

Bring Computer Science Competences into Italian Secondary Schools

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Abstract

Many educational systems adopt the competence-based approach, with the aim of enabling a more effective learning process. As a consequence, many definitions have been conceived, at different levels and in different countries, both of general competences for common citizens, and of specific competences, related to individual disciplines, as computer science and others. But the practical application of the competence-based approach is not widespread among the Italian teachers. A first case-study is proposed here, in which the informatics secondary teachers are involved to construct a set of teaching tools, according to the competence approach.

Keywords

Computer science education, informatics education, secondary schools, education by competence

INTRODUCTION

The competence-based approach is occupying a wider and wider space in the field of education, in different areas and at various levels. Initially developed by the professional and vocational sectors, this learning and teaching approach has been acquired by international institutions. Its relevant evolution produced the definition of a standard level in the general competences, standard required to the citizens of the knowledge society. For the educational systems, it is important also the definition of specific competences, characterising the individual disciplines. But, whereas the described trend is steering towards a more precise definition of the expected competences for the learners, sometimes the teachers struggle to interpret this change and adopt a competence-based approach, requested to all the actors of the system. In the following sections we describe a research, which main goal is to support the teachers in adopting a competence-based approach. The “Discussion“ and the “Specific competences” sections give several references on competences. The section “Adopting Computer science competences in Italy” focuses on the teaching of Informatics in the Italian secondary technical schools and introduces the area of interest of our research, further illustrated in the following section, “A preliminary analysis”. Finally, “A case-study with computer science teachers” gives more details on the ongoing research. A conclusion closes the paper.

DISCUSSION

The many pedagogical theories have been grouped into four different learning schools by Anderson (Anderson, 2000): the behaviourism, the cognitivism, the constructivism and the connectivism. Before the latter and most recent had been defined, the constructivism has been widely developed, generating various related approaches, methods, theories, and definitions. The competence-based approach flourished in this stream of ideas and concepts. According to this approach, learning is a personal evolution along one or more of the four dimensions of the competence: cognitive, functional, social or meta-competence (Le Deist, Winterton, 2005). The relevance of

the competence approach has been acquired by the international institutions, with the effect of further attracting the attention of the educational bodies. The definition of the eight key competences for European citizens, contained in the Recommendation of the European Parliament and of the Council (2006), started to promote a wide range of initiatives, often driven by the Ministries of Education of the member states. The key competences, also called general competences, have been coherently adopted as a base to redefine the curricula for K-10 school grades that is for the mandatory level of education. Besides the definition of the general competences, requested to all the European citizens, similar solutions have been attempted also for the single disciplines of study, which are interesting mainly for learners and teachers, at different levels and sectors of schools. Apart the renewing or integration of the member states curricula, international initiatives have been started with the aim of defining subject-specific competences.

Specific competences

The Tuning project (2014) copes with the specific competences for various disciplines of tertiary education. The effective methods adopted to develop the activity and the good results achieved by this European project, contributed to export this kind of initiative into the rest of the world. Nowadays we can count important extra-European projects, named Tuning Latin- America (<http://www.tuningal.org/>), United States of America (<http://degreeprofile.org/>), China (<http://tuningchina.org/>), Russia (<http://www.tuningrussia.org/>), Africa (<http://www.tuningafrica.org/>), and TuCAHEA (<http://www.tucahea.org/>), for Central Asian countries, which are grouping local Universities. On the specific field of Computer Science, the FETCH project (2014) is trying to build a consistent framework of competences for the discipline.

