Orchestration Challenges Raised by Transposing a Paper-Based Individual Activity into a Tablet-Based CSCL Activity: An Example

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Abstract: This article presents an analysis of the implementation and orchestration challenges raised by turning a traditional paper-based activity (dictation) into a CSCL activity. It illustrates how implementing a CSCL version of a classical teaching setting can raise many new issues for teachers. Teachers must make design (scripting) decisions at different stages, both before and during the session. Some support must therefore be provided, such as means to manage learner productions, focus learner tasks or support learner interactions in different ways. Although the concerns identified and the features implemented here relate to a particular study, they may have a wider scope of application.

Keywords: orchestration, CSCL scripts, tools for teachers, tablets

Introduction

A limiting factor to the introduction of CSCL in standard practices is that collaborative activities, especially computer-based collaborative activities, may be more complex for teachers to manage than traditional ones. This issue may be addressed using the notion of orchestration, which has been defined as "how a teacher manages, in real-time, multi-layered activities in a multi-constraints context" (Dillenbourg, 2013). The balance between the interest of the CSCL activity (with respect to an individual and/or not-computer-supported activity) and the difficulty of orchestrating it is a crucial issue. To promote adoption of CSCL activities, teachers should be offered tools that help them orchestrate the setting. At this level, a known issue is that tools that are not sufficiently user-friendly and adapted to the unpredictable context of a classroom may discourage teachers from engaging in CSCL activities (Roschelle, Dimitriadis, & Hoppe, 2013).

In the context of scripted collaborative activities, orchestration may be seen as comprising scripting (primo- and runtime scripting) and conducting activities (Tchounikine, 2013). Primo-scripting consists in defining the learners' tasks, roles, and resources before the session. Conducting consists in monitoring and analyzing learner performance and, on this basis, engaging in actions such as providing hints or adapting details (e.g., moving a learner from one group to another if it will not change any important aspect of the setting rationale). Runtime scripting consists in making or reconsidering design decisions according to the actual performance.

In this ongoing project, we are investigating what means should be proposed to teachers to orchestrate CSCL settings. For this purpose, we identified a paper-based pedagogical activity that is traditionally conducted individually. Then, using an iterative and participative methodology, we designed a computer-based collaborative version of the same activity. This version includes a task-related system that allows learners to perform the activity and a minimal version of an orchestration system that, for the moment, just allows teachers to set the session and carry out the necessary conducting and runtime scripting actions. Working with teachers on the design of these systems and then conducting preliminary tests shed some light on orchestration issues and the requirements for a full-fledged orchestration tool.

In the next section, we will present the pedagogical activity we used as an example and identity the implementation and orchestration challenges encountered. We will then present and discuss the lessons learned from preliminary experiments.

From a paper-based individual activity to a CSCL activity

Dictation is a standard primary school exercise. The teacher dictates a text to the class, and students must write it out with as few mistakes as possible. The educational objectives are numerous: learning new words; translating spoken language into written language; applying knowledge of grammar and conjugation; and learning to correct oneself using this knowledge. However, this last objective is probably the hardest one to reach as it is difficult for students to identify their own mistakes.

To address this issue, negotiated dictation is an option (Cellier, 2004). First, students do a regular dictation. Second, the teacher retrieves all the students' productions, examines them, and creates groups of three or four. Each group has to collaboratively rewrite a common version of the text using their individual dictations. This task involves spotting the differences in the individual texts, agreeing on a common version, and justifying the final text. During this phase, the teacher interacts with groups only to unblock/support them or solve conflicts. Finally, in an institutionalization phase, teachers may (for example) retrieve all the groups' dictations and engage in a discussion with the whole class. This is the scripted setting we implemented: we respected its rationale and individual/collective structure, and worked out how to support it using electronic devices.

In the national context within which this project is conducted, implementation of negotiated dictations in basic practice is still uncommon. The four school teachers with whom we worked, and all the ones with whom we informally discussed, unanimously acknowledged that it is a highly interesting setting. Yet, it is also much more complex for teachers to manage, and its implementation raises many interrelated orchestration issues. Working with these school teachers allowed us to identify some of these challenges.

Due to space limitations, in this section we will both introduce our design and explain the orchestration challenges (*in italics*).

