Empowering Talented Students:

An Italian Experience of an Enriched Curriculum in Engineering

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Abstract—This paper summarizes the design, the activities performed, and the main results achieved by an innovative teaching program, set-up for the talented freshmen in Engineering Bachelor's courses at an Italian technical University, the Politecnico di Torino, starting from 2013.

The project structure is here detailed, year-by-year, with a focus on both the reinforcement of an Engineering standard curriculum, and the hybrid activities, also in non-technical areas, such as soft-skills, critical thinking, humanities, and creativity. The strategies and methods for the students' selection are discussed, and the University human resource efforts and the costs involved are justified. The results achieved during a three-year experience, based on a structured survey to collect students' feedback, are then critically analysed with the purpose to suggest implementation and further development.

Keywords— Top Bachelor Students; Action Research; Reverse Inclusion Process; Hybrid Learning; Soft-Skills

Abbreviations—Academic Year (a.y.); Action Research (AR); Research Centre of FIAT (CRF); FCA (Fiat Chrysler Automobile); Politecnico di Torino (PoliTo); Talented Student (TS); Test in Laib (TIL).

1 Introduction

The Politecnico di Torino, from now on referred to as PoliTo, is an Italian Technical University with Engineering and Architectural schools. Like the whole Italian university system, it undergoes to the Bologna process regulation that requires a Bachelor lasting three years and a Master of Science lasting two years. In order to obtain a degree, a student needs to acquire 180 ECTS during the Bachelor program and 120 ECTS for Master. The academic year (a.y.) is divided into two semesters and each subject has two calls in the exam section right after the classes end. Moreover, there are two recovery calls, one at the end of the other semester, and one in September. An exam is passed if the score is higher than 18/30; the maximum obtainable score is 30/30.

The admission to a PoliTo Bachelor program is made by a computer-based test called "Test in Laib" (TIL), as Laib is a computers' laboratory. The test, which has demonstrated to well predict students' career, is investigating their knowledge in 4 sections: Comprehension, Logic, Mathematics, and Physics [1]. During the orientation pre-test phase, potential students can make use of support materials in order to prepare themselves for the admission, such as online materials and recorded lessons.

The quality of the preparation of our graduates is a fundamental objective, inherent to the University's mission. The graduated students in fact represent a precious output of the University and involve a relevant investment from the entire country. It is obvious that, on a subjective level, a well-trained graduated student gains an advantage in the labour market which - due to globalization - is more and more wide and competitive.

The present paper is aimed to describe the design, the activities performed, and the main results achieved by an innovative teaching program addressed to the Talented Students (TSs): "Research among Quality - Young Talent program" (La Ricerca della Qualità - Percorso per i Giovani Talenti). The project was oriented to both Engineering and Architecture areas, however, here we focus only on the Engineering Area which is more innovative. With the expression "Talented Student" we refer to a bright and clever learner who stands out in STEM subjects compared to classmates as resulting mainly during the selection performed by TIL.

In the following sections, the general context is described (Section 2) in order to highlight the research questions (Section 3). In Sections 4 and 5 the theoretical framework and the methodology are settled, respectively. Section 6 explains the findings, while Section 7 presents a wrap-up conclusion.

2 Context

In the university field, the new didactic frontiers have been only partially integrated with the classical learning methodologies, especially in technical schools. Unlikely the European and global trend, PoliTo is experiencing exponential growth of students [2] [3]. Consequently, the teacher/student ratio, currently about 1:35, is progressively decreasing, and one of the related drawbacks may be a less effective teaching performance, mainly penalising the protégé students. For this reason, the strengthening of a policy of inclusion towards protégé students has been favoured with the creation of support strategies in order to enable all students to reach an adequate level of knowledge and to complete their studies [4] [5] [6] [7] [8]. There are, in the Italian panorama, numerous and various attempts of inclusion and support in favour of students with greater difficulties.

It is not usual to stimulate the personal skills of each student in a differentiated and targeted manner by creating varied parallel paths with different levels of study on the same topic. Historically, the course of study is structured with a unique curriculum depending on the chosen mayor of interest. Starting from an analysis of the concept of teaching inclusion in the university it can be seen how its recent reversal, which means inclusion and support to the most capable and bright students for a renewal of teaching methods and contents, leads notably advantages to the entire university community and in particular to "weak" students [9].

Addressing this concept of high-level cognitive skills in High School Education and in University is a complex task, nowadays not successfully implemented in order to engender these skills in the students' curricula [10].