Also at the national level of secondary school institutions, the Ministries for Education defined some curricular supports for education by competences. In this sense, the situation of secondary school in Italy is not different. After the reform in 2011, Italian schools are gathered into three groups: Licei, with a strong base of general cultural education; Tecnici, technical schools which are divided into the Economical and the Technological sectors; Professionali, vocational schools with a shorter path of 4 years. For the first 2 school-years, the definition of competences has been derived mainly from the European key competences for lifelong learning (Chiozzi, Giaffredo, Gris & Ronchetti, 2014). With the aim at adapting the communitarian definition to the specifically Italian situation, the national revision introduced other characteristics. The most evident is the grouping of disciplines into clusters, named axes, and the definition of Italian Citizenship key competences, a revised version of European key competences. Thus, this kind of national interpretation added some issues to the system (Chiozzi, Giaffredo, Gris & Ronchetti, 2014). In the case of the three final years of the secondary schools, the reference to an European definition is less evident. For the different branches of the secondary education, some general competences have also been defined. In some cases, they are connected directly to specific disciplines, considered of election for those competences. In addition, every specific subject has been enriched with a list of discipline-specific competences. In some countries, a competence is explicitly developed by more than one discipline. In other cases, only one discipline is devoted to an individual competence.

Adopting Computer Science competences in Italy

Restricting the analysis to the field of Computer Science, also named Informatics, the situation is not homogeneous among the different European member states. In some countries, there are institutional definitions of competences, specific for Informatics. But competences defined with a normative origin often suffer for an important limitation. As claimed by Dörge (2014) referring to the German situation, the catalogue

created by a normative process contains only the competences “important to the experts compiling the list” (Dörge, 2014 p. 202). And the proposed solution (Dörge, 2014) is to extend the research by a qualitative content analysis of the textbooks on informatics teaching, limiting the risk to miss competences relevant for the literature. The results of the analysis process will help to form a complete set of long lasting competences, with a non-normative origin.

Another issue, which has not been addressed yet, is the limited adoption of the competence-based approach by the teachers, at least in the Italian secondary schools. This is an issue that has not been thoroughly investigated. There are no research data describing how popular and widespread is the competence-based approach in the Italian secondary schools. In fact, to manage a detailed survey there are a lot of difficulties to cope with, and the best way is to ask the teachers. Only to refer to one of the first issues, we would like to remind here the wide range of meanings related to the word “competence” (Winterton, Delamare - Le Deist & Stringfellow, 2006). This reflects a situation of wide variety and richness in the interpretation of a relevant educational approach, but it is quite discouraging with respect to start a complete and detailed analysis of the educational system, even limiting the study to the computer science discipline and for a small area, like a province of Italy. Nevertheless, as a first step of our research, we tried to collect some data asking the computer science teachers. The aim was to collect a preliminary set of evidences and attitudes on the adoption of the competence-based approach to teaching.

A preliminary analysis

We started interviewing a sample of seven computer science teachers, in four different schools of three towns of the analysed province. The interviewees have different roles, as some of them always teach in laboratory; the Italian name of this role is ITP, which stands for technical-practical teacher. The total number of the two kinds of teachers in the province is around sixty. Moreover, our research, related to the technical sectors, is specifically interested in the three final course years of secondary schools, excluding the teachers engaged only in the first two course-years. As a consequence, the dimension of the sample is representative enough of the local population of computer science teachers. The individual interviews were recorded by the interviewer and authorised by the interviewed, who are kept anonymous. The analysis of the collected data does not allow us to say a final word on the acceptance of the competence-based approach among computer science teachers. Nevertheless, several interesting elements are emerging as recurrent from the interviews. Relevant issues identified are: the students involvement/motivation, the needed time, and the distance from institutional efforts and the definitions of competences. The interviewed teachers are aware of the relevance of the competence-based approach, to develop the knowledge, the skills and the attitudes of the students. In order to overtake the traditional priority of the instructional content and aim at a wider and deeper involvement of the students, the computer science teachers often use the methods of the project (or problem) based learning (Blumenfeld, Soloway, Marx, Krajcik, Guzdial & Palincsar, 1991). As a critical factor, this approach has been outlined by interviewed as time-consuming in terms of work: with the students; of the students by their-own; to prepare the presentation of the problem to address in class; in some cases with teachers of other subjects; and to accomplish the bureaucratic mission. Some teachers are trying to follow a competence-based approach, also applying some didactical methods well fitting it. But in these cases, they do not find an useful scaffolding in the normative definition of the competence. And the training activities on competence approach, attended by some of the teachers during the last years, do not seem to be adequate to support the transfer of the approach into the daily work with the classes.

