A technology-enhanced learning environment to support learning by sharing professional experience in writing

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Abstract

In Switzerland, over 75% of higher secondary education is vocational. Most of it is organized as a “dual system”, in which apprentices spend 60 to 70% of their weekly training time as an employee in a company and the remaining time at school. Unfortunately, apprentices cannot always connect theory to practice, i.e. training and learning in school and the workplace is little articulated. Financed by the Federal Office for Professional Education and Technology, the Dual-T project aims at developing technology-enhanced learning designs that will help to narrow the gap between these different learning places. Our fundamental working hypothesis is that shared writing activities about professional experience can improve the apprentice’s domain knowledge and skills, help them integrate the content studied in school with the actual practice at the workplace and contribute to professional identity building (Wenger, 1998).

In this paper, we focus both on the feasibility of computer supported collaborative writing and the appropriateness of the specific computer environment we implemented. In order to propose pertinent designs, we first investigated the characteristics of the population with interviews and with surveys. We then led four studies on computer supported collaborative writing activities implemented with two different tools of the platform: the weblog engine and the wiki.

The results provide useful information at two levels: the ergonomics of the computer environment we used and the feasibility of the different learning designs. The adopted and adjusted platform (ELGG) proved to be appropriate in supporting collaborative writing to learn activities. The two collaborative and peer tutoring designs we implemented successfully fostered knowledge sharing and building within the population and furnished us valuable information for future design of this type of activities.

Theoretical framework

Our investigation draws from the idea that writing enhances knowledge constitution (Galbraith 1999). Early writing to learn literature was claiming that using new technologies at all levels of the educational system would lead to more drafting and revising, longer texts and texts of better quality. The collaborative writing literature (Crook, 1994; Littleton & Light 1999; Spek, Johnson, Dice & Heaton, 1999) suggests that collaborative writing can be: more efficient (because different aspects of the task can be shared out), of better quality (because different individuals can contribute with different ideas and with different expertise), better thought out (because each individual has to take into account the others’ point of view). However, the literature diverges regarding the efficiency of collaborative writing: texts can be written in less time (because the less able contributors are helped by the more able ones), or written in more time (because the less able contributors hold back the more able ones). In our research, we focus on “restructuring learning environments” (Flower & Hayes, 1984; Erkens et al. 2003) where the main hypothesis is that knowledge transformation leads to knowledge constitution (Galbraith, 1999).

While mainstream “writing to learn” research focuses on the production of larger texts or self contained entries, writing in a CSCL perspective rather concerns producing short texts in various genres (questions, arguments, definitions, etc.). One CSCL approach on writing is peer tutoring. Peer tutoring is a process developed by Fantuzzo and his colleagues (Wolfe, Fantuzzo and Wolfe, 1986). It allows each student to play the role of tutor and tutored. Reciprocal peer tutoring allows each student to benefit from giving directions, evaluating and providing reinforcement for their partner. It creates mutual assistance and social support among participants (Fantuzzo, Riggio, Connelly and Dimeff, 1989; Pigott, Fantuzzo and Clement, 1986). Most of the time, research on peer tutoring provided evidence for its positive effects on performance, learning, reduction of stress and anxiety and an increase in satisfaction with the progress (Riggio, Fantuzzo, Connelly and Dimeff, 1991). Still, little research has investigated the effects of peer tutoring for "writing to learn" activities (Gielen, Dochy, Tops, Peeters, 2007). In this research we focus on peer tutoring and collaborative activities fostering writing to learn activities.
When writing contributes to a larger collective body of knowledge whose elements can be edited, manipulated and put in relation, we refer to so-called computer-supported intentional learning environments (CSILE/Knowledge Forum) (Scardamalia & Bereiter, 1994). Scenarios associated with that kind of learning environment aim at articulation and reflection. In other words, they reframe the classroom discourse to support reflective knowledge building in ways extensible to out-of-school knowledge.

In this research we plan to investigate various collaborative writing to learn activity designs based on peer tutoring and collaborative knowledge building approaches.