According to Jamison, Kolmos, and Holgaard, there are currently different perspectives regarding the role of the engineer as someone able to "transfer and translate scientific knowledge in practical application", as well as to create innovation and public service [11] [12]. These perspectives have a direct impact on curriculum development and teaching methods, in particular, the non-technical areas need to be reinforced and emphasized [13] [14] [15] [16]. As a consequence, hybrid learning is developed by a combination of scientific and non-technical activities that improve soft-skills, problem-solving, problem-setting and critical thinking, humanities knowledge, and creativity [12].

Furthermore, the enrichment of the curriculum with soft transversal skills, defined as "skills, values and attitudes that are required for learners' holistic development and for learners to become capable of adapting to change" [17], promotes the student's autonomy by increasing awareness of his/her cognitive processes. If a mentorship related to the development of lateral thinking is correlated to this metacognitive path to increase the effectiveness of learning, each student finds him/herself stimulated in a diversified manner and is able to reach an adequate knowledge with respect to his/her own abilities [18] [19].

Starting from the 80s, different attempts were made in order to enhance creativity and innovation [16] [20], that is, the identification of best practices such as:

- **Academic-Industrial liaison** – A Japanese example of a slender system;
- **Project training methods** – An integrated approach that includes complementary subjects, teaching design methodologies, and working groups;
- **Innovation centre and entrepreneurship strategy** – A way to be exposed to technology incubators, entrepreneurial projects and to interact with business and industry.

In a technical university, a professor has the responsibility of governing the learning processes. With teaching skills, the lecturer must capture the learners' attention to promote knowledge of learning processes, as well as the content itself. Therefore, the target will move to the educational scheme [21] [22].

In order to analyse the effect of the different schemes, a study in higher learning institution in South Africa has been performed among 118 physical metallurgy students in an engineering course. During the study, the information regarding peer learning, intrinsic and extrinsic motivation, help-seeking, and deep and surface learning with structured questionnaires have been collected. Generally, the group of students who receive an active learning approach to the subject scored higher than the one attending the traditional lessons on all variables except extrinsic motivation. This study strongly highlighted a significant positive relationship between deep learning and academic performance in the final model [23].

However, there are very few examples of creative, innovative and active teaching application inside a structured Bachelor technical school. For example, the Gibbs' findings on 35 students of Economics attending the "learning to learn" program have highlighted a correlation between bright students and a high awareness of cognitive strategies and related processes [24] [25].

In Italy, there are few examples of reinforcement action in favour of bright students, but they regard in particular Master level and non-Technical University. Since ten years PoliTo, together with the Politecnico di Milano, has driven the experience of the "Alta Scuola Politecnica (ASP)", a Master path dedicated to talented students that offer workshops and training weeks [26].

If we consider Engineering Undergraduate Schools only, such innovative paths are almost absent. Typically, this curriculum reinforcement is managed by a Collegium, like the S. Anna School of Advanced Studies (Pisa) [27] and the Galilean School of Higher Education (Padua) [28], that create a parallel path in addition to a traditional public university. In both cases, however, the number of students involved is very limited (about 20 units each) compared to the overall student population in the local public universities and the paths provides only supplementary and in-depth complements in addition to the standard lessons that students must follow at the local public university. Moreover, these organizations offer at the end of the program a certificate, not a diploma degree.

A previous isolated attempt in the Engineering area organized by a public university was carried out by the Politecnico di Milano from the a.y. 08/09 until the a.y. 13/14. Also, in this case, however, the so-called "ASPRI" program was dedicated to the curricular reinforcement of some subjects. The program was then closed probably due to lack of interest from students.

3 Research Questions

Starting from the indispensable assumption of the absolute centrality of the student, for many years PoliTo has promoted a series of services and specific initiatives in favour of students to follow them on their educational path.

Much has been done with regard to the provision of the services themselves, which are highly computerized to streamline the procedures, ensuring a continuous and updated flow of information.

Among the teaching support initiatives to help the transition from a High School to a University, PoliTo offers various, particularly relevant, services including:

- Realignment online courses, before entering the university, for students who have specific gaps in Mathematics and Physics emerged from the admission test in order to allow them to face the first semester lessons with a more solid base knowledge
- Recovery courses dedicated to students who did not pass the first exam in Mathematics
- Recorded lessons made available online
- Tutoring assistance

With this in mind, it becomes clear that we need to keep focusing on the quality of students' preparation and to address specific action for another segment of the students' population, that is the more skilled one. Considering all the new didactic potentials and the social requirements it is fundamental for a technical university to investigate and experience a new way to reinforce the learning processes starting from the Bachelor's years.

