Sailing for Science: on board experiences for transferring knowledge on Historical Oceanography for Future Innovation

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Oceanography: a young branch of science with an interesting history!

Smart, Sustainable and inclusive **Blue Growth** means also knowing **past science** and **technology** and the paths followed by ancients in order to understand and monitor marine environments.

In general, history of Science is a matter that is not enough explored and explained or promoted in high schools or university official programmes, and, usually, scientist do not consider it as an important part of their curricula.
However, bad or good ideas, abandoned or forgotten beliefs, concepts, opinions, do still have a **great potential** for inspiring present and future scientists, no matter in which historical period they may have been formulated: history of Science - *and especially for such a young branch of science like Oceanography* - should be transmitted in a more practical way, with hands-on labs showing the **limits** and **challenges** that former generations of ocean explorers, investigators and seafarers had to face in order to answer to crucial questions as self-orientation in open sea (**Fig.1**), understanding main currents and waves (**Fig.2**), predicting meteorological conditions for a safe navigation.

Fig. 1 Captain Nemo taking the altitude of the sun. Wood engraving after a drawing by Alphonse de Neuville from an 1870 edition of Jules Verne's 'Twenty Thousand Leagues Under the Sea.'

The Historical Oceanography Society and its Cultural Heritage.

Modern methods and sources reveal things about the reception and reworking of older scientific ideas, hence all of these stories, as well as many others, deserve to be rediscovered and recounted also for future innovations.

It is what it intends to do the Historical Oceanography Society (HOS) in La Spezia, that cares about the knowledge, preservation and dissemination of texts, maps and ancient oceanographic documents.

To this end this society has formed an important bibliographic fund in which it include some **200 volumes**, **prints** and **maps** ranging from the greek-Roman times to the great nineteenth-century scientific expeditions. The collection is based in **Portovenere** (**La Spezia**) and is planning the digitization of texts, in order to create an historical archive available on the Web.
Another mission of HOS, jointly with INGV, is the preservation of rare, ancient and recent oceanographic instruments, some of them of great historical value, such as currentmeters, Secchi disk, telescopes, timepieces, astronomical instruments.

Fig. 2 Title page of "Histoire Physique de la mer. Ouvrage enrichi de figures dessinées d'après le nature" published in Amsterdam in 1725. Prior to the Histoire Physique de la Mer, no book existed that dealt solely with the sea from the scientific standpoint.

Sailing with a multidisciplinary team for a 'deep dive' in history.

From 11 to 18 October 2016 a group of **23 University students** (**Fig. 4**) participated in a pilot project aimed to teach historical Oceanography aboard "**Amerigo Vespucci**": the **oldest ship** in commission in the Italian Navy.
The pilot project has been organized by Istituto Nazionale di Geofisica e Vulcanologia (INGV) with a **multidisciplinary** team of researchers (oceanographes, geophisicians, biologists, astronomers, collectors, lecturers, historians of art, librarians), teachers and university professors coming from the Italian Navy, the Historical Oceanography Society (HOS), the Ligurian Cluster of Marine Technologies (DLTM) and its International School for Marine Technologies (ISTM), the Hydrographic Institute of the Italian Navy (IIM), the private company Monitoraggio Ambientale e Ricerca Innovativa Strategica (MARIS), the Naval Experimentation and Support Centre of the Italian Navy (CSSN) and the NATO Centre for Maritime Research and Experimentation (CMRE).

Instruments and **books** coming from HOS, the Naval Technical Museum of La Spezia and other private collections have been the basis and the core of this pilot ceanographic course.

The Pilot Project.

In a very dense week, **three** main threads marked the program course **(Fig. 6)**:
1. theoretical seminars and lectures;
2. guided tours;
3. live experimentation with oceanographic instruments.
Students were able to immerse themselves in the subject and understand its origins, through:
- technical visits to Museums (such as the Naval Technical Museum of la Spezia), Research Centres (CSSN, NATO STO CMRE) and Private Enterprises (such as the Shipment and Logistic Operator Contship Italia Group);
- lectures on the history of oceanography;
- hands-on labs with ancient and modern measuring instruments;
- study of historical books, nautical maps and charts;
- cinema club (in the evening) with screening of films and documentaries, related to the themes studied during the day (such as: "**The Red Tent**" - the film 1969 directed by Mikhail Kalatozov on the unfortunate crash of the Airship Italia in the North Pole).