From a methodological point of view we adopt a design-based research approach (Collins, 1992) that according to the Design-Based Research Collective (2003) can be defined as follows: Design of learning environments and refinement of learning theories are intertwined. There are continuous cycles of design, enactment, analysis, and redesign. Research should lead to sharable theories and guidelines for practitioners. Research must account for how designs function in authentic settings. We structure and describe our design experiments with conjecture maps. According to Sandoval (2004a:abstract), “designed learning environments embody conjectures about learning and instruction, and the empirical study of learning environments allows such conjectures to be refined over time. The construct of embodied conjecture is introduced as a way to demonstrate the theoretical nature of learning environment design, and to frame methodological issues in studying such conjectures.” Our conjecture maps are structured on four columns: Theory, (theoretical foundations), Embodiment (design elements), Process (cognitive and social processes induced by the “embodiment”), Outcomes (observed measurable results of the processes).

Preliminary investigations regarding apprentices’ attitude toward writing and technologies

In order to better know the population and to propose relevant learning activities and an appropriate technical environment, we defined 2 preliminary steps. First, we investigated apprentices’ attitude towards writing and writing with a computer. We administrated two questionnaires: the “Writing Apprehension Scale” (Daly & Miller, 1975) and the “Writing with a Computer Scale” (Shaver, 1990). Second, we investigated apprentices’ training background and experience, their attitude towards the training at school and apprenticeship in the workplace, and their use and attitude towards ICT (personal, professional and learning uses). We conducted semi-structured interviews with a sample of second year apprentices. Based on these interviews, we then constructed a survey questionnaire and administrated it to the whole second year population.

The results from the Writing Apprehension Scale showed that most students do not apprehend writing activities (average of 16 on a scale up to 25). Seven students showed a low level of apprehension and only two a high level of apprehension. A factor analysis revealed two main dimensions: the apprehension towards the writing act (with an explained variance of 32.66%) and the apprehension towards the evaluation (with an explained variance of 12.80%). The distribution of the questions between the two factors is almost identical with the one proposed by Bline, Lowe, Meixner, Nouri and Pearce in 2001. Further analysis showed that apprentices apprehend more the writing act per se than the evaluation of their written productions (F(1,24)=11.65 ; MSE=105.58 ; p<0.01). Even though it seams that the writing apprehension level does not affect the writing productions’ quality (Madigan, Linton and Johnson, 1996), we needed to investigate this dimension in order to evaluate the attitude of the apprentices towards the writing activities we intended to implement and to evaluate the feasibility of the design. The results from the apprehension scale towards writing with a computer showed mostly positive attitudes. We also found that the students appreciate the enjoyability of computer writing more than its usefulness (that they don’t really perceive) (F(1,24)= 12.46 ; MSE=3.85, p<0.01). These results suggest that computer supported writing activities are feasible with dental care apprentices.

Results from the semi-structured interviews with 10 apprentices and the follow-up questionnaire (training background, experience, attitudes towards the apprenticeship at school and in the workplace, use and attitude towards ICT) administered to all second year students showed a rather heterogeneous population. Here, we only present three salient descriptive results. Firstly, neither prior training (e.g. some started another apprenticeship before) nor career plans are the same. Second, work tasks and tutoring support varies widely across dental practices. Accordingly, our population has very different skill levels. Third, most apprentices do have access to a computer at home, but only about half at work, even though there is always at least one computer at the workplace.

Results of those preliminary investigations suggest that:

• computer supported writing activities about one’s work experience are feasible with dental care apprentices, although not necessarily in the workplace;
• the large heterogeneity we discovered in the students’ profiles could be a very good basis for collaborative knowledge building writing activities;
• the large differences observed in the quality of workplace training can be put to advantage in collaborative designs within which apprentices can learn from the skills and knowledge of their colleagues and enrich their knowledge by sharing it with the others.