The research questions addressing this challenge can be stated as:

- How can a technical university properly support talented students? Can this process be inclusive without entirely separating them from the others?
- Do those actions impact on the rest of the students' population (i.e. students with some difficulties and students with normal career trend)?

4 Theoretical Framework

Teaching has long been understood as an operational part of pedagogy. Today, however, it arises as an autonomous science that studies the conditions of a space pedagogically understood, in which lecturers and students interact [29] [30].

Following this new vision, several studies were born to model and enrich the educational landscape. These were the most significant results [31] [32]:

- The concept of **inclusive education**, able to reach all the subjects in the "pedagogical" space;
- The concept of **metacognition**, with the aim of bringing the students, with due solicitations, to the awareness of their choices. This requires developing the ability to reflect on what happens during the learning process and on the related most suitable strategies [33] [34];
- The formalization of the **traditional model** consisting of a student's modelling (imitative process), coaching (systematic teacher assistance), scaffolding (deepening and stimulation), and fading (gradual reduction of teaching support);
- The **mentorship technique**, which implies guided learning between an experienced subject (mentor) and one with less experience (protégé) [35];
- The **cognitive learning model** made up of the articulation or the exposition of the experiences of the students, from the reflection or growth in the comparison with a senior expert and from the exploration or new vision of the problems and related solutions.

In order to address the research questions above, the Action Research (AR) theory has been identified as the correct framework to use. This research strategy is used to solve a practical problem and to produce guidelines for best practice [36]. The theory has been developed by Kurt Lewin and he described it as "a comparative research on the conditions and effects of various forms of social action and research leading to social action" [37]. The AR can be seen as a looped cyclic set of inquiry: planning, action, finding, reflection, and identification of improvements. Nowadays, this practical investigation is frequently adopted in the educational field in order to develop and test new projects and experimentations [38].

5 Methodology

For this Bachelor project, we aim to merge both humanistic and technical profiles in order to reinforce the regular study by applying the hybrid learning philosophy. This fulfils the social skills' requirement by enriching the competences' framework with critical thinking and soft skills aptitudes such as teamwork and team building.

To answer the research questions, we decided to develop the Talented Students (TSs) program integrated with the standard curriculum by the use of an AR. The structure of the AR is organized into five steps: (1) Plan and Exploration, (2) Act, (3) Observe, (4) Reflect, (5) Specific Learning and Improvement. Each step includes different activities, as shown in Fig. 1.

Fig. 1. Action Research cycle in detail

Plan and exploration started in September 2013 with the first call open for the a.y. 14/15. The aim of the project was to design a program in order to favour bright students and to raise the overall quality of learning among all the students' population. After the definition of the context, aims, boundaries of the program, and review of existing experiences in a similar context, we decided to select around 200 incoming students. We chose a project structure that for a limited extent separates the talented students from the others for the entire duration of the Bachelor program.

Then, the first selection took place and the program started its first edition. In order to implement the "observe" and "reflect" stages, a structured qualitative questionnaire with scale 1 to 5 answer has been prepared and submitted to the students at the end of each academic year. The descriptor used are listed and detailed in Tab. 1.

Table 1. List of questionnaire descriptors with the related extended question

Descriptor	Related question
Homogeneous class goodness	Did the homogeneous class have a good effect?
Prof. theory exemplification	Did the professor properly exemplify the theory?
Prof. interest generation	Did the professor generate interest about the subject topic?
Prof./Expert clearness expository	Was the professor/expert clear in his/her exposition?
Effectiveness	Was the course effective?
Inherent activities	Did you feel that the activities were inherent with the program?
Anticipation difficulties	Did you find it difficult the anticipation of Maths Analysis II?
Training class and Lab usefulness/goodness	Did you find the training class and labs section useful/good?
Positive experience	Do you think it was a positive experience?
Team building	Was it useful for team building?
Organization	Was it well organized?
Enrich skills and knowledge	Was it useful to enrich skills and knowledge?
Lab. Organization	Were the laboratory sections well organized?
Lab. Involvement	Did you feel involved in the laboratory sections?
Lab. Participation	Did you take part in the laboratory sections?
Interesting/understandable/useful	Do you think the activity was interesting/understandable/useful?
Fulfilled expectations	Did the activity fulfil your expectation?
Improve knowledge	Did you improve your knowledge?

5.1 Structure of the program

The selected students, during the three years, have a curriculum that combines the standard path with some dedicated activities, that is a mixture of courses and different hybrid activities. The detailed program is schematized in Fig. 2.

