Applications

An online Biology course: a teaching-learning experiment

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Abstract

We have been experimenting with an online course in «teaching Biology» for students of the Primary Education Degree course[1] for about two years. This learning activity was created for students who work or live far from Milan and cannot regularly attend the University. Lessons are based on the participant's personal experience of the relationship with living organisms such as plants, animals, etc. This is the basis for the professional training of primary school teachers who will teach science-related subjects to children. Students who cannot attend lessons have to work very hard to carry out practical activities in Biology-related contents. During this Distance-Learning course they are helped to follow it and, finally, to produce materials that will be evaluated during the examination. Students can discuss their learning with peers, with teacher and with tutor using a forum cafè, and they have five thematic forums to carry out reflections, to ask for explanations, etc. These interactions constitute the real advantage of this type of teaching-learning mode, which encourages collaborative learning and the sharing of experiences and of acquired knowledge. The role of the teacher goes beyond the traditional view: first, it consists of planning activities; this is followed by monitoring interactions, in correcting Biology contents, in suggesting further studies, etc., while students are performing their tasks. The site is still in an experimental phase. At present, only a few students can participate, but three or four editions of the online course are provided during a year.

[1] A university degree to teach in kindergartens and primary schools.

1. Starting: Biology at school and at university

Teaching biology does not involve a mere transmission of a specific body of knowledge, but also an effort to help students to acquire an authentic relationship with living organisms (plants, animals or micro-organisms), not easily achieved in a classroom environment.

The classic face to face lecture followed by text reading can be effective, from a learning perspective, only when backed by direct experience in controlled environments, laboratories or in the field.

Personal experience and contact with living organisms promotes the desire to deepen specific aspects of the discipline and to acquire a more complete and lasting knowledge. The training of prospective teachers requires a great emphasis on laboratory research, outdoor analysis, museum visits, etc. in order to enable them to use the same active methodology with children.

Furthermore, Biology studies *processes* and not objects. A mere description of plants or animals structures is not enough: reproduction, physiology, synergic relation among parts, etc. are the most important aspects, and should be emphasized and carefully examined. In studying biology, we are required to recognize and follow «the stories of life»: observing living organisms means understanding how they are born, how they grow, communicate, reproduce and die. It also requires understanding how they are positioned inside an ecosystem, as well as within the history of the evolution of the species that embraces all of us.

2. Primary Education Degree course: Methodology for teaching Biology and a proposal for an online course

The course offers two modules in biology: Biology as a subject, and Methodology for the teaching of the subject. The latter aims at suggesting useful paths to students for their future careers as analysed from an educational perspective.

Teaching biology at university is carried out, when possible, by analysing live plants, animals, mushrooms, etc. It is based on lessons, discussions, indoor and outdoor laboratory experiences.

Some 50% of the students enrolled at the Primary Education Degree (the only Degree to train primary and pre-primary school teachers in Lombardy) is unable to attend lessons on a regular basis for different reasons: they teach, work, or live outside the Milan area. They face great difficulties in performing practical tasks and activities because they have never dealt with such issues. An experimental online course in «Teaching Biology» was set up and launched two years ago in order to overcome this obstacle. Such an online course aims at suggesting, monitoring and evaluating a «practical task» by using a «virtual medium», which might at first appear a paradox.

3. Website description

The online course in «Teaching Biology» uses a site activated on Ariel, a CTU[2] platform (Figure 1).