Technical aspects

To support collaborative writing to learn and knowledge building activities, there exist a number of different technical solutions, e.g. complex systems like Knowledge Forum, content-management systems, simple blogs, wikis, forums or “office 2.0” applications. Given the characteristics of our student and teacher population and research goals we needed a solution fostering knowledge construction, knowledge sharing and community building. The tool also should appeal to younger generation. After a feature comparison of various solutions, we selected the ELGG “social software” platform (www.elgg.org). It offers functionalities like: blog, comments, document management system, community building (sharing of relationships), RSS-feeds and profile-definition. We were particularly interested in the blog functionality. It supports writing activities, an ergonomic follow up of the students’ entries, and a commenting option. Another interesting tool is the document management system that could serve as a database for other productions (e.g. words files, photos and videos) and support different learning activities. It is relatively easy to create aggregation pages from individual contributions with RSS feeds, e.g. to provide a central view for the teacher or the class. Other web applications can be integrated with the platform. Combined, these tools provide a substrate for E-Portfolios and knowledge community building.

In our project, we made some initial adaptations to the platform; in particular, given our population, we simplified the interface. We then had to adapt it further to design needs and usability problems that emerged during the first pilot study which we now shall present.

Pilot studies

In this paper we shall present four early studies. The first two served to introduce computer supported writing designs in school, investigate the appropriateness of the tools and learning designs and adjust them. The other two studies introduced simple learning activities to prepare two kinds of pedagogical designs: knowledge building and peer tutoring. These studies also addressed several change management issues like introducing computers with a wireless internet connection in the classrooms.

First pilot study: writing about a problematic situation

Research and Design objectives: The goals of this preliminary activity were: (1) Introduce computer supported writing application to the teachers and the apprentices and identify usability and acceptance issues. (2) Gather information on the student’s ability to engage in writing activities, i.e. reporting and commenting. (3) Gather extra information that may be useful for the design of future computer-supported collaborative writing activities and the computer environment. (4) Investigate the use of blogs to support collaborative experience sharing activities.

Context: This first activity was co-designed with an ICT teacher of the dental assistant school. It took place in her regular second year office automation course. The activity took place in a PC room with “half classes” of 12 and 11 apprentices.

Scenario: The learners were asked to report on a difficult, problematic situation they experienced at work, in the dentist practice. They then were instructed to comment on one colleague’s entry. The activity took place on the Elgg platform using the blog functionality.

Results: (1) The IT teacher, in an interview, focused on usability problems about the platform, but also showed optimism regarding the platform’s utility for supporting the course and knowledge building activities. She encountered several problems using the different functionalities of the platform: difficulty to identify where she was in the platform (a hierarchic hint); menu redundancy and difficulty to accomplish certain operations (too many clicks needed). She then formulated the need for printable page versions of the platform content. Finally, she expressed the wish that learner should be able to re-edit the blog entries and have access to the editing history.

(2) Most students quickly learnt how to make entries and comments; they all were able to complete the task. They were not reluctant to write about their experience. Quantitative analysis of the writing productions revealed a great heterogeneity in the length of the produced text, especially for the comments. For the 15 minutes dedicated to problem telling, the 23 apprentices wrote a sum of 862 words, i.e. a mean of 37.4 words per student
found in the commenting activity could be explained by three factors: Students had to do actions that are more technical in order to find the peer’s entry, read it and post a comment. Qualitative analysis also revealed large differences in the quality of the writings. 852 words with a mean of 37 words per student (min=0, max=196, SD=36.2). Five apprentices did not produce any comment. Qualitative analysis also revealed large differences in the quality of the writings.

Those results show that this type of writing activity is feasible with apprentices. The large heterogeneity found in the commenting activity could be explained by three factors: Students had to do actions that are more technical in order to find the peer’s entry, read it and post a comment. Second, this activity may be more cognitively complex. Finally, students might not have understood the importance of the commenting activity and therefore did not grant enough importance to this part of the activity.

(3) Qualitative analysis of the written productions led to a first classification of the problems dental care apprentices face during their work practice and that we may integrate in further scenarios. We identified five categories of problems. The apprentices mostly reported difficulties regarding work organisation and interpersonal relations with the colleagues. Difficulties regarding skills and knowledge came second.