The project foresees the common attendance with all the other students, for the first-year courses (Chemistry, Computer Science, Mathematical Analysis I, Linear Algebra and Geometry, and Physics I). The standard courses are managed with parallel classes of around 250 students each. During the first semester reinforcement on the two curricular courses of Chemistry and Mathematical Analysis I are organized. The aim of these reinforcements is to provide a more organic, practical approach to the laboratory sections and an in-depth view of the topics covered, above all by stimulating a more autonomous study. The interventions also aim at enhancing interdisciplinary themes. During the second semester, in advance with respect to the regular timing, the student must follow a reinforced course of Mathematical Analysis II. This in-depth teaching will be given to a homogeneous class, as well as Physics II that is taught in the third semester.

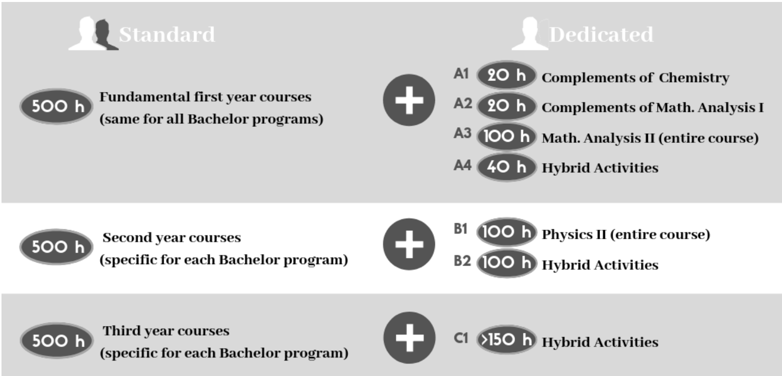

Fig. 2. The detailed structure of the program

The hybrid activities are a core element of the program and, for this reason, they are present each year of the curriculum. In fact, the main focus of the program is to apply the concept of hybrid learning by training students also in non-technical areas. This approach has a gradual increase year by year: it starts with few daily and weekend activities during the first year, it is organized in activities lasting weeks during the second year, and finally it covers a full semester in the third year.

More in details, as soon as the program begins, in November, the first seasonal weekend is organized. It consists of a three-days full-immersion activity, during which students are trained through seminar classes in order to generate a creative approach in solving practical exercises, a problem-solving competition in small teams, and activities such as hiking in the woods for educational purposes. Usually, the training weekend is organized in a remote small town in the mountains. This is an activity strategically inserted at the beginning of the path to allow students to get to know each other and start working in teams.

During the second semester, a guided visit to the CERN in Ginevra is organized to meet scientists and to discover the organization and management of an innovative research centre.

During the second year, in order to strengthen the linkage with the local industrial stakeholders, some visits to manufactory plants of famous companies, such as Maserati, are organized as well as some laboratory sections inside a FCA (FIAT Chrysler Automobiles) factory in Turin. This laboratories' activity is performed in small groups in which each student has the chance to reinforce labour knowledge. The experience is articulated in a two-hour plenary session dedicated to the presentation of vehicle development, the production processes, the main automotive research objectives of the coming years and open discussion. Following the plenary session, there are six different thematic sessions of 4/8 hours in a laboratories at the Research Centre of FIAT (CRF).

For the practical experience, each student can choose the subject among: crash FEM analysis, computational fluid dynamics, electromagnetic compatibility, powertrain development, smart materials, and cooperative and wearable robotics. Students are given the opportunity to choose one of the proposals and deepen a phase of the R&D process in close contact with FCA and CRF engineers and technicians.

During the third year, students are divided into small groups to follow different activities:

- **Study abroad** - Students can spend a semester of study abroad. The aim is to encourage the possibility of training experiences abroad thanks to large network agreements with other universities;
- **Interdisciplinary project** - Projects with a concrete social impact, related to the improvement of the local environment in collaboration with public administrations;
- **Seasonal Schools** - Different kinds of learning full-immersion are proposed in order to reinforce specific knowledge;
- **Internship** - A period of work experience inside important and innovative local factories.

Then, special events and dedicated conferences are organized as well. For example, a cycle of conferences, named "Building up the future", concerns not only relevant scientific issues but also humanistic topics such as philosophical implications in science, history of technological evolution, adaptability to change and ethical problems. In the meantime, dedicated meetings are organized with important international CEOs and top managers to understand the current work environment and to head off innovative challenges.

The hybrid activities, whose IDs are defined in Fig. 2, can be directly related to the skills acquired as shown in Tab 2.

