SCRIPTING STRATEGIES IN COMPUTER SUPPORTED COLLABORATIVE LEARNING ENVIRONMENTS

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Free and unstructured collaboration tasks do not systematically produce learning. One way to enhance the effectiveness of collaborative learning is to structure interactions by engaging students in well-defined computer supported pedagogical scripts. A script (some authors use the term scenario) is a "story" that the students and tutors have to "play" as actors play a movie script. We conducted a study with three different learning scenarios embedded in regular high school biology curricula and focused on the students' learning processes and results. The scripts for these scenarios were based on the following common principle: (1) A first phase should lead to the production of a critical mass of information into the system (e.g. hypertext accessible to all members of the learning community). (2) In a second step students are induced to link similar concepts. (3) A third phase should sustain critical altercation with the work produced by other members of the community.

Results show that these strategies lead to a deeper immersion with the treated subject, better subjective perception of efficiency, and a somewhat measurable better learning progression. We shall focus on the performance of two classes exposed to the same task in different scenarios. One regular high school class accomplished the task in a conventional learning unit while another vocational high school class was sustained with a collaborative hypertext (Swiki). The two groups showed a similar increase of factual knowledge which clearly shows an experimentation effect, i.e. in the selective Swiss school system, the regular high school class should have shown better pedagogical performance in a comparable "normal" situation. We will present salient features of this realistic "in-situ" experience.

1 Introduction

Much collaborative learning research has been conducted over the last few years. Most of this happened in a laboratory environment or with special pilot classes. Results have identified critical parameters to improve learning effects. However, knowledge gained from laboratory or test environments are sometimes difficult to apply to "normal" curricular learning situations. In fact 'every-day-'s learning' depends on a vast number of factors [1]. The apparently identical lesson with the 'same' students at the same time of day can give a totally different score of efficiency or of satisfaction of the students just because their favorite soccer team lost the match the evening before. Two apparently similar classes with the same previous knowledge can react in a totally different way just because in one class a 'leader' shows enthusiasm about the set-up. The importance of the way the lessons are constructed and the students are integrated in the setting is crucial in every type of learning situation. In conventional instructional units, students are strongly guided by the teacher. In more constructive based learning the importance of direct guidance decreases and the freedom of students' raises. But no matter which type of learning, it is important to involve students in the lessons.

Collaborative learning without any guidance is not efficient [6]; a certain amount of guidance is suitable and part of the ‘storyboard’ [4] or ‘script’ [3] for the lessons. Our pedagogical engineering approach tries to describe the impact of a few parameters on specific situations and we will discuss some opportunites for improvement. Some may be applied to other more general learning environments; others may not. Contextualized pedagogical engineering also means to adopt or change settings while the ‘experiment is running’ when the presumed settings do not show the expected outcome.

We conduced action-based, hypertext creating, computer supported, collaborative learning units in biology with high school students in different classes. Our scenarios fit the theoretical setting of a constructive learning environment [2] and followed a “pedagogy of activity” approach [3]. We tried to involve students in rich learning actions and built complex collaborative conversational learning environments.

We were working with three learning units: he first is about evolution, the second about human anatomy and the third about human embryology. In all units students worked in small groups and produced a collaborative hypertext, which means that the whole class produced one text with different subjects treated by the working groups. We differed the way we organized and orchestrated the different units. We were interested in scripting and its impact on learning efficiency and work produced by the group. **We tested different scripting methods in different learning environments.** To sustain creation of the hypertext and communication within the learning community we used an unstructured collaboration tool called Swiki.

Our principal working hypothesis were:

- The use of a Swiki as collaborative editing tool causes no technical and comprehensive problems for high school students without experience in collaborative editing but having some basic skills for text-editing and information search on the Web.
- Scripting which induces students to compare and comment on the work of the whole learning community (using a collaborative editing tool) leads to better learning performance (as assessed by pre- and post-testing) than a more traditional script where students work without such a tool and get little advice or / and the opportunity to make comments and compare their work with the learning community.
- The quality of the product of the working groups is better (longer and more detailed) when students are induced to compare and comment on their work (with a collaborative editing tool) during the learning unit.