(4) Taking into consideration the qualitative and quantitative analysis results of the apprentices written productions, we may affirm that the blog tool successfully supported the experience sharing writing activity. But as explained in (1), certain ergonomic features of the tool need to be improved and functionalities to be added.

**Design implications:** Following the analysis of the first study’s results and the interview with the teacher, some modifications were brought to the platform. We added new functionalities such as the possibility to view the combined blogs entries in chronological order, to print individual blog entries and the possibility to export student’s productions as a single PDF file for reading after class. These additions improve portfolio functionality. Concerning the other usability problems, we are still working to solve them. Since the built-in blogs do not support editing history or collaborative writing activities with a same text, we also interfaced ELGG with a wiki system, which we introduced in the second study reported below.

**Second study: writing about procedure – building an “Excel Guide”**

**Research and Design objectives:** (1) Introduce the modified platform to new second year apprentices and gather feedback about general features (e.g. revised menu structure) (2) test a different kind of writing activity as described below (3) implement the activity with a wiki and gather information about usability issues and interface features.

**Context** For the second activity, we worked with the new class of second year dental care apprentices and a new IT teacher. The IT teacher suggested a pedagogic scenario that was taking into account both our research and her course objectives. The wiki used was a Mediawiki with a through web editor and a skin suitable for beginners. The pages used for the exercise were created in advance and included the scaffolding questions that apprentices had to answer.

**Scenario:** Each apprentice was asked to fill in a wiki entry which represented a part of an “Excel Guide”. The scenario had three steps. First, each student had to choose one of the several procedures proposed by the teacher and write down the different steps of the procedure in a wiki page. Second, each of them was asked to comment one of the colleagues’ entries with the help of scaffolding questions already inserted in the associated “discussion page” (Hand, Prain and Yore, 2001; King, Staffieri and Adelgais, 1998). Third and last step, each student was to review and amend her own entry according to the commentaries received on the “discussion” page. However, due to lack of time, this third step could not be completed and we were unable to study the effect of comments on the quality of productions through analysis of the history.

**Results:** (1) Familiarization with the platform, e.g. navigation, was easier. Students were able to accomplish user interface task more intuitively and the learning activity could be initiated quickly (about 7 minutes after the beginning of the class).

(2) We analyzed both mastery of Excel software and the quality of the written production. Regarding Excel mastery we noticed that all students had a good knowledge of the various procedures and functionalities and described them using an average of 40 words. This came as a difficulty for an activity designed to help collaborative knowledge construction through commenting. A modified SSQS scale (Six Subgroup Quality Scale) (Ransdell, S., & Levy, C. M., 1996) was then used for the qualitative analysis of the student’s wiki entries. For the purpose of the study, only the most appropriate dimensions of SSQS were kept and new relevant ones were added. The productions quality was evaluated using a 1 to 5 scale (1=very good, 5=low). We noticed that students particularly well adapted their written expression to the task (m=1.57), although they did not receive any specific guidelines. Contrary to these results, we nonetheless noticed that the text layout (m=3.57) did not reach the same level of appropriateness. We believe this can be either linked to a lack of knowledge about the wiki’s editing features or to the students’ lack of developed structuring skills to organise their knowledge into a textual structure (i.e. the “translation step” Flower...
and Hayes, 1980). Finally, only a single comment was interesting, i.e. embedding an advice to the author of the original entry. All the others just commented that contents were sufficient.

<table>
<thead>
<tr>
<th></th>
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<th>Mean</th>
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<td>43</td>
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</table>

Table 1 - Quality of student’s productions

The quantitative analysis of the wiki entries has shown that they were largely homogenous (sd=12) but that large differences in size appeared in the commentaries (sd=16). Only three out of seven students made comments, as explained before by the characteristics of the task for which students had similar knowledge levels. The quantitative results of this second activity are similar to the ones of the first activity for the main writing activity (m=37.4 vs. m=40) but different for the comments (m=37 vs. m=8.6).