Table 2. Skills assessments activity by activity

ID activity	Teamwork	Team building	Responsibility	Motivation to career	Research awareness	Decision making	Leadership	Result orientation	Problem-solving	Organization	Critical thinking	Technical
A1	x									x	x	x
A2										x	x	x
A3	x									x	x	x
A4	x	x	x	x	x	x	x	x	x		x	
B1								x		x	x	x
B2	x	x		x	x						x	x
C1	x	x	x	x	x	x	x	x			x	x

The students are placed side by side of mentors who will not only strengthen their knowledge, as the typical role of the tutor requires, but will also be able to broaden the cultural background, foster personal growth and integration in the group through the transfer not only of technical knowledge but also of professional experience and labour market skills.

Students who join the program will receive not only a didactical motivation but also some economical and welfare advantages as well as a special certification.

In order to get the "Progetto Talenti" diploma, a student needs to fulfil the requirements until the end, to take part to all the activities required and must graduate on time (until December of the third year of the Bachelor path).

At Polito, the tuition fees are proportional to the family income ranging from no tax area to a maximum of around 2,800 euro. Considering this taxes distribution, all the students of the program are exempted from taxes if the amount due is less than or equal to 1,500 euro, while if it is higher, students have a tax reduction of 1,500 euro.

Finally, students receive a package which includes the local transportation subscription (Bus and Bike sharing), and a card for free access to many regional museums.

5.2 Structure of the selection process

By looking at the PoliTo incoming population in the last couple of years we were able to highlight a group of talented students transversal to all the Engineering programs. In particular thanks to the strong correlation between the TIL admission test score and the student career, the TIL score behaved as a good selection instrument [1].

Considering the whole community of freshmen, students who have obtained a score equal to or greater than 70/100 are around 7% of the approximately 5,000 students attending the test (Tab. 3). Students belonging to this set are the ideal candidates for the project.

Table 3. Distribution of the number of students considering their TIL's score per a.y.

Score range	11/12		12/13		13/14	
- 9.99	214	1319	220	1880	276	1372
10 - 19.99	396		541		383	
20 - 29.99	709		1119		713	
30 - 39.99	805	1479	1275	2323	870	1856
40 - 49.99	674		1048		986	
50 - 59.99	541	956	548	891	956	1548
60-69.99	415		343		592	
70 - 79.99	191	278	140	234	299	456
80- 89.99	75		73		123	
90- 100	12		21		34	
Total	4032		5328		5232	

Although the language of this first experiment is Italian, the program is open to all students, both national and international ones, requiring, however, a basic knowledge of the Italian language, while the common courses can be followed either in Italian or in English.

The number of participants is amounting to around 4% of the total (over the approximately 4,500 students enrolled).

In order to remain in the program, the students need to fulfil some requirements year by year. In particular, there are the following checkpoints:

- End of the first semester
- End of the first year
- End of the second year
- End of the third year

In the event that the student does not meet the requirements, he/she will continue the studies on the regular path. In the meantime, maintaining the requirements of the maximum enrollment of 4% of the total population (around 200 seats), it is possible to include new students into the program during the first two checkpoints listed above.

5.3 Resources planning

The design has been articulated in high-level governance, medium level or management, and low level or planning and execution.

A commission of 6 components, including a representative student, has been appointed in order to define the whole structure of the path. The board meets once a month to approve all the different activities and project works.

The main objects of the commission are planning of the yearly program contents, selection of the teaching staff, tutors and mentors, monitoring the program quality, and definition of the budget.

For the management level, two administrative technical persons were seconded to full-time.

In Tab. 4 the Human Resources, as a Full-Time Equivalent (FTE) effort, necessary for the yearly implementation of the project, are summarized.

Table 4. Resource effort in term of Full-Time Equivalent

Typologies	Number FTE
Management staff	1
Administrative staff	2
Teaching staff	7
	(5 Academics and 2 Industrials)

The economic framework of the project takes into account the costs necessary for its implementation and maintenance over time.

The project involves a series of ad hoc expenditure items as the creation of a specific three-year path that goes alongside the standard pathways; in particular, it includes:

- Lower income from the registration fees due to the total or partial exemption
- An increase in the number of teaching hours

- Organization of seasonal schools and related teaching hours
- Mobility grants
- Ad hoc management and monitoring of the enrolled students' career
- Tutoring and mentoring.

In order to cover partially these extra costs an agreement between PoliTo and the CRT Foundation, a Torino private banking foundation, has been signed.

6 Findings

6.1 Quantitative analysis

In September 2014 the first students' selection took place and the program started engaging 191 students. The gender ratio is of 86% male and 14% females. Around the 30% of students come from Piedmont (the Region in which PoliTo is located), 15% from Apulia, 12% from Sicily, and the remaining part is equally distributed among all the other Italian regions and several foreign countries.

