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Commitment of teachers in a digital learning project to reduce school failure in STEM and linguistic subjects

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Abstract

The project "Scuola per Tutti" took place during the school year 2017/2018 in the secondary school Amaldi-Sraffa of Orbassano in order to recover school failures of 9th and 10th grade students in English, Mathematics, Latin and Physics. A tutor, who was specifically trained on the methodologies of the project, held each course during afternoon meetings at school and online tutorings via a web-conferencing software. The goal of the project was not only to overcome learning difficulties but also to reduce the phenomenon of early school leaving, to increase motivation in studying and to facilitate the transition between lower and upper secondary school. In order to do so, a virtual learning environment was chosen, integrated with different plugins that allow the implementation of collaborative and cooperative learning as well as adaptive teaching, problem solving and learning by doing, thanks to the possibility of creating and sharing interactive materials.

Besides technologies, the key point for the success of the project was the close cooperation between tutor and teachers in order to provide a better education continuity. Results will show that the project had a higher impact on those students whose tutor and teacher carried out a successful collaboration.

Keywords: Virtual Learning Environment, School Failure, Advanced Computing Environment, Automatic Assessment System, Collaboration Tutor-Teacher.

Introduction

The phenomenon of early school leaving in Italy mainly affects vocational and technical schools and the most involved disciplines are Foreign Languages and Mathematics, according to MIUR statistics (MIUR, 2008a; 2008b; 2014). The most delicate period is precisely the one between grade 9thand 10th: in fact, compulsory education ends at the age of 16, in Italy.

Moreover, in Italy the 9th grade represents the beginning of the upper secondary school therefore the transition from grade 8th to grade 9th is crucial.

Around 2635600 pupils throughout Italy enrolled in high schools in the school year 2018/2019 (MIUR, 2018); among them, 49.1% enrolled in lyceums, 19.5% in vocational schools and 31.4% in technical school, of which 18.7% in ITT (i.e. technical schools specialised in electronics, computer science and other technologies) while 12.7% in ITE (i.e. technical schools specialised in management, finance and marketing). In addition to the problem of early school leaving, technical schools also have to cope with low profit, especially in Foreign Languages and Mathematics. The INVALSI Math test in the 10th grade during the school year 2017/2018 (INVALSI, 2017) had an average score of 190.76 in ITE, 199.17 in ITT while in "scientific" lyceums it was 232.08 (score expressed with a Rasch quantitative scale); the Foreign Language test had similar results.

Technical schools surely need more recovery activities in order to fill this gap. This led to our decision of starting a recovery project called "Scuola per Tutti" ("School for Everyone") in the upper secondary school Amaldi-Sraffa of Orbassano (https://amaldisraffa.edu.it/) with the purpose of reducing school failure in STEM and linguistic subjects (where STEM stands for Science, Technology, Engineering and Mathematics). This school has different curricula but we decided to mainly involve those belonging to the technical school; only two classes were from the lyceum, in order to activate a Latin course too (that is not studied in the technical branch). In details: 2 classes from the lyceum, 4 from the electronics ITT, 5 from the computer science ITT and 5 from the management, finance and marketing ITE. The classes were selected on the basis of the teacher's interest in involving their class in the project.

The project was made possible thanks to the good collaboration between the Head Teacher of the school, a professor responsible for the project, and our research group from the Mathematics Department of the University of Turin. The actors involved were many more, belonging to the school (students and their families, teachers, school staff) and to the University of Turin (professors, trainers, fellows, and tutors from the departments of Mathematics, Languages, Humanities, Physics, Philosophy and Science of Education).

The project has different objectives: not only to reduce the phenomenon of early school leaving, but also to recover school failures and to overcome learning difficulties, to increase motivation in studying and to facilitate the transition between lower and upper secondary school.

The first edition took place during the second half of the school year 2017/2018 and it involved 16 classes; 10 courses were activated for the following subjects: English, Latin, Mathematics and Physics. A tutor was assigned to each course; they were university students and have been selected on the basis of their course and their profit. To better carry out the project, we decided to take advantage of digital education methodologies trying to enhance a good collaboration between tutors and teachers.

State of the art

As it has been shown in previous projects (Brancaccio et al., 2015; Palumbo et al., 2012), technologies can take on the role of cognitive partner in scholastic recovery and increase motivation in studying, if appropriately used by the tutor and the teacher.

Unfortunately, teachers are sometimes reluctant to adopt new technologies. Sacristan (2017) identifies the cause of this in a general difficulty in accepting changes (even when the benefits of technologies are recognized), in a fear of losing control of the class (showing technical deficiencies) that is a consequence of lack of confidence in digital technologies and fear of knowing less than their students. Moreover, most teachers do not have an adequate training and they struggle integrating technologies with the curricula.