Moreover, all students had to participate to life onboard and carry out all the managing activities while extending their basic knowledge of navigation and life at sea, included other training activities carried out by the Amerigo Vespucci's officers (like the use of the sextant to fix the ship's position).

The School Ship "Amerigo Vespucci".

In the mid 20's of the 20th century, the Italian Navy tackled the problem of the **ships modernization** for the **training** of the **Naval Academy Cadets**. It was considered that the best impact with the marine environment was to **live aboard a sail ship**, which requires the **widest knowledge** of the natural elements.

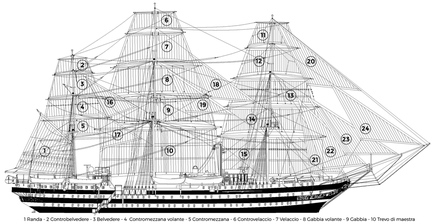
Launched in 1931, "Amerigo Vespucci" is a **sailing ship** with auxiliary power plant.
The ship's **waterline length** is **70 metres** and the maximum length at bowsprit is 101.

The hull is of the three main decks type (deck, battery and tween decks) with quarter-deck and poop deck which are two superstructures rising on the main deck.
The hull's full breadth is about 15 metres, but it can reach 21 metres if we include the volume of the boats overhanging from the ship's side and 28 metres between the extremities of the highest yard of the main mast. The maximum draught is 7.30 metres.

Some parts of the ship are in wood: teak for the main deck and steering compartment; mahogany, teak and holy wood for the nautical fittings; oak, mahogany and walnut for the interior furnishing.

For what concerns the sail rigging, "Amerigo Vespucci" is a square-rigged ship, with three masts, firesail, main and mizzen (all equipped with yards and square sails) plus the bowsprit and the fourth mast. The ship has also fore-and-aft sails, jibs on the bowsprit, stays between the masts and the spanker (**Fig. 3**).

The **permanent crew** consists of **264 people**. The ship carries out **training cruises every year** (*mainly for the Naval Academy Cadets, but also for the Students of the Military Naval School "Francesco Morosini", Helmsmen as well as youth members of Sailing Associations such as the Italian Naval League and the Italian Sail Training Association)* but also for other activities (i.e. marine environments monitoring campaigns etc. or our Pilot project on Historical Oceanography) in collaborations with other Research Centres and NGOs such as WWF, UNICEF and Mare Vivo.



1 Randa · 2 Controbelvedere · 3 Belvedere · 4 Contromezzana volante · 5 Contromezzana · 6 Controvelaccio · 7 Velaccio · 8 Cabbia volante · 9 Gabbia · 10 Trevo di maestra
11 Controvelaccio · 12 Velaccino · 13 Pennochetto volante · 14 Pennochetto flaio · 15 Trevo di trinchetto · 16 Strallo di belvedere · 17 Strallo di contromezzana · 18 Strallo di velaccio
19 Strallo di gabbia · 20 Augelletto · 21 Trinchettina · 22 Cranfiocco · 23 Flocco · 24 Controflocco

Fig. 3 "Amerigo Vespucci"'s 24 canvas sails names (**total surface** is about **2800 square metres**) and its traditional hemp-rope rigging.
Under full sails, the ship can reach considerable speeds, at least in relation to her weight: the **record** is **14.6 knots**.

The handling of the sails is carried out by means of **cables**, of different diameters, for a **total length** of about **20 km**. © *Image courtesy of Italian Navy.*

Fig. 4 The 23 students that participated to the one week Pilot project on board sailing ship "Amerigo Vespucci". Aged from 19 to 33, they came from **6** different faculties (Biology, Environmental Sciences, Naval Architecture, Geology, Natural Sciences, Nautical and Aeronautical Sciences) of **4** universities (University of Liege - Belgium; University of Torino - Italy; University of Pisa - Italy;Università of Naples Parthenope).

The first results of the Pilot Project.

Fig. 5 Hands-on labs with a Niskin bottle (a) and a sextant (b).