2 Scenario definitions and methods

The whole research took place in a normal curricular class environment. The classes were not aware of a special learning situation and that the output they produced was going to be studied in depth. We tried to embed the scenarios in an absolutely everyday teaching situation and students were supposed to adopt the same motivational state as in other lessons.

We adopted the following scripting elements for the three scenarios:

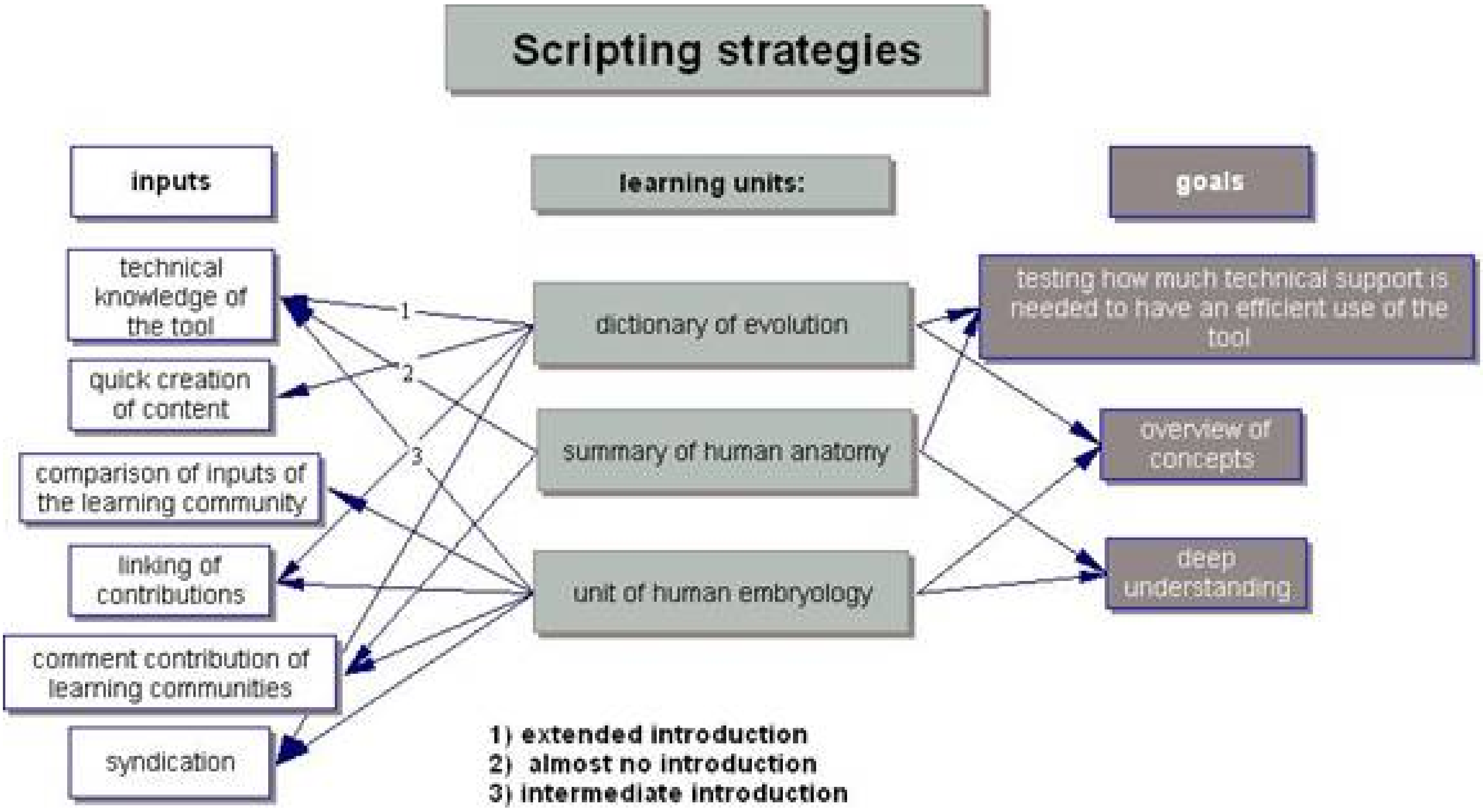

Figure 1: Comparison of scripting strategies in the three learning units

Most learning scenarios embedded in normal curricular classroom teaching last more than one single lesson. If students accomplish a longer task it is very difficult to see what they have done after one, two or three lessons. Normal teaching makes it possible to see the final result or to intervene when students ask questions. Evaluation by the rest of the learning community is especially difficult to set up under such circumstances. **We tried to set up a scripting which reinforces comments and evaluations by the teacher and the learning community while work is ongoing**. Two effects were presumed. First we hoped that students would get more involved with the work of the whole class, be aware of all contributions, comment on them and link them to other concepts. Secondly we wanted them to think about the way they did their work. When other students ask questions of the type ‘why’ about their work, metacognitive capacities are invoked and supported. In the learning scenario about human embryology where we compared two classes we could also compare their final product. Of course we hoped that the final work produced with a collaboration tool would be better than the other. What does ‘better’ mean? The products of the group work were texts: summaries, definitions or explanations. Because of the open tasks, students could choose the subject they wanted to treat and no specifications were made about length, precision and diversity of themes. Two factors were analyzed. First the complexity and precision of the described subjects then the diversity and the number of different themes. In the scenario about human embryology in particular we could compare these factors.

To collect data we used questionnaires, observed students while working and for one setup we asked students to write three tests. Of course the students asked about the purposes of the tests. We tried to motivate them to perform as well as they could without telling them the real reason of the tests.

3 Subjective perception of the scenarios[1]