According to Sacristan (2017), a possible way to overcome these barriers is to promote collaboration among teachers or between teachers and tutors. The fundamental prerequisites for a successful collaboration that have emerged from the studies of Aquario et al. (2017) are voluntariness, equality, shared goals, shared choices and shared responsibilities, a willingness to listen and connect and the will to learn continuously, without fear and resistance to change. Collaboration appears to be a complex process and sometimes it is difficult to predict; it could start right away or encounter difficulties that prevent an adequate exchange of communication between the parties. Obstacles that negatively affect the establishment of profitable collaborations could be bureaucratic, related to the human nature or linked to a poor methodological training.

If the collaboration is between teachers and tutors, Colautti (2002) claims that the role of the tutor is to connect and integrate the different components of the learning system, i.e. keep the connection with the different actors of the learning path and the different learning methods used. The tutor should facilitate the connection and the integration between different learning resources made available to participants and between the different moments of the learning path.

Methodology

The project “Scuola per Tutti” decided to benefit of the collaboration between teachers and tutors in order to help the former in the use of digital technologies and the latter in the creation of appropriate material to help students recover school failures and to overcome learning difficulties.

The project provided eleven meetings held by tutors, for each group of eight students, once a week in a computer lab of the school; moreover, the tutor would be available online one hour a week for an online tutoring through a virtual learning environment (VLE). In fact, the project contemplated the use of the VLE Moodle that has been integrated with the Adobe Connect web conferencing software, the MapleNet plugin and the automatic assessment system (AAS) Möbius (Möbius Assessment, 2018), thanks to the collaboration with the ICT services of the Computer Science Department of the University of Turin (Barana et al., 2015a).

The Moodle platform (that can be consulted at https://scuolapertutti.i-learn.unito.it/) integrated with the plugins listed above allows to implement collaborative and cooperative learning as well as adaptive teaching, problem solving and learning by doing thanks to the possibility of using forums, and of creating integrative and interactive activities (Barana et al., 2015b). The font used on the platform is "EasyReading" (http://www.easyreading.it/it/) that is Dyslexia friendly and high legibility.

The MapleNet plugin allows the access to interactive material created with the advanced computing environment (ACE) Maple through the Moodle platform. Maple was installed on all the computers of the lab where the tutoring took place but thanks to the MapleNet plugin, the interactive materials created are always available to students, also at home where they do not have the ACE.

Möbius (Möbius Assessment, 2018) is an AAS that allows the creation of algorithm and adaptive questions. The use of tests, exercises or problems with automatic evaluation that allow pupils to self-assess their knowledge has been proven really useful for the formative assessment of STEM disciplines (Barana et al., 2018) and languages (Marchisio et al., 2019).

The Adobe Connect web conferencing software is accessible through Moodle and it allows to use the microphone or a chat and to share the screen (the webcam was not used for this project). Thanks to this, the tutor would meet his students for an additional meeting once a week. In summary, one tutor was responsible for each course for which he had to plan and give eleven tutorings at school and eleven meetings online. For each of his lessons, he had to create at least one interactive file and one online test in accordance with the methodologies he had been trained to before the beginning of the project. All the materials created were uploaded on the platform that was available to all the students registered on it. While the two hours of tutoring at school were only for a restricted number of students in order to make the project more effective (eight students per course), the online meeting was open to every student of the class.

In fact, sixteen classes were involved, with a total of 323 students, 47% of them from grade 9 and 53% of them from grade 10. All of them were registered on the platform where they could attend online meetings and consult all materials created by the tutor with the ACE Maple and the AAS Möbius at any moment. From these classes, 80 students could attend afternoon tutoring too; they were selected on the basis of their grades in the subject of the course (English, Mathematics, Latin, Physics), which were on average 4.48 / 10.

All the teachers of English, Mathematics, Latin or Physics of the classes involved were registered on the platform as well, in order to collaborate with the tutors. This collaboration was the fundamental prerequisite for the success of the project in order to create an education continuity between the curricular hours at school with the teacher and the afternoon meetings with the tutor. By supporting each teacher with a tutor, the expectation was to overcome most of the barriers pointed out by Sacristan (2017) that usually prevent them from adopting new technologies. The tutor was specifically trained on the use of the technology and on the methodology to adopt in order to integrate it with the transfer of disciplinary knowledge. On the other hand, the tutor did not know the level of his students nor what they were used to doing in class: the support of the teacher was fundamental in this respect. In any case, the digital material was created by the tutor (with the support of the teacher about the topic) allowing the teacher to overcome the problem of lack of time and lack of confidence in digital technologies.

Tutor and teachers shared the same goals, choices and responsibilities about the success of their students and they both voluntarily chose to participate in the project: this promoted the collaboration between teachers and tutor as it had all the fundamental prerequisites listed by Aquario et al. (2017).

Moreover, tutors were asked to continuously update teachers about the progress of their course in order to give the tutor the role, as described by Colautti (2002), of connection with the different actors of the learning path and the different learning methods used.