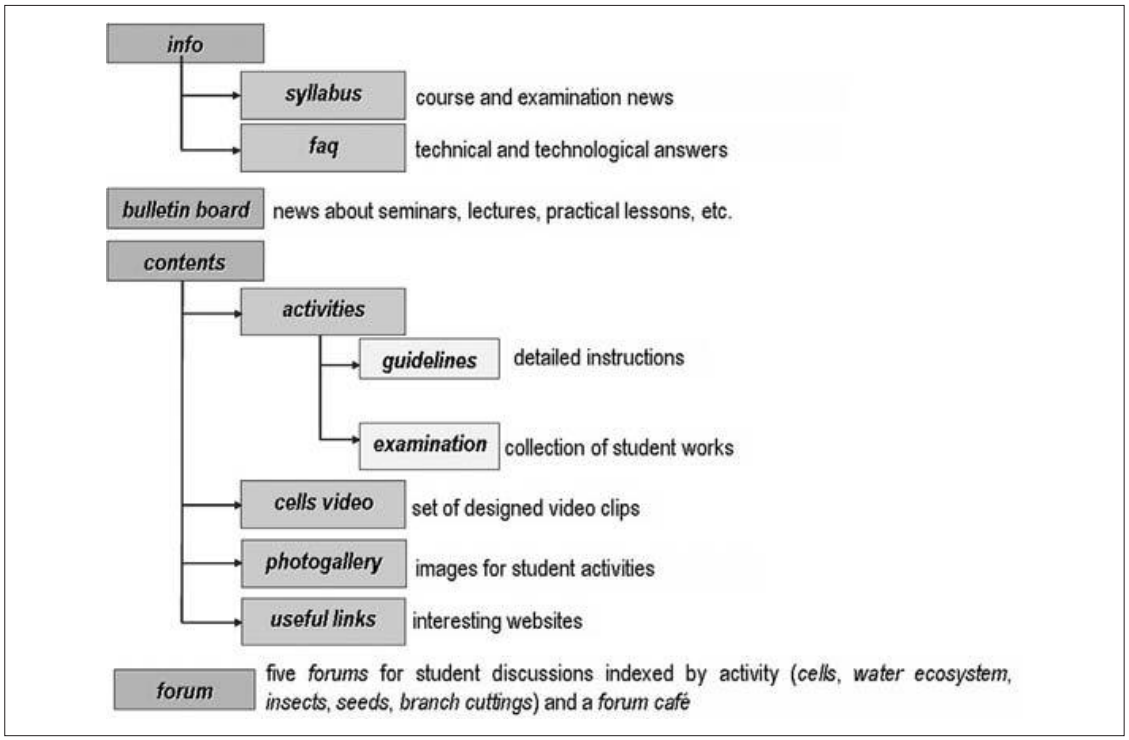

Figure 1 Structure of the online course in «Teaching Biology».

The site is still being experimented and accessible to external visitors as well. They can explore the site, see pictures and videos, read news on the bullettin board, etc. It is also a useful resource for students attending lessons regularly.

An information technology tutor, together with a FAQ section with a list of problems and solutions, are provided in the online course.

4. Organization of the online course

Before the course starts participants are required to perform – at home – some practical exercises to enhance their personal experience in the use of information and communication technology. Then they are required to share their individual thoughts on this discipline as well as to discuss them in the group. Students are offered five forums to interact with their teacher, tutor and classmates, to express

[2] Multimedia and distance technology centre of the University of Milan (http://ariel.ctu.unimi.it).

their thoughts and to ask for clarification of doubts which have arisen from the individual tasks.

The interactions developed within the online community represent a valuable addition which would be quite difficult to achieve in a university lecture theatre: they encourage co-operative learning and promote a positive and active disposition to share experience and acquired knowledge.

Five online activities (cells, water ecosystem, seeds, insects, branch cuttings) have been devised. We are considering a wider range of activities to offer students the opportunity to choose the path that best suits their interests and that better reflects the different meteorological and environmental conditions during an year.

Carefully designed protocols are provided to the students – including data gathering and the analytical activities – to guide them in their tasks. These are constantly improved and updated.

Specific instruments such as videos, photographic records, graphs and tables, final tests, etc have also been devised. Vegetal and animal living cells have been videotaped to enable the vision of their movements, feeding and reactions to stimuli. Such images have proved to be more realistic than those printed in textbooks. Students are required to create personal tables, descriptions, drawings, videos and photos comments, etc. for every activity. Their work is assessed by the teacher and discussed during the exam (Figure 2).

