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STEM analysis of a module on Artificial Intelligence for high school students designed within the I SEE Erasmus+ Project

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The I SEE ERASMUS+ Project

The EU ERASMUS+ project I SEE (inclusive STEM Education to enhance the capacity to aspire and imagine future careers) stems from the awareness that one of the main challenges for mankind today, above all for the young, is to recover a good relationship with time, merely with the future. We live in a multi-speed society in which the capacity to predict sudden changes are decreasing and this causes a compulsive search for opportunities. The educational system is not able to keep up with social acceleration. This project bet on STEM education as a breeding ground for preparing young people for uncertainty and making them developing future scaffolding skills, i.e. skills that enhance their capacity to aspire, envisage themselves as agents of change, and push their imagination towards future careers in STEM (Branchetti, Cutler, Laherto, Levrini, Palmgren, Tasquier & Wilson, 2018). STEM education can give two main contributions in this direction, one epistemological and the other technical. From the epistemological point of view, the issue of uncertainty related to future predictions is intrinsic to science: the perspective of complexity values uncertainty and probability as sources of a non-deterministic and non-linear paradigm which opens horizons of possibilities, instead of a unique inescapable path and ground the discourses about possibilities on a rational basis. On the technical side, STEM disciplines investigate potentialities, limits and applications of innovations in the present, hypothesizing their possible impact on the future; this enlarges students' and teachers' imagination towards future challenges and careers.

The structure of I SEE modules and the case of Artificial Intelligence

Among the results of the first two years of research within the project, there are concrete teaching/learning modules for high-school, already tested in real contexts with 18-19 years old students. Although the issues addressed are very different (e.g. climate change, artificial intelligence, quantum computing), all the modules have a common structure in which the students are encouraged to: i) encounter the focal issue; ii) engage with the interaction between scientific ideas and future; iii) synthesise the ideas and put them into practice (Branchetti et al., 2018). The design and implementation of the Italian module about Artificial Intelligence (AI) were carried out by a team of researchers in Mathematics, Physics and Informatics education, together with high school teachers and experts in engineering, applied physics, epistemology of science and complex systems. The students encounter the focal issue thanks to a group activity, about AI applications in many fields, and two seminars, about: i. the relationship between AI and complexity science; ii. the history of AI. In the second phase, they are showed different approaches to AI (imperative,

logical/declarative, machine learning) applied to the Tic-Tac-Toe game; then, they are introduced to applications of AI in STEM research and to the future-relevant concepts of complexity (system, feedback, projection, scenario, non-linearity, agent/model-based simulations). In the last phase, students are involved in group activities about the imagination of a future ideal city, more or less influenced by AI, and are asked to design actions to do in the present with an eye to desirable futures, thinking about future careers, also in the STEM fields.

STEM analysis of the I SEE module on AI: Integration and “Big Ideas”

Since the project aims to propose guidelines and examples of inclusive and future-oriented STEM education, we wondered what aspects of our research could be relevant for contributing to the emerging debate about how STEM education should be conceived and concretely realised. As framework we chose the STEM “big ideas”, defined as key ideas that link various discipline understandings into coherent wholes, mediating the construction of in-depth knowledge (Chalmers, Carter, Cooper & Nason, 2017). We analysed our module separating its S-T-E-M components, discussing their integration and searching for different kinds of big ideas underlying it (encompassing, cross-disciplines, and within-disciplines big ideas).

The STEM disciplines are all included and structurally integrated within the module, since the topic allows to show the dialectic relationship between the technology/engineering and pure scientific/mathematical issues. Mathematics is relevant, not only in terms of concept and methods technically necessary, but also of thinking tools and skills. As content encompassing big ideas, we recognised AI and Future. As conceptual encompassing big ideas, we identified paradigms like linearity/complexity or practices like problem posing and solving. The cross-discipline big ideas we used are the concepts like algorithm, which are transversal to the STEM domains. There also within-disciplines big ideas that have an application in the other disciplines, like cost function, which is a mathematical optimization concept relevant to other STEM disciplines.

Results and conclusions

The main results of our analysis are three: a) the lens of the “big ideas” is effective to flesh out the connections among the S-T-E-M disciplines within our module on AI; b) the analytic separation of the contributions of the different disciplines and the search for their integration allows to emphasise the specificity of each of them; c) our module can be considered an example of a meaningful integration between disciplines, with STEM “big ideas” connecting them.

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