive to write. While creative writing using the computer has been investigated previously, e.g. by Bers and Cassell (1997),

Scenario

Title: The Amulet from the Jungle

Hero: A young cannibal by the name of Djenga

Goal: Recover the magic amulet that was stolen from her village.

Environment: The story takes place in the jungle

Figure 1: A scenario for a story

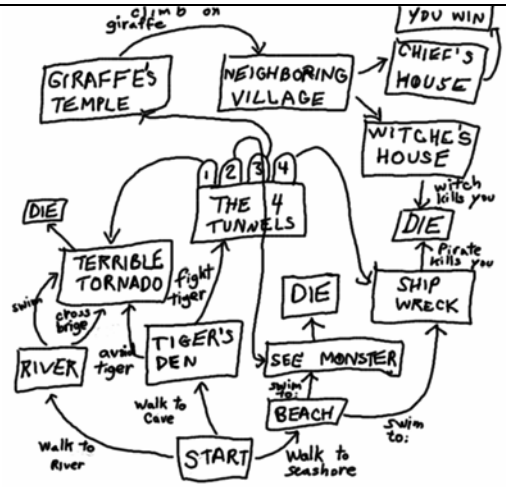

Figure 2: a nodes and arcs network map for a story

Simsarian (1999) and Brna et al. (2000), collaborative, Web-based hypertext story creation by children has not been investigated.

In this paper, we present a case study where **primary level** students (Grade 4-6) used a Wiki for collaborative **storytelling**. By using Wikis to write hyperlinked, non-linear stories in teams, children should be enabled to learn through practice on several fronts. On the technology side, they can learn about the nature and mechanisms of hypertext and basic information architecture. On the writing side, they practice their composition skills. On the logical-mathematical side, they are required to think about complex sequencing of pages that can be traversed in a number of different orders. Finally, they have an opportunity to engage in self-coordinated, collaborative work. Since 2002, we have observed several groups of children involved in such an activity. While we didn't have preconceived ideas of what we would observe, we had several goals in pursuing this investigation. We wanted to see if and how young children would be able to use the Wiki tool in collaboration; we sought to identify potential usability problems with the tool (Désilets et al, 2005); we wondered if this type of activity would attract girls as well as boys to use computers; and we wished to see if non-linear narratives were easy to grasp for children that age. In this paper, we focus mainly on the first issue, i.e. how did children use the tool to work collaboratively on their story.

The paper is structured as follows. In **Section 2**, we describe the collaborative web-based storytelling activity in sufficient details to allow it to be replicated in other schools. In **Section 3**, we describe interesting collaborative behaviours that we observed during the activity. In **Section 4**, we discuss the implications of those observations for teachers wanting to use Wikis for web-based collaborative storytelling, as well as for developers creating tools to support this type of activity. In Section 5 and 6 we present conclusions and directions for future work.

2. Description of the activity

The collaborative web-based storytelling activity was held as an after hours extra-curricular activity at École Côte-du-Nord, a French-speaking school in Gatineau, Canada. There were no selection criteria and the students ranged widely in terms of scholastic aptitude and computer literacy. To date, the activity has been held 5 times since the Fall of 2002, 3 times with Grade 5-6 students and twice with Grade 4 students. The stories written by students were non-linear in nature. In other words, at each page, the reader could choose between one of many possibilities for the next page. In a sense, this is a web version of a genre that already exists in paper form (*"Choose your own adventure"* books); however the web is better suited than paper to support this genre. In other words, students used the web to create a type of story that exploits the unique capabilities of that medium.

Most children wrote their story collaboratively in teams ranging from 2 to 5 individuals but some opted to work alone. The stories were written in 6 sessions of 90 minutes each, divided in two phases**: Story design** and **Story writing**, which we discuss below.

Phase 1: Story design (session 1)

In this phase, each team was asked to come up with a scenario and a map for its web-based story. Students were shown a live example of a web-based story created in a previous semester. The instructor then showed them the scenario and the map that had been written for that story, and asked each team to do the same for its own story.