(3) The Wiki functionality was particularly relevant for this type of activity and came as an appropriate support for the pedagogic scenario and course objectives. As compared to blogs, two of the main advantages of the wiki application are: (a) the possibility to follow the modifications of every page in a chronological order (which is of interest to the teacher), the (b) associated “discussion page” used for commentaries. In our study, this tool offered good enough support to implement this activity. In addition, Wikis also could provide support for more complex knowledge co-construction activities on an individual and/or group basis, something we plan for the future.

**Design implications:** This information led us toward several ideas for future design studies:

- Set up more difficult exercises where students have different skill levels and heteroclite domain knowledge in order to obtain more relevant and elaborated comments from their colleagues
- Leave more time for the commentary activity.
- Explain to a deeper extent the significance of this activity to the students.
- Scaffolding questions for the commenting activity may need to be revised in order to simulate students’ quality of comments.
- Learning activities needed preparation of the wiki pages with scaffolding indications. Given this preparation costs, we should find means to speed-up the process of preparing the pages and make this process teacher-friendly.

**Third study: writing about professional procedure**

**Research and Design objectives:** The purpose of this intervention was (1) to propose a collaborative knowledge building activity, (2) to test a more difficult subject area with a wider heterogeneity in the student’s previous knowledge and (3) to get useful information for the design of a reusable repository of knowledge.
**Context:** For the third activity, we worked with the same second year class of dental care apprentices. The activity was fully integrated into the syllabus of a core course on root treatment, which is taught by a dentist.

**Scenario:** Apprentices had to learn about the different approaches to root work. They were grouped in teams of 2 or 3 taking into account their professional knowledge and experience on the root work, which are quite heterogeneous. They had to write the response to the following questions, on the platform’s wiki: (Q1) “What is your role during root treatment?”, (Q2) “What instruments do you prepare on the shelf for this kind of intervention?”. In addition they had to (Q3) “present a difficult and exceptional situation in connection with the root treatment.”

The teacher could track online, in real time, the progress of the exercise and responded to questions orally or on the platform. After students completed the exercise, the teacher projected each entry and discussed its correctness and the differences between the various approaches with the students.

**Results:** At the end of the class we administered an evaluation questionnaire in order to gather more information about 3 dimensions: the student’s perceived learning (6 issues), satisfaction with the lesson (7 questions) and opinion on the wiki (4 issues). Each question was measured on a 4 point scale (1= totally agree, 4= totally disagree). Descriptive statistics showed high averages for each dimension of the questionnaire (learning m = 1.8, satisfaction m = 1.5 and wiki m = 1.6); with small standard deviations: 0.6, 0.3 and respectively 0.4. These data suggests good acceptance of the design in the population.

The teacher showed interest in this kind of design, found it useful and representing a good basis for designing new learning activities. He commented very positively on the quality of apprentices’ entries and these comments were coded on a 7 to 10 scale (Overall grade).

Qualitative analysis of participants’ productions is summarised in Table 2. The productions quality was evaluated using a 1 to 5 scale (1=very good, 5=low). The mean level of the quality of the answers to the three questions (Q1, Q2, Q3) was good. Nevertheless an important heterogeneity was observed. That opens a potential for implementing peer tutoring scenarios. Formal text quality, defined by four dimensions (grammar, formulation, exactitude and layout) was satisfactory.

The tangible result of this activity was a good collaboratively built knowledge base that is reusable and expandable for future activities.
Table 2: Quality of written productions

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**Design implications:**
Analyses of this study conclude that this type of design could and should be extended in the future. Important question that we will have to answer are:
- The wiki pages were prepared in advance by the research team. Could teachers manage to do this preparation part alone? If no, what should be done in order to help them become autonomous?
- Would it be possible to engage students and teachers in long term activities including homework for students?

**Forth study: writing about procedure**

**Research and Design objectives**
The purpose of this intervention was (1) to introduce a simple peer-collaborative writing activity, (2) to make students contribute to a knowledge repository that they could use to prepare the exam.