Our three scenarios differed mainly in the degree of guidance through scripting. We called it structured scripting against unstructured. The learning unit about human anatomy was not structured, which means that students did not get any introduction and while the work was ongoing no input by the teacher had been made to structure and ‘guide’. In a questionnaire we asked students about their perception of the scenario. We found differences within the following questions: **We found out that students working in an environment with structured scripting showed significantly less difficulties to use the computer and the tool**. A Mann-Withney test showed a significant difference between medians of evolution against anatomy Swiki (U = 1027.5; p=0.03) but no differences between embryology and anatomy (U = 574; p = 0.13) or embryology and evolution (U = 1559; p= 0.41).

We wanted to know whether students discussed their questions while working. Arguing about different concepts especially when the pears have different opinions is fruitful for learning. **The comparison of the three scenarios with respect to discussions indicated a significant difference between anatomy and embryology** (U = 39; p = 0.03), but no statistical differences between the two other set ups (Anatomy<->evolution: U = 65; p = 0.14; evolution <->embryology: U = 143; p = 0.21).

The final product of all scenarios was a hypertext. We wanted to know whether students got lost easily in the text. We found a significant difference between the unstructured Swiki (anatomy) and the other two Swikis ((A Mann – Withney test showed: anatomy <-> evolution: U = 60; p = 0.09; anatomy embryology: U = 46; p = 0.07 and evolution <->embryology: U = 189; p = 0.81)). **Students had a greater impression of getting lost within the hypertext of the anatomy Swiki than in the other Swikis**. We counted the number of pages and links of the three units and found the amount of links and pages in the anatomy Swiki is no greater than in the two other Swikis.

4 Increase of knowledge awareness of personal knowledge and quality of the produced work[1]

In our main research where we compared two classes which had to produce the same performance given different script. We analyzed the learning efficiency with a test conducted before the unit (pre test), a test conducted after the unit (post test) and a test six weeks after the end of the unit (final test). We then tested the increase of factual knowledge within the tests.

Vocational high school students apply for a diploma, which permits them to become an elementary school teacher or a nurse or to go to a university of applied sciences. Normally these students do not have the same capacities of abstraction as ‘normal’ high school students. Generally, they require a greater effort to understand difficult concepts. They usually show an inferior performance in exact sciences like physics, mathematics, chemistry and biology. On the other hand they usually have better level of social competence than ‘normal’ high school students.