In the scenario, the team had to describe: the title; the central character; his or her goal in the story; and the environment where the story takes place. Figure 1 shows a (fictitious) example of such a scenario. Next, the team was asked to draw a map of its story on a poster-sized sheet of paper. In order to make this exercise more intuitive, we grounded it in terms of a spatial metaphor. We told the students to think in terms of: places in the story where the hero could go, things that happened there, other places where the hero could go from there and actions or choices the hero had to make to go to those next places. Although places and choices were meant to correspond to pages and links, at this point of the process we did not use such web terminology.

Although the story was grounded in a physical metaphor, students were asked to draw it using a more abstract representation, namely a network of nodes and arcs. This network had the following characteristics.

- Each node represented a "place" in the story where a particular part of the action took place.
- Each node was labeled with a name and a brief description of what happened there.
- A series of arcs was drawn from each node to the other nodes where the character could go to from there.
- Each arc was labeled with a name describing the action that the character had to do or the choice he had to make to move from the first node to the second node

This mapping exercise was explained to the students in terms of "places" and "choices" as opposed to the more abstract nodes and arcs terminology. Students were given guidelines on the number of nodes and arcs (maximum of 5 nodes per child on the team, no more than 3 arcs leaving from any node) to ensure that their story could be implemented in the remaining five sessions. Figure 2 shows a (fictitious) example of such a map.

Phase 2: Story writing (sessions 2 – 6)

In this phase, each team used a Wiki system developed at the National Research Council of Canada (Desilets *et al,* http://lizzy.iit.nrc.ca/) to collaboratively implement the story they had planned in the **Story design** phase. Throughout this phase, team members sat side-by-side, each at their own computer, with the map of their story posted in front of them in plain view of the whole team. Figure 3 shows a photograph of a typical setup for a team of two children. Students worked individually on separate Web pages for the same story, but they were encouraged to

Figure 3: A typical setup for a team

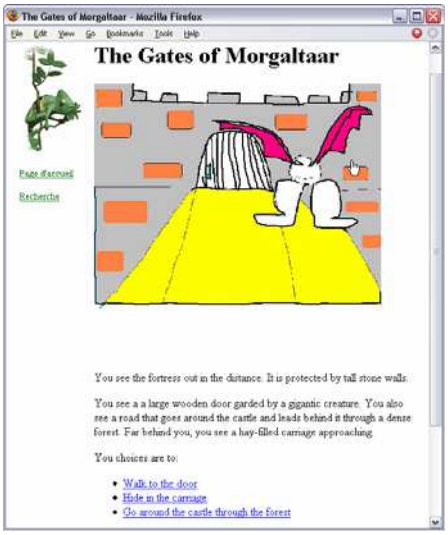

Figure 4: A page from a story

talk to each other to coordinate the work (ex: *"I'm working on page ABC, so nobody touches it OK?"*). They were also encouraged to seek technical help from their teammates before asking a question to the instructor. Except for these, students were given no directives as to how they should coordinate and collaborate to get the work done.

The **Story writing** phase started in session 2 with a brief demonstration showing how to create pages on the Wiki and edit their textual content only (no images yet). Students were told that they had to create a page for each of the "places" on their map, and that they had to link those pages according to the "arrows" on the map. The students then proceeded to create the textual content of their story in sessions 2 and 3. During session 4, students were given a second demo showing how to upload images onto the pages of their story. They were told that they could draw the images themselves or search for appropriate images using Google. Students then spent the last three sessions illustrating their stories in that way. Figure 4 shows a (fictitious) example of a page of a story, with text and image completed. Note that after each session during the **Story writing** phase, the instructor spent approximately one hour reviewing the content of stories, and posting comments on the title page of each story.