Looking at the TIL score of the TSs of each cohort, the general trend is growing as shown by boxplot in Fig. 3. It is clearly visible that, not only the average score is increasing year by year, but the overall quality of the enrolled students has improved. Hence, as it can be seen in Fig. 4, the number of whole freshmen reaching TIL scores higher than 70/100 referred to the overall freshmen is significantly increasing. In the meantime, also the number of students graduating in 3 years and within 3.5 years keeps incrementing.

Following the direction described in the above section, considering the first three cohorts, the number of students in the program becomes more stable, as it can be observed in Fig. 5. In addition, we can notice that in the first cohort the 83% of TSs obtain the "Talenti" diploma.

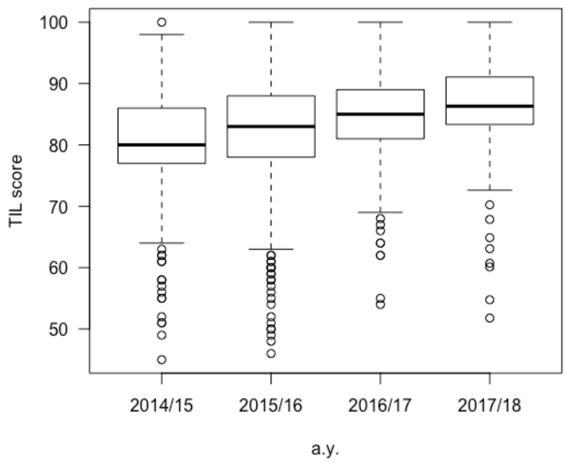

Fig. 3. Boxplot of the TIL score related to students of each cohort

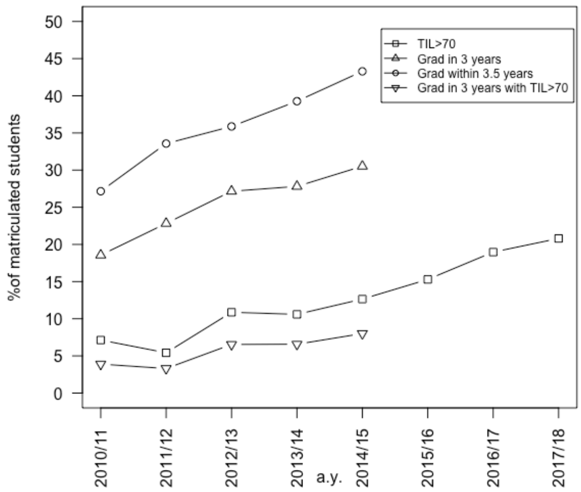

Fig. 4. Percentage distribution of overall matriculated students based on enrolled ones and of students with TIL score higher than 70/100

Speaking about the continuation of studies, all TSs continued their studies. Considering the 158 students graduated with the "Progetto Talenti" diploma, 124 of them applied to a Master of PoliTo, while 34 students continued their studies in European Universities with ranking higher than PoliTo. For example, 11 of them were admitted at the EPFL, 4 at the ETH and 4 at TU Delft. In the meanwhile, 25 TSs have been accepted at the ASP [26].

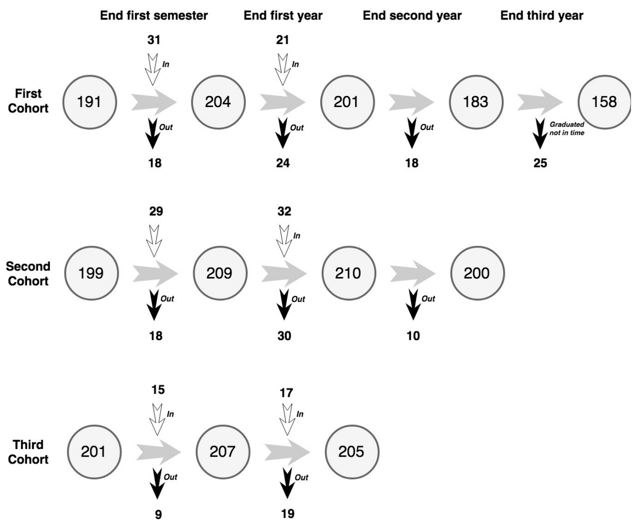

Fig. 5. Number of students involved step-by-step (in the circles), entering (white arrows) or leaving (black arrows) the program

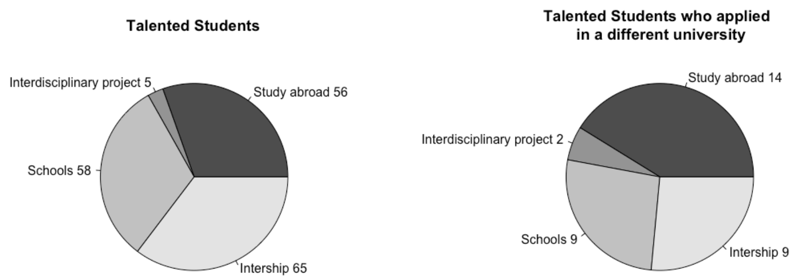

Fig. 6. Analysis of third-year activities selection by the overall talented students (right) and the ones that applied in a different university (left)

A possible correlation between the hybrid activities chosen during the third year and the studies prosecution has been analysed, but no direct influence has been highlighted (Fig. 6).