Therefore, we would expect a worse performance from these students. We hoped to obtain a better learning effect through adequate scripting. Students of the vocational high school worked with a Swiki while students of the 'normal high school in a conventional unit without tool and structuring script.

We found a comparable increase of factual knowledge in the different tests:

		Pre test	**Post test**	**Final test**
	Amount of questions	Number of correct answers: average (standard deviation)		
Conventional class	19	5.9 (2.1)	9.7 (2.6)	10.4 (2.8)
Swiki Class	19	5.4 (2.5)	9.8 (2.9)	10.8 (2.1)

Figure 2: increase of factual knowledge between pre- post- and final test

A one way analysis of variance showed no significance between: Pre test conventional <-> pre test Swiki, post test conventional <->post test Swiki; final test Swiki <-> final test conventional but a strong significance ($p<0.001$; $F(5, 101) = 14.841$) between pre test Swiki <-> post test Swiki and Final test Swiki <-> final test conventional; **which means that both settings lead to a comparable increase of factual knowledge.**

We further asked all students to state how sure they were about their answers. We found an increase in self-assurance between pre and post test for both classes. The students of the Swiki class were a little bit less certain about their answers in pre and post test compared to the students of the conventional class. The increase of self-assurance within pre and post test was almost parallel for the two classes

		Pre test	**Post test**	**Final test**
	Amount of questions	Confidence in correct answers: average (standard deviation)		
Conventional Class	19	11.4 (4.6)	21.4 (8.3)	21.3 (7.9)
Swiki Class	19	9.2 (5.03)	18.2 (7.8)	20.4 (4.7)

Figure 3: Increase of confidence in correct answers between pre- post- and final test.

Both classes showed a significant increase in self-assurance between the pre and post test, although no significant difference could be found in the pre, post or final test of the two classes (one-way ANOVA: $F(5, 101) = 11.05$): no significance between: Pre test conventional <-> pre test Swiki; post test conventional <->post test Swiki and pre test Swiki <-> post test Swiki; high significance ($p< 0.001$) between pre test conventional <->post test conventional and significance ($p<0.01$) between pre test Swiki <-> post test Swiki.

We compared the work output of the two classes, i.e. the text produced about the treated subject. Students wrote summaries about different themes of human embryology. The conventional class wrote the summaries with text processing software and all summaries were copied for the class. The ‘Swiki-class produced a collaborative hypertext. Here we found a considerable difference between the two classes. While the conventional class published summaries of **9 different topics,** the Swiki class completed summaries on 14 different subjects. Some summary subjects were proposed by the teacher. The conventional class chose the proposed titles, while the Swiki class changed the titles and added new ones.

5 Conclusions

Our units have been set up to fit Wilson’s action-based, constructivist learning scenarios [2] and that can be characterized by being “active, complex, collaborative, constructive and conversational”. We called our set-ups: Action based, hypertext - constructive, computer supported, collaborative learning units (ABAHCOCOSUCOL). We set up a computer-mediated group activity where the Swiki takes the role of an individual and group artifact, relating to the activity theory approach of computers as ‘extension tools’ [1]. Our building blocks of a longer activity are ‘actions’ which we define as operational work units of a student or a group of students. This choice is connected to the goal- related notion of the term ‘action’. Note that other researchers choose the term ‘activity’, however we believe that ‘action’ fits better to what students do (produce, think, and manage) while learning. Following activity theory actions are always situated in a context and are impossible to understand without it. Our scenarios were embedded in a normal curriculum and took place in normal classrooms. This learning situation is perfectly comparable to usual lessons.

The Learning performance for an ABAHCOCOSUCOL is good especially concerning the following factors: increase of factual knowledge, long term knowledge retention, mastering problem solving strategies and increase of metacognitive skills. To optimize efficiency the following general scripting advices can be given.