3. Observations

The present case study is based on observation done over five semesters since the fall of 2002. In each semester we observed a group of students as they went through all 6 sessions of the activity. In three of the semesters, students were from Grade 5-6 while students in the other two were from Grade 4. Group sizes varied from 12 to 25, with the Grade 4 groups being typically larger. Most students in the Grade 5-6 groups had done the activity in a Grade 4 semester the year before. All 5 semesters were held as a non-compulsory after-hours extracurricular activity and students were aware that their performance in the activity would not affect their school grades.

Through our observations, we gained valuable insights into: (a) how children used the Wiki tool to collaborate, (b) usability issues of the Wiki tool for young children, (c) gender differences in terms of appreciation and performance in the activity and (d) the ability of young children to write complex non-linear hyperlinked stories. However, in the present paper we focus only on (a), the issue of collaboration.

3.1. Network map played a central role in collaboration process

We found that children could very naturally design their story collaboratively and map it out on paper using a network representation. Indeed, most of the problems during the **Story Design** phase were of a social nature as opposed to story design per se. Most difficulties were related to forming teams and finding a topic for the story that all team members could agree on. Once those issues were resolved (typically within the first 20 minutes), teams were able to collaborate very well around the poster-sized piece of paper.

The paper map also seemed to play a pivotal role during **Story writing**, both in terms of individual and collaborative work. Even though students were not directed to do so by the instructor, we frequently observed the following uses of the paper map:

- student using the map to choose a page to work on next, and then using the map to mark that page as being worked on by her;
- student checking off a node on the map after completing the corresponding page on the Wiki;
- student using the map to orient herself around the story on the Wiki;
- team using the map to assess the current state of the implementation of the story on the Wiki and/or discuss particular problems with the implementation
- student using the map to explain the story to students from other teams;

3.2. Collaboration modes

Children collaborated very closely throughout both phases, but in two very different modes. During the **Story design** phase, teammates collaborated in a **co-located synchronous** manner, all working at the same time on the same common piece of paper (but each with their own pen and eraser). During the **Story writing** phase, students were working in a more asynchronous manner, with team members working in parallel on different parts of the same story. However collaboration was not completely asynchronous since teammates sat side by side and there was much real-time feedback (ex: *"Wow, that's a cool picture you're drawing"*), coordination *("I'm going to work on*

image XYZ now OK?") and information sharing (ex: *"How do I change the size of an image again?"*) that took place. We call this mode of collaboration **co-located semi-synchronous**.

We also tried a third mode of collaboration in session 2, which we call **pair-editing**. This is analogous to **pair-programming** which is gaining popularity in the world of software development (Cockburn and Williams, 2000). In pair-programming, two programmers sit together at the same computer. One programmer called **"the driver"** types at the computer while the other programmer, called **"the navigator"** observes helps him by spotting mistakes, asking for clarifications, suggesting alternate designs, retrieving information that she anticipates will be needed soon by the driver, etc. In the world of software development, pair-programming has been found to greatly improve the quality of the resulting software code, as well as foster learning and sharing of knowledge between team members. Moreover, programmers usually report that they find this way of working more enjoyable than working alone.

Because we expected the students to be in highly unfamiliar and cognitively demanding territory during the **Story writing** phase, we expected that pair-editing (creating and editing the Wiki pages in pairs) would present similar benefits. However, pair-editing failed dismally from the outset and we discontinued its use after a single session. The main issue was that the student acting as navigator was simply not engaged at all. It is unclear why pair-editing failed where pair-programming succeeds. It could be that pair-editing is not appropriate for children of that age. Another possibility is that creating and editing Wiki pages is not cognitively demanding enough to warrant the presence of a navigator. A third possible explanation is that we did not provide sufficient guidance on what the navigator should be doing (ex: correct spelling mistakes, help the driver write in a way that is consistent with the rest of the story, etc.). More research is needed to determine if and how pair-editing could be beneficial for young children involved in collaborative web-based storytelling.

3.3. Strategies for division of labor

Teams were left to self-organize and divvy up the work in any way they felt appropriate. We observed the following 3 strategies: **random walk**, **page-based** and **role-based**.

