



#### VIEW POINT

## Didactic of scientific disciplines in school: a possible role for LaguNet

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### View Point

The Italian Constitution ratifies (Art. 9) the promotion of the culture and the research in scientific and technological fields as an instrument to reach the “full development of the human person and the real contribution of the citizen to the political, economic and social organization of the Country” (Art. 3, par. 2). To reach this purpose, in Italian primary and secondary schools the obligatory scholar formative plans should be strongly enriched including strengthened scientific and technological didactic programs, which could be able to improve both logic and knowledge favouring logical-mathematical approaches and experimental practices of scientific disciplines (i.e. biology, chemistry, physics). In fact, typical theoretical didactic curricula followed by teachers in primary and secondary schools are not sufficient to mature in students the scientific competences, well-sized on the experimental method on which all scientific disciplines are based. In particular, interdisciplinary approaches able to develop strong connections among scientific disciplines as mathematics, informatics, physics, biology, chemistry, are strongly disregarded. Technological and informatics facilities are useful to propose in an appealing graphical form scientific disciplines and to improve dialog among teaching groups and young students, which

could quickly learn throughout the use of familiar instrument as computers are. Many European countries have made significant investments for implementing the use of Information and Communication Technologies (ICT) to encourage the integration of ICT into the curricula (Eurydice, 2011). In spite of that, their diffuse application in didactics represents an exception rather than a common practice due to problems related to temporal limits to develop alternative didactics, to the lack of economic resources and to teachers’ personal aptitudes in the use of technological instruments and software. As principal consequence, a great part of Italian students evidence low interest towards scientific disciplines, which are proposed throughout a not appealing language showing, also, a clear lacking of ability in producing original and personal elaborations or logic/creative connections among knowledge acquired separately studying throughout classical didactic methods the different scientific disciplines.

To overcome this gap, an effective approach could be represented by the direct and active participation of students to scientific experiments. Through the direct observation and repeated laboratory experiences, students can interpret relationships that underlie and determine phenomena themselves, improving their knowledge, first of all, empirically.

Finally, on the basis of experimental data obtained, students can theorize concepts and verifying relationships on the basis of which observed phenomena are occurred. A direct participation to experimental activities is particularly useful to develop in students a critical approach towards problem solving procedures, which allow them to improve their knowledge and the use of logic deductions developing interest towards scientific disciplines.

Furthermore, the implementation of experiences performed, enhancing the contact with the natural environment, could favour the cultural growth of students throughout emphatic, emotional and affective reactions towards nature itself also improving concentration, attention and self-control and reducing stress and aggressive behaviour with notable positive effects on the learning process and the memory of the knowledge acquired.

A not secondary aspect to consider is represented by the need of develop specific and well-sized curricula for students with special educational needs finalized to integrate, develop and enhance their knowledge. At this regard, working with computer-based tools such as simulations can be considered as a useful support to enhance students' learning (Tao and Gunstone, 1999, Singh and Haileselassie, 2010). These students have to be supervised with great attention in primary and secondary schools in order to avoid both the risk of isolation from the class group and the lack of interest towards the school itself. In Italy, efforts acted to integrate in obligatory scholastic courses students affected by intellectual and physical handicaps represent a notably success. On the contrary, the incentive of excellences is jet severely neglected despite it is clearly ratified by the Italian Constitution and it is, also, detailed in a recent decree (D. Lgs. n. 262 of December 29th 2007, *Dispositions to stimulate the excellence of the students*

*in scholastic curricula*). Excellences would be selected throughout the participation to specific programs, would be certified by scientific authorities (University, Academies, professional organizations), and would be encouraged with the recognition of their scholastic results (i.e. certifications and/or credits, economic incentives).

The development of alternative *curricula* could represent an important strategy in primary and secondary Italian schools to overcome the exposed problems. Ecology is an interdisciplinary discipline, which represents the knowledge field in which mathematical, physical, statistical, biological, chemical and logical competences could be strongly tied together through well-sized experimental approaches developed within a natural context. Ecology is the science of interactions (or of the interfaces), which has a main focus on the study of the relationships that living organisms establish reciprocally and with the natural environment they are living within. Topics of interest include evolution, biodiversity and effects induced by natural resources exploitation and human-mediated pressures at different hierarchical scale-levels. Performing experiments on ecology themes needs the application of different competences by students in different fields of theoretical and applied science.