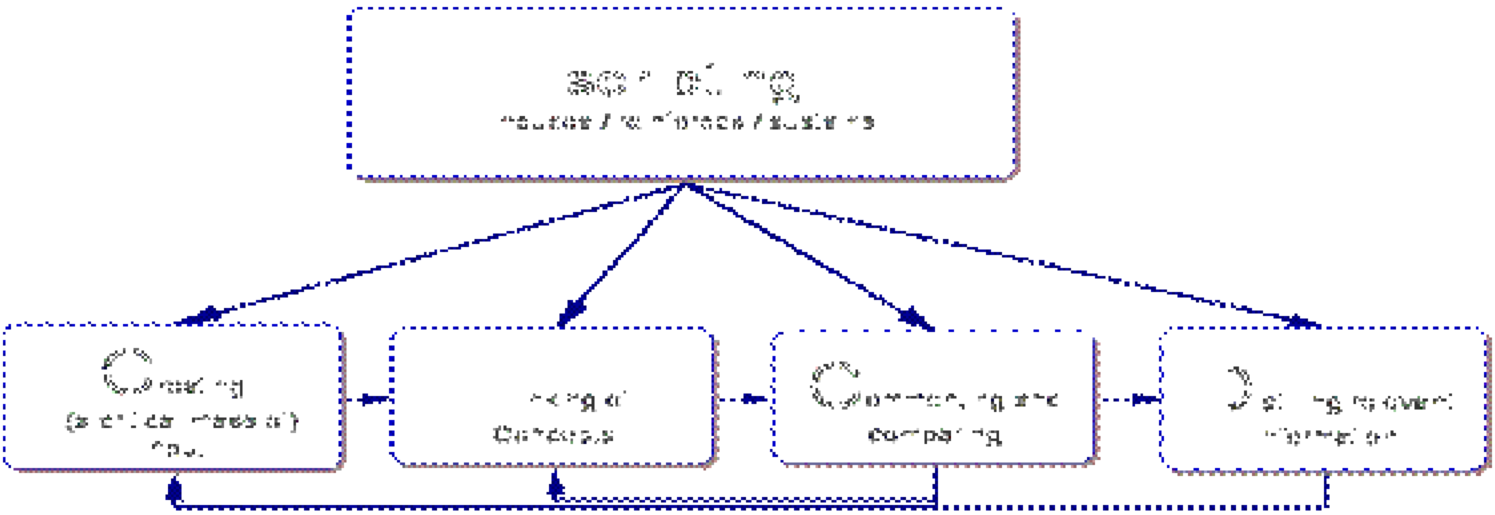

Figure 4: Scripting for action based, hypertext –constructive, computer supported, collaborative learning units (ABAHCOCOSUCOL)

The scripting input leading to the creation of input is important at the beginning of the unit. Here we call it ‘creation of a critical mass of input’. Students should immediately compare and comment the work of the others to augment the interactions between the learning community. Scripting should induce students to publish what they have produced as soon as possible and it should be mentioned that there will be an ‘evolution’ of the text during the unit due to the comments and questions of the other members of the community. A ‘critical mass’ of input at the beginning is important for the start of interactions and the creation of a communication culture. Of course other ‘creating inputs’ can be made during the learning unit for instants when new questions rise.

The linking of concepts is important for the awareness of the common goal and the cross-linkage of the treated concepts of the unit. The learning community creates one collaboratively elaborated hypertext where the different pages are interwoven and linked together. Creating links sustains the awareness of the community and produces a basis for the comments and comparisons to be produced in further action. Finally, the distillation and re-grouping of relevant information leads to a self-evaluation learning community’s product.
Action-centered constructivist learning may include many elements other than the hypertext production that we focused on in our work. Research into the impact of such elements in ‘real’ learning situations has really just started. We hope that the experiences we gathered and future syndication of field-tested new methods and techniques will lead to a proliferation of these ideas to many teachers and instructors in the educational community.

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[1] Further results can be seen on: http://tecfa.unige.ch/perso/staf/notari/ thesis_michele_notari_scripting.doc