With the **random walk** strategy, members of a team would browse the story until they found some task that needed to be done and that interested them. Then they would start working on that task, often telling their teammates about what they were doing. With the **page-based** strategy, members of a team would split the pages amongst themselves at the start of the **Story writing** phase. Each member would then be responsible for the complete creation (text, images, proofreading) of the pages that were assigned to her. With the **role-based** strategy, members of a team would choose a particular type of task that they liked or in which they felt particularly competent (ex: writing the text, drawing or searching for the images, uploading images, proofreading). The student would then be responsible for carrying out that type of task on all pages of the story.

The most popular strategy was **random walk**, presumably because it is the most straightforward and requires the least amount of coordination between team mates. The second most common strategy was **role-based**. This strategy was only used by teams that had at least one member who had previous experience with the activity. Because first timers did not start out knowing about all the tasks involved in the activity (ex: they did not learn about uploading images until the 3rd session) it was difficult for them to divide the work according to roles and tasks. The **page-based** strategy was used only by a small number of teams, both first timers and second timers.

Note that in all three strategies, we observed a strong sense of collective responsibility and ownership for the story. In other words, even when children were supposed to only work on particular pages or tasks, they would not hesitate to work on other pages or other tasks if necessary. Conversely, children felt comfortable with having teammates occasionally work on pages or tasks that they were responsible for.

All three strategies seemed equally efficient and successful, with division of labor happening mostly seamlessly and with very little coordination overhead. This is probably due to the fact that Wiki (or Web) editing is highly parallelizable, since the content is spread over a number of small pages instead of one large document. The only time where division of labor tended to be problematic was a short period at the beginning of the **Story writing** phase. During that time, collaboration could be awkward because too few pages had been written yet and children could not work independently without colliding (ex: two teammates trying to edit the same page at the same time). This tended to happen mostly for larger teams, and it never lasted for more than 30 minutes.

3.4. Team leadership

The vast majority of teams did not have a clear leader and followed a colloquial approach with collective responsibility and ownership. In only two teams did a leader clearly emerge. In one of those teams, such leadership was highly effective. The leader had strong computer-skills, a good grasp of the overall story and its current state and was well respected by his teammates. Through most of the project, he acted as central architect and coordinator, answering teammates' questions about the overall plan and what to work on next. Leadership in the second team was more problematic. In that case, the leader was a child who had masterminded most of the story during **story design**, and with little input from his teammates. Since he was the only one who understood the story, the rest of the team had to rely on him for guidance. But in the end, the rest of the team never really bought into the story and the leader had to do most of the work alone.

3.5. Large versus small teams

The size of teams varied between 2 and 5 children. Surprisingly, we did not observe a significant decrease in productivity for larger teams versus smaller ones. As mentioned in **Section 3.3**smaller ones. As mentioned in **Section 3.3**, larger teams tended to incur a certain amount of coordination overhead during the first 30 minutes of session 2, but afterwards they seemed as productive as the smaller teams.

Although larger teams were able to produce bigger stories, they seemed to be of lower quality in the sense that they were less consistent. This is to be expected in a situation where a greater number of authors contribute to the story, each with his or her own style of writing and understanding of the storyline. Again, the paper map seemed to help in keeping the group focused on a common plan, but there were often discrepancies, for example in the voice used for narration (ex: *"You die"* versus *"The hero dies")* and ways of formatting the text (ex: writing the list of choices as bullet points versus regular lines of text). Large teams could probably have benefited from appointing a single individual as being responsible for checking the coherence and consistency of the story.

3.6. Instructor as a collaborator

We found that the Wiki was also a very efficient platform for asynchronous collaboration between the instructor and the various teams. At the end of each session, the instructor would spend approximately 60 minutes traversing the stories and posting comments on their title page. These comments ranged from general praise and criticism (ex: *"I love the storyline and the great pictures. Be careful about spelling mistakes."),* to messages that pointed to a page with specific problems (ex: *"On page: **TheTreasureChest**, you should tell the reader that she needs to have found the key before she can open the chest."*). These comments would invariably be read by students at the start of the next session and they tended to immediately act upon them or ask the instructor for clarification.