A case-study with computer science teachers

Our case study intends to explore a different way to make competences a real application of a more effective approach to education. An action-research will support the engaged teachers in constructing their personal learning path towards the competence-based approach. In our prospective case-study, the teachers will be trained applying to themselves the constructivist approach to learning, which they often follow in their plans with classes: they will construct learning artefacts focusing to competences for their students, in this way building up their knowledge. The teachers will be sustained to form their competence on competence-based teaching in the same way the students often construct their competence through constructive activities.

We are going to start with a very small number of three computer science teachers, in two technical secondary schools. They will be involved in defining several Learning Units (in Italian: *Unita' di Apprendimento – UdA*) to develop with the classes. The work will be also supported by a software system, enabling teachers to manage the design and definition of the Learning Unit, the assignment to the students and the assessment of the resulting learning outcomes, and helping them to cope with competences. The units will be built according to the problem based learning approach, because PBL can “enhance motivation and thought as students attempt to learn in classrooms”: the students can “better understand subject matter content” and the teachers can sustain this development process, shaping to the students “opportunities for learning, guiding students' thinking, and helping them construct new understandings” (Blumenfeld, Soloway, Marx, Krajcik, Guzdial & Palincsar, 1991, p. 392 and 393). This aspect of PBL fits the “learning to learn” competence, a key competence which could, in turn, help to base the work of the project on competences, considering the competences as the learning objectives for the students. The teachers will design the UdAs, freely choosing whether they do it according to the institutional competences or not. The first instances of UdAs will probably have the same shape of previous projects developed by the teachers, and will be based on their reliable experiences. At the same time the research, also supported by the software, will provide to the teachers the right scaffold to identify and define the competences, all along the life-cycle of the UdA: from the design, through the development in classes, and during the assessment activities. Completed the single UdA, the teachers will be asked to observe the students' evolution, with respect to the development process of the competences, highlighted during the activities included in the UdA. At the end of the work, the teachers will have a repertory of teaching and learning tools. These tools support the educational activities, activities designed and performed in the classes following the competence-based approach. The experience will help the engaged teachers to be aware of the importance of the competence-based approach, since from the phase of teaching/learning design. The teachers will achieve this result not in order to be compliant with a normative suggestion, defined far from the everyday classes; but because they have been supported in the autonomous construction of Learning Units, then applied with the students, following the competence-based approach.

The goal of the action-research is to plan, to manage and to analyse a case-study, directly involving computer science teachers through a process of construction of professional awareness, oriented towards the competence approach to learning and teaching. This process will help teachers to intend the competence approach as a possible and effective one, not too far from reliable activities of practitioners. And it is a constructivist process to build up their practical knowledge of competence. The next step of the research will start on the next school-year. It will be the cloning of the experience done with the small sample, and will extend it to other small groups of computer science teachers, starting in the two schools hosting the case-study but

involving also more schools. The development of the second step will be supported also by the software system and moreover by the results of the first round: the Learning Units, the competences, and the discussions around their definitions. Nevertheless, in the second round the teachers will be request also to build up a repertory of learning tools, according to the competence-based approach. There will be new processes to construct professional knowledge with different teachers.

CONCLUSION

The competence-based approach is spreading through European and international educational systems. But in some cases, teachers could be found who are not applying it. We gave an overview of the introduction of the competences approach in Europe, then focusing on Italian situation, and on the specific subject of computer science in technical secondary schools. As a first result of an introductory survey, some evidences have been shown to highlight the biggest challenges met by teachers in developing this approach in daily classes. All the same, the Informatics teachers seem to be eager for project-based learning, which can be adopted as an effective driver to introduce the competence-based approach into the classes. Supported by a software system, specifically developed for this research, we plan a case-study involving a small sample, formed by secondary teachers of Italian technical schools. An extension of the case-study has been also suggested.

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