	9:00-10:00	10:00 -11:30	11:00-12:00	12:00-13:00
Tuesday 11 October	BOARDING AND BRIEFING Presentation of the course		15:00-18:00 Logistics and general informations	
Wednesday 12 October	Visit Naval Technical Museum in La Spezia		HOS Presentation	HOS Presentation
Thursday 13 October	Visit NATO CMRE	Visit NATO CMRE	Visit Naval Technical Museum in La Spezia	Visit Naval Technical Museum in La Spezia
Friday 14 October	Film/Documentary		Visit CSSN	Visit at Cassino
Tuesday 11 October				
Wednesday 12 October	Boating Astronomy	Boating Astronomy	Visit Planetarium of the High School Capellini-Saura	Visit Planetarium of the High School Capellini-Saura
Thursday 13 October	XBT	XBT	Historical Oceanographical instrumentation	Historical Oceanographical instrumentation
Friday 14 October	Film/Documentary	Film/Documentary	Film/Documentary	Film/Documentary
Saturday 15 October	Operative Oceanography	Operative Oceanography	Operative Oceanography	Operative Oceanography
Sunday 16 October	Underwater Physiology	Underwater Physiology	Underwater Physiology	Underwater Physiology
Monday 17 October	Using the sextant (Bernagiere Ship)	Using the sextant (Bernagiere Ship)	Using the sextant (Bernagiere Ship)	Using the sextant (Bernagiere Ship)
Tuesday 18 October	Air Force Presentation	Final test and customer satisfaction survey	Final test and customer satisfaction survey	Delivery certificates of attendance

Fig. 5 Overall Programm of the course: 7 theoretical modules, 4 Technical visits, 4 hands-on labs.

The overall experience has been considered very positive (**Fig.7** and **Fig. 8**).

Students have been tested at the end of the course in order to evaluate general understandig of each one of the modules.
Comments left by students showed a high degree of satisfaction with the teaching staff and the organization of the course. The multidisciplinary offer and life aboard a school ship won the interest of students.

On one hand, from the organizational point of view the possibility to use the "Amerigo Vespucci" ship indeed gave greater prestige, but on the other hand the complexity of programming such an event of this magnitude with poor economic resources has been a real challenge.

The close cooperation between the Organization (INGV) the Navy, has made possible to meet the incoming problems, solving them quickly and effectively.

For participants, the added value of the project was the opportunity to stay aboard and live close to the Navy staff.

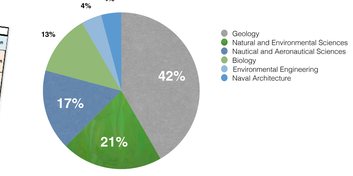


Fig. 7 Provenance faculties of the 23 students participating to the Pilot Project.

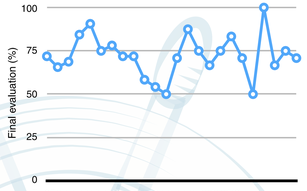


Fig. 8 Final evaluation for all 23 students. The main average has been 72%.

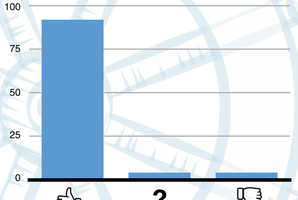


Fig. 9 Customer satisfaction survey result: "*Would you suggest this course to other Students and/or Colleagues?*"

Suggested readings

[1] M. Locritani, I. Batzu, C. Carmisciano, F. Muccini, R. Talamoni, H.L. Tassa, M. Stroobant, G. Guccinelli, L. Benvenuti, M. Abbate, S. Furia, A. Benedetti, M.I. Bernardini, R. Centi, L. Casale, C. Vannucci, F. Giacomazzi, C. Marini, D. Tosi, S. Merlino, E. Mioni, F. Nacini, Feeling the pulse of public perception of science: Does research make our hearts beat faster?, in: MTS/IEEE OCEANS 2015 - Genova: Discovering Sustainable Ocean Energy for a New World, 2015.
[2] National Science Foundation, 50 Years of Ocean Discovery: National Science Foundation 1950-2000. Ocean Studies Board, National Research Council ISBN: 0-309-51744-3, 276 pages, 8.5 x 11, 2000.
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