In this context, national scientific associations (SIte, Italian Society of Ecology and LaguNet, Italian Network for Lagoon Research), international ones (EuroMedLag, EuroMediterranean Federation on Coastal Lagoon) and scientific European networks on biodiversity (i.e. LifeWatch), working in ecology fields, could significantly contribute to the development of high-quality experimental activities and programs in primary and secondary schools offering their know-how and different facilities to students and teachers.

In today's societies, Ecology is of great interest in many scientific and non-

scientific areas, but is dealt in secondary schools in Italy only marginally. Now a national initiative, *EcoLogicaCup* ([www.ecologicacup.unisalento.it](http://www.ecologicacup.unisalento.it)), is providing an example of an innovative tool to support the teaching of Natural Sciences and Ecology in schools. *EcoLogicaCup* is promoted by the *Observatory on Ecology and Health of Mediterranean Ecosystems* of the University of Salento with the support of the Italian Ministry of School, Research and University. It is aimed at stimulating the interest of young people, secondary school students, in Natural Sciences and the ecosystems that provide our society with goods and services through a web-platform where training courses on ecology are developed and a national final competition is organized. Furthermore, from 2009 till 2012, LaguNet was involved in experimental pilot activities performed in eleven secondary schools, funded by the Province of Grosseto and supported by the University of Siena, which were aimed to develop excellence training experimental activities. Research experiences were sized to introduce students to the study of different actual ecological themes getting them to narrow contact with the research world and developing laboratory and in field experiments. Activities were developed to allow to school students to present their original results to national scientific congresses and workshops (i.e. SItE, LaguNet). Results obtained by these pilot experiences have encouraged teachers and researchers to develop other similar activities and, in 2012, *EcoLogicaCup* has been extended to secondary schools of second degree. Another interesting European project is “*Research Game*” which aims both to motivate and improve knowledge of secondary school students by replicating the excitement of scientific research. The project started in 2013 and will create an Internet-based game to develop an understanding of research work and to teach best practices.

The goal of the *Research Game* is to develop a new teaching approach and pedagogical strategy for learning a methodology useful in the scientific research; it will favour the development of critical skills that future employees will need to follow in an increasingly technological and scientific based workplace. The aims of the project are to excite young students in the research and enhance their ability to realize creative thinking, to support European teachers to use these proposed innovative approaches, to support the development of innovative ICT-based content, services, pedagogies and practices for lifelong learning, to understand the importance of informatics and English language in science. Another interesting experience is represented by the project *Hydropsyche* developed by the University of Salento. It aims at a reinforcement of the concept of natural heritage value, with respect to transitional waters, and at a dissemination of scientific achievement using typical Lecce pottery handicraft as the approach to reach the aims of the project. A local artisan works with the project group and the school teachers to realise terracotta whistles, typical of the area, as perfect representations of benthic invertebrates and phytoplankton taxa characteristics of the protected aquatic areas studied. The project supplies information on their ecological relevance in the ecosystems, behaviour and functional role while the teacher integrate the activity in the program of zoology and ecology, describing in detail the morphology of the taxa linked with their behaviour and ecological functions. Finally, students apply the acquired knowledge on morphology, phylogeny and ecology to realize perfect copies of animals and plankton cells with terra cotta.

In conclusion, didactical activities in Italian primary and secondary schools need to be significantly improved concerning scientific disciplines in particular enhancing

experimental and interdisciplinary approaches including mathematical, chemical, biological and technological fields of knowledge. Ecology could represent the scientific discipline, which best synthesizes teaching needs and both societal and students' interests. Furthermore, results from pilot experiences performed by some Italian universities and scientific associations encourage to develop new activities for schools. The possibility to find economical resources to develop these fields both on national and European basis could encourage also scientific associations and universities to develop these kinds of projects.

### References

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