6.2 Qualitative analysis

Thanks to the data collected by the structured survey, an analysis of the students' feedback has been conducted. To date, we have collected the data from three cohorts of students for the first year of the program, two cohorts for the second and one for the third one.

The first-year survey is made of 20 questions corresponding to a level of satisfaction between 1 and 5, and an additional optional comment box. Fig. 7 shows a graphical representation of the results. Inside the comment box, the students give suggestions and observations about all the activities' organization and content. Almost 25% of students of the first cohort underline an unbalance weight between the first and the second semester and almost 20% report the importance of the laboratory sections in the Chemistry reinforcement.

The second-year survey is made of 15 questions with a similar indication. Fig. 8 is a graphical representation of the results.

Based on the data and on the comments achieved, it is important to formulate some reflection on the course structure.

Considering the first year, all the courses and activities are well performing, and the prefixed skills have been acquired. However, the mentorship support has obtained very low evaluation score especially on the questions about its efficiency on solving doubts, interest generated and on the number of meetings. In fact, a very low percentage of students has been requested at least one meeting with their mentor. Therefore, for the following cohort, it has been deactivated. A generic tutor has been introduced as a reference for each year to reply all the questions inherent to the structural and the organization problems.

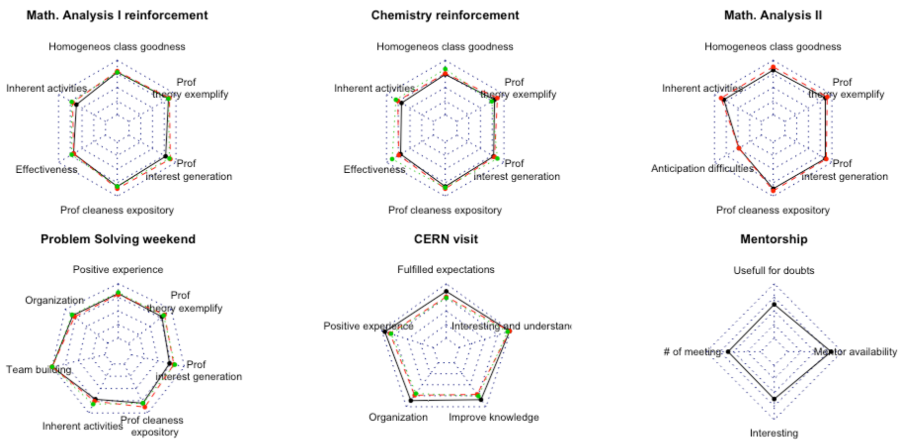

Fig. 7. Radar graph for each activity of the first year for the 3 cohorts

The first cohort of this program highlighted the importance of Chemistry's laboratory section in order to gain the correct technical knowledge. For this reason, starting from the a.y. 15/16, the laboratories sections inside the traditional Chemistry course have been enriched by a larger number of hours in lab ensuring, in the meantime, the access to all the students divided in smaller groups.

Looking at the Mathematical Analysis II survey's result, no special issues are reported about the anticipation of the course from the first semester of the second year to the second semester of the first year.

However, as the students suggest in their comments, the work-load is not well balanced between the two semesters. This leads to a more general reflection and reorganization on the standard path of the first-year courses. Considering the courses background requirements, the Computer Science course was the best candidate to be moved from the second to the first semester. Then, this course anticipation has been implemented to all the students starting from a.y. 16/17.