The first design decision was to equip all students, and the teacher, with an individual tablet. With respect to the collaboration objective, the mobility of tablets enables students to join their group with their tablet. Moreover, the possibility to lay them flat on a table prevents the devices from being seen as physical barriers and promotes face-to-face interactions between learners (Alvarez, Brown, & Nussbaum, 2011).

With respect to orchestration issues, the use of tablets presents the following advantages:

- *Respects learner pace*. The dictation is stored in an audio file and cut into small sections that students listen to using headphones (see Figure 1, A). This allows each student to type and edit the dictation (individual phase; see Figure 1, B) at his/her own pace, and to listen to sections again as needed. From a teacher perspective, it makes it possible to respect individual differences, which is impossible when orally dictating to the class.
- *Facilitates teacher support*. Using a tablet allows the teacher to conduct the session while physically going from one student/group to another and helping them as needed.

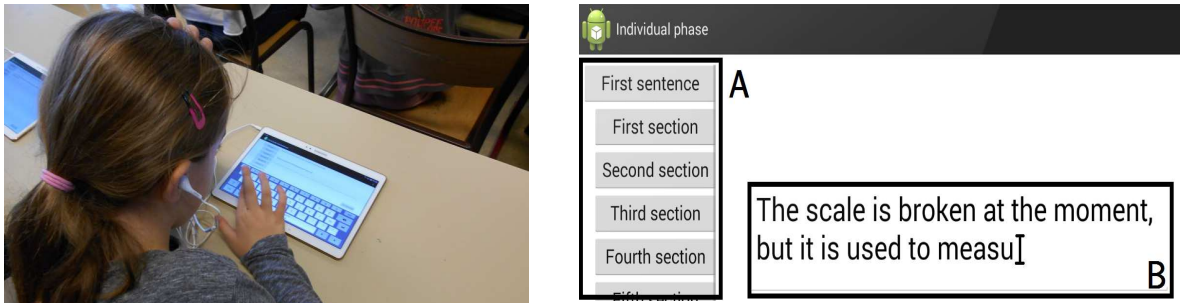

Figure 1. Student interface during the individual phase (using an example in English).

The students produce a digital file (list of characters), which may thus be computationally manipulated. This allows for different issues to be addressed, including the following:

- *Facilitating teacher management of learner productions*. In the described setting, this issue is critical because groups are created between the individual and the collective phase. In the paper-based version, collecting and analyzing the student's dictations is time-consuming, and the collective phase is often delayed to the day after. In our design, the teacher is presented with a compilation of the individual dictations immediately after the individual phase, and provided with tools to set and launch the collective phase with no delay (see below).
- *Focusing learner tasks*. In the paper-based version, when students work together they have to copy the entire text again, which is tedious. In our design, when a group is constituted they can manipulate their individual productions to create their collective version. This makes it possible for groups to focus on the goal of the exercise, i.e., to collaboratively consider the grammatical rules and their applications, instead of wasting time rewriting the dictation.

- *Allowing grouping flexibility*. Because of the static nature of paper, it is impractical to modify groups during the collective phase of a traditional negotiated dictation. In our design, groups may be changed on the fly, with data managed accordingly on the tablets (this is also another example of *facilitating teacher management of learner productions*). A student may thus be prompted to negotiate the first sentence with two peers and the second sentence with two others. This allows the setting to be scripted by implementing *a priori* strategies—such as creating homogeneous groups (as a way to promote collaborative construction of justifications) or heterogeneous groups (as a way to promote tutoring interactions)—and then, while groups enact the collaborative phase, adapting the groups on the fly.

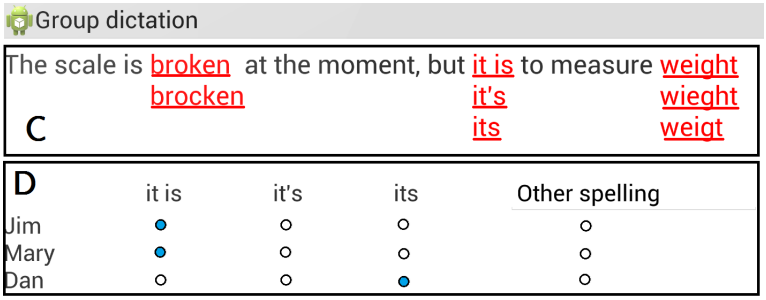

Figure 2. Student interface #1 during the collective phase: aligned dictation and voting tool

Considering together the design of the system offered to students and the orchestration issues led us to elaborate new notions such as "aligned dictation". An aligned dictation merges the group's three individual dictations (see student view in Figure 2, C; each word appears as many times as there are different spellings for it in the individual dictations; following the teachers' suggestion, the dictations are not tagged with the students' names to avoid stigmatization). This calls the students' attention to the differences and allows them to fully focus on their negotiation/justification tasks. The aligned dictation also opens up further possibilities to *focus learner tasks* by designating and/or ordering words that a given group should negotiate (in red and underlined in Figure 2, C). These words may be designated before the session (primo-scripting) or once the teacher has analyzed students' individual productions (run-time scripting), by selecting these words in the aligned dictations.

The "aligned dictation" notion, however, raises *teacher management of learner productions* issues, including a very practical one. As students may write words in an incorrect way (e.g., writing "your self" instead of "yourself") or omit some words, the words in individual dictations may not correspond one to one. To address this orchestration issue, we designed a production management tool that displays the dictations one below the other on the teacher's tablet and offers him/her features to align the dictations by merging multiple words into a single word, dividing words into multiple words, or adding blank words (via "gestures", i.e., direct manipulations on the tablet screen, Figure 3). In Figure 3, the first line shows the correct sentence as the reference for aligning the dictations as necessary. Here, the string "moment,but" must be separated into two words. In some cases, such as this one, the required treatment is obvious and may be more or less automated; in others it requires human intervention, which is the rationale for this tool.

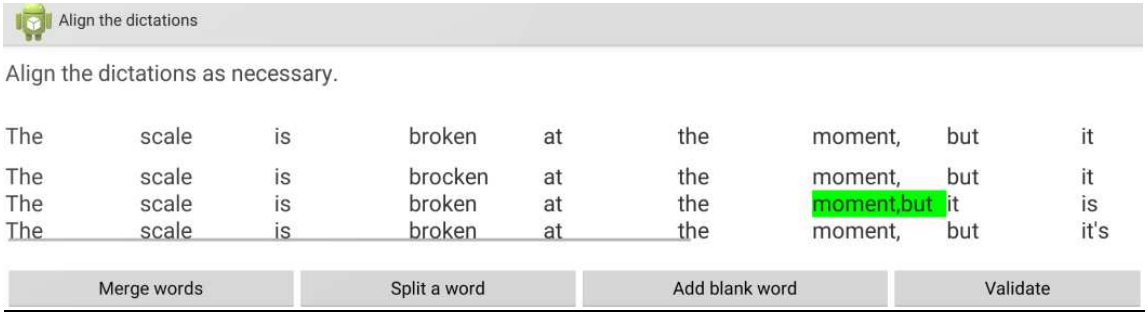

Figure 3. Teacher interface to align the students' dictations.

Another important orchestration aspect is *offering teachers different ways of supporting learners*. The *raison d'être* of negotiated dictations is to make students discuss grammar and conjugation rules and how they

apply. Researchers and practitioners agree that it is difficult for students/groups to engage in such interactions and propose well-constructed justifications. This difficulty depends on multiple factors, such as the students' characteristics, group composition, the dictation, or students' experiences with this exercise. To deal with this, teachers are interested in means for adapting the support provided to students.

To explore this issue, we designed an agreement/justification support tool that functions as follows: During the collective phase, the groups of three students share two dedicated tablets. On the first one, they start by selecting the word or group of words to be negotiated by touching it on the screen (Figure 2, C). The system then displays a voting tool (Figure 2, D) on that same tablet. This voting tool requires students to adopt an individual position (which may be the same as or different from that of their peers) by selecting a spelling (i.e., agreeing on one of the solutions submitted by students) or proposing a new one. When they have voted, the system displays a justification tool on the second tablet. Different options are available for this phase (Figure 4). For example, support can be provided in the form of predefined justifications, or students can be asked to type their own justification in a blank text box.

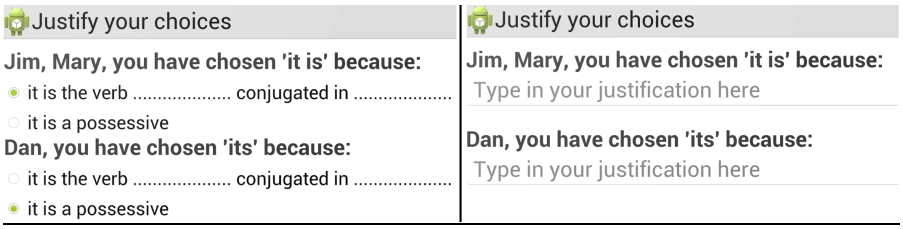

Figure 4. Student interface #2 during the collective phase: two different justification tools.

As a final summary, the activity proceeds as follows: Students first copy a predefined sentence to get used to the tablet, and then engage in their individual dictation. The teacher then terminates that phase, aligns the dictations, creates the groups, and then defines the words groups should negotiate. The students are assigned to a group via a message on their tablet and join their peers. Each student/tablet in a group is associated with a role: one tablet displays the group's aligned dictations and the "voting" device (Figure 2, C and D); one tablet displays the selected justification tool (Figure 4); and the third tablet displays some help (e.g. conjugation tables). Here again, this gives options, such as switching roles. Finally, the teacher receives all the group dictations and justifications and can proceed to the institutionalization phase. Although we have not yet addressed this phase, teacher interviews and overall design characteristics suggest many strategies based on displaying/sorting the different dictations and/or justifications.

Preliminary tests and lessons learned

We conducted preliminary tests with three successive groups of three students (grade 4, 9-10 years old) and then a second test in a classroom (grade 4, 28 students). The first test included the individual and collective phases. It aimed to verify technical functioning and usability of the student system; to determine whether students negotiate; and to verify technical functioning of the system (i.e., that it enables setting the session, visualizing and aligning dictations, creating groups, and prompting students to join their group for the collective phase). The second test focused on the individual phase. It was conducted in half-classes, i.e., approximately 15 students working on the dictation while the others worked on other activities. It aimed to verify that the setting could be deployed in an actual classroom, i.e., given the potential technical and pedagogical issues related to use of the system by 15 students, and to identify further orchestration issues. The considerations identified hereafter are based on data collected during these two preliminary tests.

Some of the students were already familiar with tablets because they had one at home, while others were discovering this type of device for the first time. None of the students, including those who were unfamiliar with tablets, had serious difficulty in manipulating the tablets or, most critically, typing the dictations. All of them quickly became familiar with the system. There were, however, important differences in how long it took to type the dictation, with times ranging from 13 to 26 minutes, and average and median times close to 20 minutes.

All the students tested indicated high appreciation of being able to listen to the audio dictation at their own pace and to listen to sections again as needed.

The first test, within which the groups used the system during the negotiation phase, showed they do collaborate. This corroborates the findings of not-computer-supported negotiated dictations. How the system's overall design (e.g., the aligned dictations) and the justification interface (e.g., use of predefined sentences)

impact this negotiation will be examined in future studies with a larger number of groups. However, studies related to scripted argumentation (Stegmann et al., 2007; Weinberger et al., 2010) suggest that such design may positively impact collaboration.

With respect to orchestration, teachers were afraid that students' dictations would be difficult to align. In fact, very few required merging or dividing effective words. However, many dictations did not respect typographic conventions regarding the use of whitespace characters with punctuation marks. This suggests a need to support teachers by implementing an automated preprocessing phase prior to manual alignment to manage easy cases (i.e., another *teacher management of learner productions* tool). Similarly, it may be useful to facilitate teacher grouping process. In both cases, interactions with teachers clearly define the design strategy to be adopted: propose a solution to the teacher, who can accept or refine it as needed.