To foster the engagement of the teachers involved, before the beginning of the project they were offered a specific online training in order to better understand the opportunities that a VLE like Moodle gives in education and to better follow the progress of the project. They learnt, inter alia, how to monitor the work of their students on the platform, how to find the results of tests carried out with the AAS by their students and how to understand which interactive material had been visualized.

The teachers that decided to attend this training turned out to be the more engaged and committed to the cause of the project, which is the reason why, from now on, they will be referred to as the "committed teachers".

This led us to the definition of the research question: *would the commitment of teachers and their collaboration with tutors influence the progress of the project?*

In fact, technologies could take on the role of cognitive partner in scholastic recovery (Giraudo et al., 2014) but the attitude of the tutor and even more of the teacher is fundamental.

Results and discussion

In order to evaluate the quality and the effectiveness of the project, we asked to all the actors involved to fill some questionnaires. Each student who attended the afternoon meetings had to fill one while their teachers and their tutors had to fill one for each one of their students. In this way, it was possible to compare results about the same student with the point of view of his teacher, his tutor and the student himself.

We also asked every teacher to provide us, for each student, the average evaluation in the discipline before starting the project and the evaluation of the first test after the end of the project. From the analysis of these grades we computed that students started the project with an average mark of 4.48 out of 10 and their first mark after the end of the project was 5.43 out of 10, with an average increment of 0.95. However, it is important to point out that the first test after the end of the project for students of Latin was particularly difficult. Considering only students who attended the courses of English, Mathematics and Physics, the average increments is 1.10 while the average becomes 1.19 if we consider only those students of "committed" teachers.

Analyzing questionnaires of students, it was clear that 97% of students were able to consult all the online materials whenever they wanted as they stated to have the possibility of using a computer or tablet at home and 100% of them had an internet connection.

Another question asked students if their grades had improved after the project: 83.3% of students of "committed" teachers replied affirmatively while only 62.0% of students of "not committed" teachers did (results given by a chi-squared test with p-value=0.034). Also the self-confidence about the subject increased more in students of "committed" teachers, with an average increment of +1.12, differently from students of "not committed" teachers, with an average increment of +0.66 (results given from an ANOVA test on the "increment" with significance equal to 0.095).

Taking in consideration questionnaires of teachers, Tab. 1 summarizes some of the most statistically significant data. Teachers responded to the questionnaire by writing a number between 1 and 5 next to each question regarding different aspects of student's attitude before and after the project. The variable "increment" has consequently been computed by subtracting the score after the project and the one before it. The ANOVA test on the "increment" variable shows a statically significant difference between answers given by "committed" teachers and "not committed" teachers.

It is also relevant to notice that at the question "Have you noticed an improvement in the student's attitude towards the discipline?" 80.0% of the "committed" teachers answered yes, while only 65.3% of the "not committed" teachers did.

Increments in:	Students of "not committed" teachers	Students of "committed" teachers	Statistical significance
Self-confidence about the subject	0.4286	1.0667	< 0.001
Home study	0.4082	1.0000	< 0.001
Learning ability	0.3673	0.9000	0.001
Competence in the discipline	0.4694	1.0667	< 0.001
Motivation	0.5714	1.0667	0.005

Table 1 – results of the ANOVA test on increments in the teacher questionnaire

Conclusions

The first edition of “Scuola per Tutti” was a very valuable service for the high school Amaldi-Sraffa, especially in those courses for which the teachers were fully engaged.

The methodologies of the project allowed students to improve their grades but more importantly they had a major cognitive impact on them. Students increased not only the competences in the discipline and the learning ability, but also the motivation and the confidence in their own possibilities. As a consequence, also the amount of home study and the participation at school increased.

From the results it is also clear that the so-called “committed teachers” were the more engaged in the project and this had a positive impact on their students providing a greater education continuity between curriculum hours and tutoring hours.

The cooperation with the tutor was a key factor: the teacher could easily give directions to the tutor on the contents of the materials to create. The tutor could consequently create materials aimed at the needs of his own students, in preparation of classwork or further evaluations; students, perceiving this, understood that online materials were useful and were stimulated to be more engaged.

The material was sometimes so accurate that the teacher decided to make it compulsory for the whole class, assigning tests as homework or classwork and using the other interactive materials as a useful tool for his tutoring activity.

The commitment of the teacher was probably perceived by his students as well. Firstly, because it is likely that the good opinion the teacher has about the project is passed on to his students while he was motivating them and encouraging their participation. Secondly, because students knew that their own teacher was checking on their work on the platform and they were stimulated to perform better, intervening more during the afternoon tutorings and participating more during the online meetings.

We should not forget that “committed teachers” voluntarily decided to attend the online training on the use of Moodle. Since the beginning, they were probably the ones who immediately intended to commit more to this project and, thanks to the online training, they had tools to do it and that engaged them even more reflecting this positive behavior on their students.

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