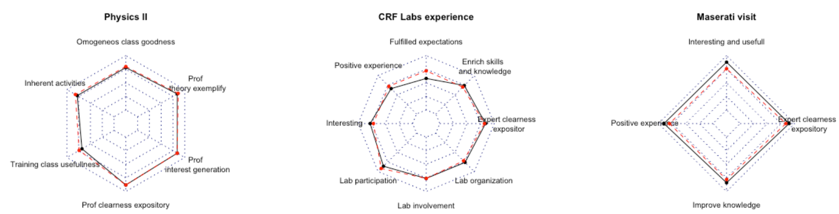

Fig. 8. Radar graph for each activity of the second year for the first 2 cohorts

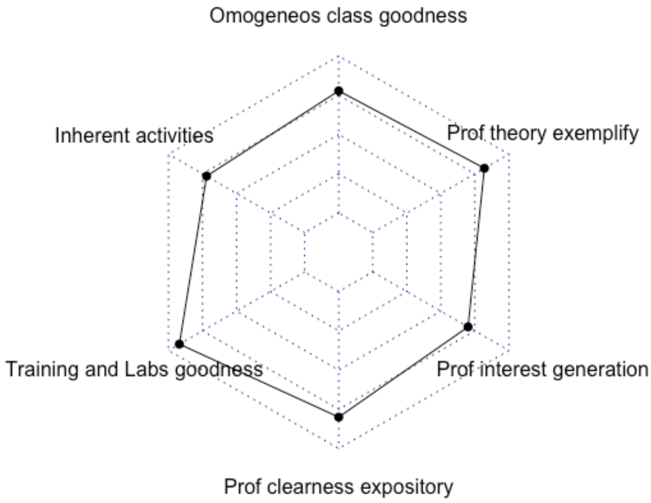

Fig. 9. Radar plot with the results of the Linear Algebra and Geometry course's survey

The standard Geometry class needed a review in term of contents with a reinforcement of the Linear Algebra part and the introduction of MatLab software, and a new course of Linear Algebra and Geometry has been planned. Instead of implementing this completely restructured course in the standard path, the trail test is made in a dedicated course for the TSs. In fact, students in the program can perfectly simulate the numerousness of a standard class and can help to judge the goodness of the new syllabus. The students have been giving good feedback about this new course (Fig. 9).

Thanks to this trial, the contents of the second semester courses has been arranged and, starting from a.y. 16/17, the new Linear Algebra and Geometry has been proposed to all the students in the traditional path instead of the previous Geometry course.

Another aspect that needs to be considered is the frequency of usage of benefits such as the Museum card, the Bike card and the Public transportation card. The use is very high for all the three services with the students' majority concentrated in the weekly/daily usage of the mobility cards and monthly of the cultural card (Fig.10).

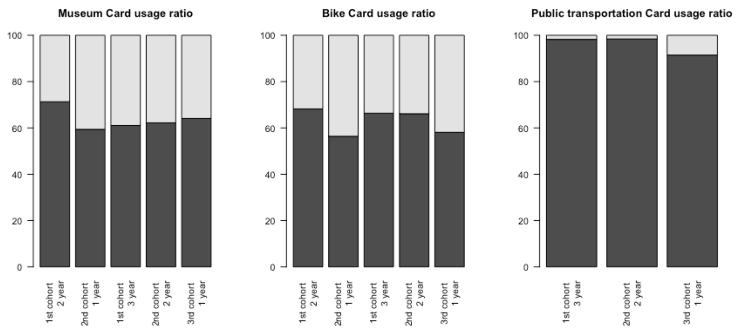

Fig. 10. Bar plot of the usage of each service year by year

As per the data collected, students find the Museum Card and the public transport subscription very useful. For this reason, starting from a.y. 17/18, these tools have been offered to almost all the students enrolled based on their career and their economic status.

7 Conclusion

The creation of this program facilitates TSs without the creation of a complete differentiated path. Students in the program foster hybrid imagination by gaining technical and soft skills that help them to fit the industrial world requirements [12]. Thanks to dedicated activities, like the problem-solving weekend, students become a cohesive group although they are not in the same courses. Moreover, they influence each other creating a very inspiring environment that affects also the standard courses.

Hence, the existence of this program highlighted that, by enriching the curriculum of around 200 students, the entire community gains different benefits and increase in quality. This phenomenon is been defined as "reverse inclusive processes", that is, "all the activities that, thanks to the mixed class formation, indirectly include the protégé students by stimulating and motivating the deserved ones" [9].

In particular, as highlighted by the "Reverse inclusion study", the program has already increased the overall quality of all the students and reduced their graduation time [9]. In addition, it is a precious opportunity for the possibility to experiment course improvements or modifications on a small and well responding class instead of letting the changes impact the overall community.

Considering the study continuation, all the TSs apply to a Master either in our institution or in another university. Those who decided to continue their studies in a different university chose a university with a higher ranking position than PoliTo.

In the end, the talented program seems to be well suited to answer the need of the university. The human and economical effort foreseen by its implementation is properly impacting, not only the TS ones but a larger audience.

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9 Disclosure Statement

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