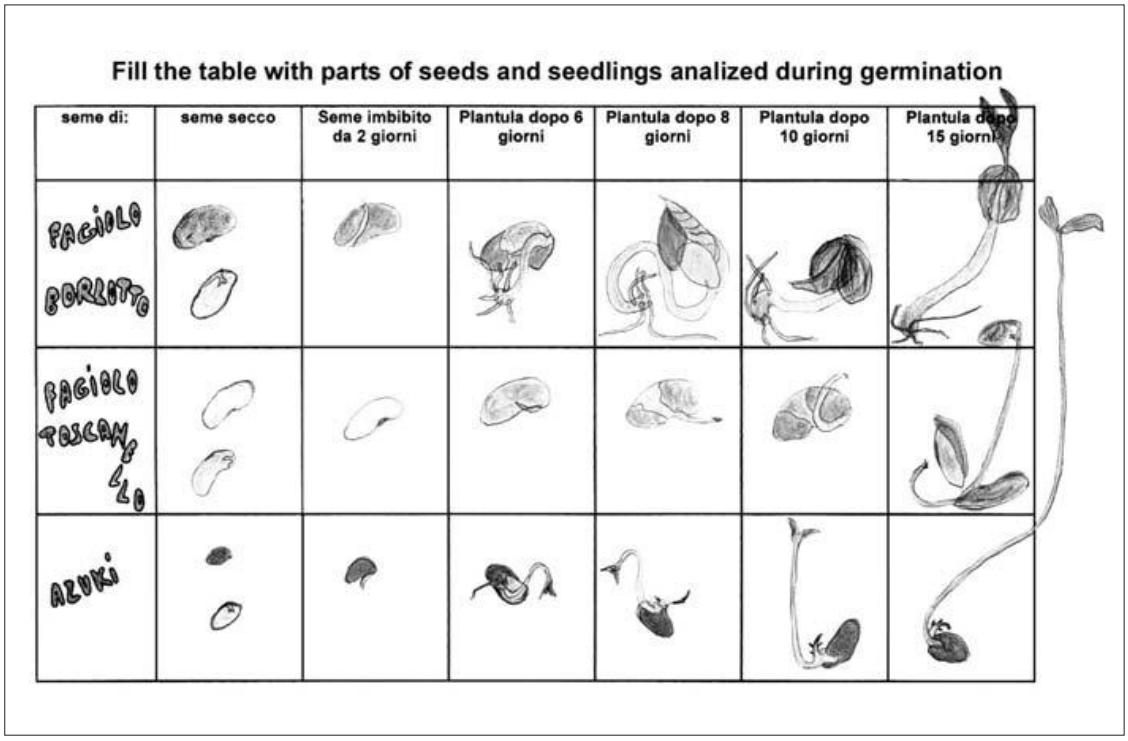

Figure 2 Students' activity production: table of seed germination (variability in different species of plants).

The final evaluation takes into account what knowledge has been acquired, but also the practical work and specific communication competence. The activities have been carefully thought out and devised also to stimulate this kind of competence. Moreover, great emphasis is given to active participation in the discussion forums.

5. Analysis of the messages exchanged in the discussion forums

Communication has been initially evaluated on a quantitative basis calculating the total number of messages sent by each student and by the entire community in every forum (among peers, among students and tutor, among teacher and students, etc.).

A qualitative evaluation aiming at a more articulate picture of the interactions and their cognitive value was realized lateron (Figure 3).

	Message tipology				
sudent	*generic, unrelated to topic*	*showing personal reasoning*	*standard, book-learned*	*containing incorrect answers*	*starting new topic threads*
A	seeds: 1 cuttings: 4 cells: 2	cuttings: 1	seeds: 3 cells: 1	cells: 2	seeds: 2
B	seeds: 2	seeds: 4 cuttings: 1	seeds: 3	—	seeds: 2 cuttings: 4
C	seeds: 2 cuttings: 7 cells: 2	seeds: 2	seeds: 3	seeds: 2 cuttings: 1 cells: 3	seeds: 1
D	seeds: 1 cuttings: 5 cells: 1	seeds: 2	seeds: 2	cuttings: 1	seeds: 1
E	seeds: 2 cuttings: 7 cells: 3	seeds: 4 cuttings: 2	seeds: 4 cuttings: 2	seeds: 1 cells: 1	—

Figure 3 Messages gathered from the different activities (cells, seeds, branch cuttings). Third edition of the online course in «Teaching Biology».

6. The role of teacher, tutor and external observers

The role of the teacher in the online course is very different from that of the teacher in a university lecture. Initially, it consists of the implementation of contents and communication in the activities proposal. The teacher intervenes

at the later stage in order to correct disciplinary errors, to raise awareness in the themes and issues, to suggest further research, etc.

The tutor cooperates with the teacher in organizing the activities and in preparing materials. He moderates the discussions in the forums by helping students not to lose the track, by encouraging them to exchange data and to compare results so as to meet the deadlines, etc.

The course has a web communication and a media expert. They co-operate in the analysis and evaluation of the students' interactions and course organization.

7. The online experimentation course compared with university lectures

A comparison between these two different educational models constitutes an approach to a complete evaluation of the proposed experiment.

The university lecture has an initial stage where the teacher starts with testing what students already know, their attitudes and their expectations on similar topics often by means of a collective discussion. This stage is currently not offered by the online course, but could be introduced in the future.