**Context:** For this forth activity, we worked with the third year class of dental care apprentices, the same class that was engaged in the first pilot study (writing about a problematic situation one year ago). The activity was a part of a branch core course on radiology, a problematic issue in the dental assistant’s training.

**Scenario:** The purpose was to improve student’s knowledge on dental radiography i.e. be able to describe the photographic and technical quality of a radiograph and provide an explanation for the deficiencies identified. In the beginning the students worked individually. Each of them had to comment on a different radiological image in the platform’s wiki. The wiki pages were prepared in advance by the research team in collaboration with the teacher. Apprentices had to fill in a table with four columns. The first column contained the radiograph to be commented and the following three contained a scaffolding question each. Apprentices first had to describe the image, then to indicate the mistake in the radiography procedure that produced the bad cliché. In the second phase, the teacher
projected and discussed each entry with the class and indicated mistakes apprentices did in their evaluation of the clichés. In the third phase, every entry was “corrected” or completed by a peer colleague taking into account her own experience and the teacher’s previous comments. In the fourth phase the peer had to write a procedural “solution” in order to solve the problem of the cliché. A last teacher correction took place at the end of the class and this final knowledge repository could serve students to prepare the exam.

**Results:** At the end of the class we administrated the same evaluation questionnaire used for the previous study. We shall not discuss the results of this questionnaire here.

We made a qualitative analysis of written productions. The length of an average wiki entry was 33 words. Since the production of this knowledge base included two revision phases (the first by pears, the second by the teacher) overall quality of the final productions was certified so we didn’t evaluate it considering the criteria used for the previous studies but only evaluated the modifications brought to the text and its evolution. The changes in the content were coded with six criteria measured on a zero to 3 scale (0=no intervention, 1=small intervention, 2=medium intervention and 3=strong intervention). Mean peer correction was situated between small and medium intervention with an important variance. Similar values were observed for peer completion of the text. Both students and teacher made small grammar and expression correction. Teacher’s corrections and completions were small but systematic.

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Table 3 - Quality of students’ productions

**Design implications:** These results show that this simple peer commenting design was successful in terms of the quality of student productions and teacher satisfaction. It encourages investigation of further, more complex peer tutoring and collaborative or cooperative activities. The same questions regarding teacher’s autonomy raised in the previous study remain open.

**Conclusion**

The four pilot studies we presented in this paper enabled us to analyse the feasibility of computer supported collaborative writing activities with dental care assistant apprentices, to analyse and to improve the usability and utility of the platform’s features.

The tool’s ergonomic characteristics were particularly investigated in the first two studies. The redesigned tool presented the needed functionalities and features as well as better usability. We added functionalities such as wiki integration, PDF export and awareness tools. Nevertheless, all the technical preparation of the lessons, in all four studies, was made by the research team. This raises the question whether teachers could manage to do this preparation part alone. If not, what should be done in order to help them become autonomous or should the present tool still be modified?

The four studies provided evidence for the feasibility of the learning designs. In all four studies, in a typical 45 minutes lesson, students were able to produce texts containing on average between 30 and 40 words. During such a lesson they also produced comments and interacted orally. These texts are sufficiently large to express valuable vocational domain knowledge. In the second and third study conducted with the same second year class, we evaluated the text quality using a modified SSQS scale (Ransdell and Levy, 1996). Results showed similar good general quality of grammar, formulation and exactitude, and improvement of the layout features.

Evaluation questionnaires, formal and informal interviews with the teachers and students suggest good acceptance of the different implemented simple designs.
We also found interesting information regarding writing to learn tasks. Activities where students’ skill levels and domain knowledge were different produced more interesting comments and interactions. Scaffolding writing activities with questions and forms seemed to be appropriate and facilitate the knowledge building activities. Nevertheless, it would be very interesting to test more open-ended writing activities.

We currently are leading more advanced computer supported writing activities in relation with the main objective - to bring workplace practice in school activities - in order to study the effects of commentaries on the written production quality and on the several learning dimensions, notably the procedural knowledge acquisition.

Bibliography:


