Video-experiments: a possible apprenticeship of awareness

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Goals

This communication is aimed to report the preliminary results and pedagogical perspectives of a mixed strategy for improving the effectiveness of IBSE organic chemistry laboratory experiences (but not only laboratory skills) through the planning, making and playing of videos with students in the three year high school, specializing in chemistry.

Content

«How can I tell what I think till I see what I say?» (Forster, 2005)

Origins of the idea

The idea of using videos as a learning/teaching strategy came up to me while I was occupied in shooting videos of lab experiments for pure documentation purposes. I acknowledged the great efforts that student-actors had in communicating through a meaningful speech or argumentation (sometimes I experienced similar difficulties when I had to play a part). While there were some improvised-unwilling actors who seemed perfectly prone to understand the role and able to talk and act by the first shot, others, like me, seemed unable to think, speak, act and follow a script at the same time. I recognized that this wide range of aptitudes wasn't a problem of syntax, or language fluency, but of different "mental managing" (De La Garanderie, 1991) of the speech, of differences in nature and the speed for the language of reflection (inner language) and the language of external speech (Vygotsky, 1986), and maybe of an important role of auto-stimulation of one's own voice on associative and "conceptualizer" mechanisms of consciousness (Dennett, 1993).

This simple switch in my perspective was enough to change what could be viewed as a weakness of the quality of videos for external watchers, to an interesting practical route to meaningful learning and deep understanding (Tifi, 2010).

In December 2011, an inquiry-based experiment was planned and carried on by five high school grade cooperative groups to determine the partition constant of adipic acid in diethyl ether/water. This was part of a theoretical and practical learning objective about solvent extraction technique. The students were already familiar with concepts such as partition constant, dynamic equilibrium, polarity of substances and molecules, and they were used to the normal laboratory practice and related calculations, such as for acid-base titration, analytical weighing, etc. The experiment was carried on without any 'cook book' type recipe, using a plan derived in a collaborative setting. At the end of the experiment, good results were obtained by the groups. I exploited them to introduce a Dixon text, which showed the students their oddest result could be included in the average calculation, and that the obtained mean result was compatible with literature data. But, in a subsequent assessment occasion, by checking the students' ability to redo the calculations from experimental data, and asking for oral recounts of the whole or detailed rationale of the experiment, I bitterly disappointed to learn that *the students had not lived a true modifying, or inquiring experience*.

Doing the experimental hands-on activity, with students expected to calculate the same steps, write similar reports, find, criticize, compare and draw conceptually the meaning of the experimental outcome, to check students' understanding during the experiment, was not enough for most of the students to become sufficiently aware of the procedures and the related concepts.

The video play idea

It was clear that a different strategy was needed.

So I decided to redo the experiment with a renewed plan, aimed to make a video. This proved to be worthy and offering much promise. The screenplay was assigned to the five groups as

a table of scenes with actions and speech that were elaborated as Google-docs and a calculation spreadsheet, and these edited at school.
The play objective was presented to the students *not as a remedy to the failure of the previous experiment in terms of their learning*, but as an educational video to promote the specialization of chemistry of our institute to younger students, and also to make non-experts able to understand what happens to invisible molecules during solvent extraction.

I wasn't surprised when - during the reviewing phase - it became clear to everybody that the experiment should be changed. Instead of beginning with a water solution of adipic acid (that was a pre-condition in the first inquiry experiment) titrated before and after ether extraction, which would have made the substance invisible in each part of the video, the students decided to use visible, weighed-solid adipic acid and that also the extracted amount should also be made visible and weighed after solvent evaporation.
Collective reflection on how to make things understandable to others represented the true inquiring activity. This helped better representations of the phenomena and concepts, leading to better understanding.

This episode gave a true insight and deep understanding for all and showed this is possible in a inquiring context, but not necessarily in a straightforward sequence – of this kind: 1st assign the problem, 2nd assist and guide students with hints till they devise and understand how to obtain a possible procedural solution; 3rd apply the suggested solution.

Video interview
After the video (ITT Divini, 2012) was successfully made, and enjoyed by the students I decided to reveal that the true aim was to make them understanding better the practical and conceptual aspects of partition equilibrium. At the same time I gave them a series of questions to answer through a video interview. All students answered using a Google-Form to the questions and, as before, starting from the shared and reviewed answers, the students prepared their possible speeches for the answers in groups using Google-Docs. Their answers were reviewed at school. This editing step was a fundamental one: students couldn't simply read the answers, as the speech needed to be fluent and thus required several rehearsals. The students were simply unable to say something until it wasn't completely understood by means of silent reading and discussion with classmates, or teachers. Due to being a minds-on task, *this kind of text transformation activity had high impact in making students confident with the concepts and corresponding word-labels and "language games"* (Roth, 1996; Tifi, 2010; ITT Divini, 2012). Subsequent assessment sessions and references to the activity revealed firm conceptual and practical learning associated to the topic.

Other related activities
Other experiments involved screenplay-making in English during "Content and Language Integrated Learning" activities (CLIL) through which CLIL can be viewed as a further type of disciplinary language transformation, helping construction of meaning. As an example, a 4th grade, high school class video-synthesized the flavour "champignol" (oct-3-en-1-ol), by a Grignard addition. Groups of two or three students trained themselves to recite and act for each shoot. The scenes were based on a collaboratively made script that underwent adaptations in each trial stage. As an enthusiastic teacher I can report the same atmosphere described by Pavisic: «A good teacher has to be enthusiastic about his topic to generate an atmosphere that is open and positive. When students are treated well, respected, encouraged and the work has meaning, high levels of motivation will automatically develop» (Pavisic, 2011). But it should be noted that the time of production was abnormally expanded, while learning impact was weaker and engagement of students more

uneven in comparison to the previously described experience.

Other CLIL activities, screenplay representations of reaction mechanisms have been undertaken and a second interview about TNT (trinitro toluene) synthesis in 3rd grade high school class is planned for the first week of June.

Reflection

When students undertake an experiment for the first time they need the entire time to practice their process skills on different parts so as to make sense of a series of situated experiences that are very important to making oneself feeling "expert". But this is not the same as mastering the general cognitive insights of the inquiry experiment and the related conceptual frame. Experimental noise and working memory overload (Johnstone, 1997) is an aggravating circumstance that hangs over a general and unavoidable stance of 'apprentice' people tackling new situations. To ensure an inquiry orientation for the laboratory activity, it is important for a second round for actor-learners, where the minds-on activity is most relevant. But also, in this case, the inquiring experience is lived as an a-posteriori one. Guided inquiry-based experiences mean that the complete awareness of the problem, the comparable strategies and the solution may only be consciously rationalized, as a whole, *after* the experience is finished. Giving the students an opportunity to teach themselves, as described in this article, implies practice with, and rehearsal of key words, images, representations that form a detailed, holistic and indelible sense of the experience, and that cannot be yielded by a single inquirybased experiment (as I had pretended in the past).

Outlook

After the scholastic year is coming to its end, I can reflect and compare the educational strategy of the adipic acid experiment with other subsequent experiences and attempt to understand why the former was better and to formalize the approach so as to make it transferrable to other learning activities. First of all, I intend to try to transfer the idea to inquiry-based, *minds-on* activities (i.e. true lessons for younger students), that could be less time demanding yet equally effective.

All these efforts have been accompanied by a parallel PROFILES course and can be viewed as an attempt to put into practice PROFILES philosophy. The MoLE questionnaire, which was assigned to all students, will be a further source of improvement.

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