4. Implications for collaborative web-based storytelling in primary school

The observations we discussed above have many practical implications for both teachers wanting to try collaborative web-based storytelling in primary school, and for developers of tools aimed at supporting this type of activity.

For teachers, we have shown that web-based collaborative storytelling using a Wiki system is quite feasible at a primary Grade 4-6 level. Moreover, our experience yields a number of useful guidelines for ensuring that the activity is successful and that children benefit from it.

- Use **synchronous collaboration** around a paper map for **Story design** and **co-located semi-synchronous** collaboration (kids sitting side by side each at their own computer) for **Story writing**.
- Let teams self-organize instead of trying to prescribe how they should coordinate and divide the work. One possible exception to this is that for larger teams (4 students or more) teachers should encourage them to appoint one person as a consistency and quality assurance person.
- Avoid pair-editing because the "navigator" tends to not be engaged enough.
- Frame the **Story design** phase in terms of a spatial metaphor with the hero making choices that allow her to move from one place to another.
- Take the opportunity to use the Wiki yourself to collaborate offline with each of the teams.

For developers of web-based collaborative storytelling tools, our experience suggests that an electronic version of the paper nodes and arcs map might be a highly desirable feature, especially for non co-located situations where a

physical paper map cannot be shared. To be useful, such an electronic map should be viewable and editable by all team members. Such a shared electronic map might ease the transition from the paper map to the web medium. It might also allow teammates to coordinate their activities, for example by allowing a child to mark a particular page as being completed or being worked on. The electronic map would probably also help teams get a more global view of the current state of their story, and this could help in terms of consistency checking

5. Future work

The present analysis of Wiki for collaborative storytelling concerned itself only with collaborative aspects of the tool. There are a number of other interesting questions that could be studied, including those below.

a) What were the most frequent usability problems encountered by students while using theWiki for collaborative storytelling? How could the tool be modified to alleviate those problems? (see Désilets et al., 2005)
b) What was the average size and complexity of the stories (number of nodes and arcs, branching factor, number of loops, number of ways to get to the final winning node, length of the longest path through the story, etc.)? How can the activity and/or tool be improved to foster the production of more sophisticated stories?
c) Did all students on a team contribute significantly to the story? If not, how can the activity and/or the tool be improved to ensure that all students are able to make a significant contribution to the story?
d) Would an electronic version of the paper nodes and arcs map actually benefit children involved in collaborative web-based storytelling? If so, how should such a map be implemented to be useful?
e) Why did pair-editing fail so miserably when we know that pair-programming is clearly successful in software development? How could the activity and/or tool be modified to generate more engagement for the navigator and better synergy with the driver?
f) Does collaborative Web-based storytelling appeal equally to boys and girls and do both genders perform as well? If not, how can the activity and/or the tool be modified to allow both genders to experience success?
g) How can the activity and/or tool be modified to improve the consistency and coherence of the stories produced?
h) Is non-linear web-based storytelling more difficult or easier than traditional paper-based linear storytelling for Grade 4-6 children?
i) What is the maximum team size for collaborative web-based storytelling? Could a whole class enjoy collectively writing a story? How should the activity and/or tool be modified to support collaboration at such a large scale?
j) Could collaborative web-based storytelling be done in a non co-located situation, for example between different schools? If so, how should the activity and/or tool be modified so that children still enjoy it and experience success?

6. Conclusion

We have shown that teams of 2 to 5 students at the primary level Grade 4-6 are able to use Wiki for the purpose of collaborative web-based storytelling. We also provided a detailed “recipe” and guidelines to allow teachers to use Wiki for this type of activity in their own classroom. Our work yielded a number of valuable insights into the collaborative process that children undergo when using Wiki for collaborative storytelling. It also suggests that Wiki could be enhanced by the addition of a graphical, editable electronic map similar to the paper map that used by children during our storytelling activity.

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