These tests also suggested additional features that the full-fledged orchestration tool should provide, including the following:

- *Heterogeneity management*. The counterpart of the (positive) fact that students go at their own pace is that, in a given amount of time, they will write a significantly different number of sentences (see the figures on dictation typing time). In the tested groups, there were also disparities in the time spent justifying words. This highlights the importance of helping teachers deal with heterogeneity. In our case, it may be addressed by offering teachers the means to decide when to stop the individual phase (typically, when all students have advanced sufficiently to have issues to negotiate on), then adapt the number of words to justify, and finally manage the groups accordingly. Another option is to offer teachers means to decide whether some students should skip to the collective phase while others continue the individual one, and to manage the activity accordingly.
- *Management of technical issues*. Teachers are often reluctant to use technology because the systems may not work. This is wise. Addressing this issue presents a technical challenge. In our case, given how tablets function, it is technically impossible to prevent students from quitting the application and/or generating events that may cause the application or network to break down. Therefore, it has proven essential that the technical architecture be natively designed to account for the fact that such problems will occur and deal with them, i.e., that teachers be offered features to seamlessly reintegrate students facing technical issues into the activity without disturbing others.

Discussion

The first test we conducted allowed us to check technical aspects of the system and its usability. The second test confirmed the usability and provided hints for further orchestration means. Both of these tests, although involving a limited number of students/groups, suggest that the CSCL version of the exercise works well. However, because of the innovative nature of this project, the setting has two important characteristics that make it difficult to analyze results.

The first issue concerns disentangling the effect of the system's designed properties from the impact of using a new technology in classroom. The students were not used to working with tablets in a school context, and some were even manipulating tablets for the first time. Their general reaction was very positive, as suggested by their enthusiasm when they discovered the tablets, their use of the devices and their wishes to use the system again. At this level, however, it is difficult to separate the effects of the system and its designed features from the effects of using some "cool" technology in class.

The second issue involves disentangling the tool from the procedure. Negotiated dictation is still very uncommon, and none of the teachers or students had participated in such a task before. The positive feedback from teachers and students may thus be partly related to the negotiated dictation principle and partly to how the system supports it.

Disentangling these aspects is not easy, and requires repeating experiments.

Nevertheless, these tests at least illustrate how the technology facilitates the negotiated dictation procedure (e.g., by avoiding copying text) and provides teaching options (e.g., by offering different types of justification support). They further suggest that the design is usable (students reported no difficulty and acted intuitively).

Conclusion

We have presented a case study that illustrates different aspects of CSCL scripted settings orchestration issues. First, implementing a CSCL version of a very classical teaching setting may raise many new orchestration issues for teachers, which may prevent "teachers acting in standard situations" (as opposed to "teachers acting with researchers") from taking the plunge. It is therefore important to consider teachers' perspectives and requests as

such, and offer them high flexibility. Second, considering the task-oriented system and the orchestration system jointly suggests design options for both systems. Third, orchestration requires that teachers make design (scripting) decisions at different stages, both before and during the session.

Although this is far from an exhaustive typology, we have highlighted and illustrated a number of orchestration features that were implemented in a context-specific way but have a larger scope of application: facilitating teacher management of learner productions; focusing learner tasks; enabling grouping flexibility; offering different ways of supporting learners; offering means for managing heterogeneity; and offering means for managing technical issues. These features include conducting features (means to respect individual learning paces, offer different supports, facilitate teacher support for learners, facilitate teacher management of learner productions, manage heterogeneity, and manage technical issues) and scripting features (means to facilitate the grouping process, to allow group flexibility, to focus learners' tasks, and to support learners interactions in different ways).

The research agenda includes deepening these orchestration features, studying how to avoid overwhelming teachers with too many options or too much information, and empirically studying whether the proposed features allow them to satisfactorily orchestrate the session.

Whether the system allows teachers to adequately orchestrate the session may be regarded from different perspectives. One is the output in terms of learner collaboration and learning. The other is the teacher's perception of how the system allows him/her to set and manage the session. For instance, we mentioned that teachers proposed different ways of supporting/constraining learner interactions (allowing differences or imposing one group answer; asking for individual or group justifications; proposing a predefined justification sentence to be instantiated or no support). The outputs of these strategies in terms of learner collaboration and learning may be tested by empirical work. From an orchestration perspective, however, another interesting aspect is that teachers had different opinions on the strategy they would like to use, and reported that it would vary by learner and over time. Offering teachers the flexibility to decide (and to change decisions on the fly if/when needed) was perceived positively, whereas imposing an option could prevent adoption of the system. Studying these aspects is a critical issue for research on orchestration and, more generally, educational software design (Tchounikine, 2011).

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