The university lecture requires a number of practical activities. Students have to perform them by themselves in order to improve their observation skills, their ability to notice transformations and changes, and to properly think about these issues. During this stage of individual work, students are occasionally helped by the teacher for a few minutes, generally only at the beginning or at the end of the lectures. During the online course, on the contrary, the teacher can constantly monitor each student's work (*e.g.* messages exchanged in the forums) and supervise it as well. The interaction between teacher and students is very limited in university lectures: there is only one teacher to 60-80 students. In each edition, the online course has one teacher for 15 students.

The existence of a virtual place where students can exchange materials, opinions, doubts and problem-solving activities is a useful resource not available in university lectures. Students attending university lectures often perform their tasks either by themselves or in pairs. In the online course, on the contrary, every participant is given the opportunity to communicate with others and to exchange his experiences with the entire group, constituting a real *learning community* which aims at realizing a resourceful cooperation on a practical and cognitive task.

The possibility of monitoring students' tasks in the discussion forums enables the teacher to stimulate quite a production of messages and materials. Students are thus trained in content, correctness, and the efficacy of communication.

The possibility to store and document together with all the exchanges, promotes the users' metacognitive processes and enables students to examine, reconsider and retrieve them. Moreover, the written communication emphasizes the emergence

of emotions, the role of which is considered ever more relevant in the learning process. The forum interactions highlight the most rewarding aspects of scientific experiences: the satisfaction of discovery, the uncertainty about how to proceed, the curiosity but also the fatigue of data collection and organization. Such interactions enable prospective teachers to understand and consider the relation between the emotional and the cognitive development path.

8. Problems and perspectives

The selected software platform is not as flexible as it could be, with respect to the managerial and technological aspects of the course but, on the other hand, it is free and ready for use today.

The problems consist in the speed at which the online material is available to the students and the management of the same material. Text files, for instance, cannot be opened directly and have to be downloaded on the computer first, which considerably slows their fruition. Images and videos cannot be downloaded on personal computers making their vision and critical analysis time-consuming and, consequently, it fails to promote their use.

The forum organization structure does not allow for a global vision of all the threads in the discussion: every page contains the source messages but not the replies. The latter can only be seen by performing an additional operation. We would prefer to organize all messages into a tree structure, thus improving the inspection of the relations between different contributions and facilitating the analysis of the interactions between all participants.

The long-term storage of all messages is another issue that needs a solution. The current analysis has been carried out with very few messages because the forum exchanges from previous years have been erased by the platform operators.

This important loss proves that the documentation of online activities is not yet considered relevant for an evaluation of the technological and educational aspects of distance-learning projects. One is tempted to conclude that this sector is not yet mature, since it is unable to exploit one of its strengths, namely the possibility to re-use any of the data that has passed through the website for any educational conceivable purpose. The exchanged messages during this experimental phase represent data to be studied, elaborated and compared, with a view to improving the future editions of the course.

The opportunity of interacting with their peers and teacher together with the feeling of being part of a group working towards the same goals have reassured students and made them more responsible in their activities, even though communication has occasionally been weaker than desired. This difficulty does not seem to have been solved for the time being, notwithstanding the tutor's commitment, the role of whom is currently undergoing further investigation.

Besides the above suggestions, we believe that future editions should also involve other professional figures such as primary teachers. They are experts in all aspects involved in their job and have the necessary competence to analyse the educational aims of the project.

9. Conclusion

Considering the pedagogical and educational aspects of this course the results obtained so far are satisfactory. One of the parameters used in our evaluation was the number of participants per academic year: more than 90% of the students not attending lectures has chosen the online course.

The proposal has been positively accepted and has enabled students to develop their activities and to pass the exam successfully (45% obtained a mark higher than 25 in a scale from 0 to 30, with 18 as the pass mark).

The online course does not only offer students living outside Milan the opportunity to carry out the same activities performed by students attending the university lectures: it also provides a more efficient teaching methodology for the following reasons:

– students' personal tasks and group tasks can be easily analysed and monitored by the teachers;
– the emerging competence involves increased familiarity with practical and experimental tasks, enhanced knowledge of Biology, and refined communication skills in order to be able to discuss Biology in an effective way over the net;
– students learn to perform their task in a very cooperative way and use discussion with their peers as a learning modality.

These results are very important for the professional development of students who will in the future be teachers in primary schools.

The students' enthusiasm for such a proposal and the hope to provide courses for working-students suggest that we should continue in this direction. We hope to fill a void in the educational offer and to get students in Primary Education used to this new educational modality, by encouraging them to keep the habit of discussing the educational task, to feel part of a community, to take advantage of information technology as a useful support for their teaching activity.

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