Teaching Without Borders: A Gamification Paradigm for Practical Subjects

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Abstract
Practical activities, unsuitable for a digital curvature centered on remote activities, have been particularly penalized by the pandemic. Our response was the study and implementation of a series of hybrid learning units, based on gamification strategies, to allow mechanics involved students not to lose contact with practical activities, keeping the laboratorial subjects at the center of the processes. The idea was to transform a series of laboratory exercises into a movie set for a detective film, in which the student's skills and knowledge are necessary to solve a puzzle. An educational unit was designed and built, whose final product was a Google Form, suitably equipped with multimedia inserts, through which the student is transported into a role-playing game, in which he plays the role of a private investigator dealing with a murder case that took place in a mechanical workshop. To solve the case, the player will have to rely on his observation skills and on his knowledge and skills developed in the mechanics related curricular subjects. In fact, he must be able to solve problems related to the means of transport present in the workshop and, if able to detect and correct the anomaly, he will obtain clues that will allow him to identify the guilty. Goal of this approach was to increase technical-methodological skills, indispensable for a professional maintenance technician in the automotive sector. The students really appreciated this approach and we look forward to release new episodes of this "crime series", blending them with real manual activities.

Keywords: Gamification, Practical Subjects, Innovation

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1. Introduction

During the 31st "Didamatica" conference, held in Rome in May 2017, the authors of this paper presented a work focused on a series of good practices adopted by their home school, necessary to integrate the adoption of new technologies which, in order to how innovative they were, alone would not have been sufficient to ensure a significant impact on teaching and, consequently, on students' academic success. On that occasion, it was shown how the development of a teaching centered on the profile and needs of the student could improve their attention, motivation and involvement. As an operational example of what was theorized, first, and then realized, a dedicated work environment was presented, called the "Easy" classroom, in which a group of teachers, adequately trained, designed a teaching oriented to the personalization of the students' paths, to promoting their academic success, promoting their inclusion and recovering situations of disadvantage, focusing activities on discovery, experimentation and research, using tools more similar to the languages and communication styles of the students.

The experience of the "Easy" classroom was the springboard for extending the aforementioned good practices to the whole Institute, guaranteeing, in the following two years, collegial homogeneity on the didactic methodologies adopted and consequent achievement of the objectives set with the work of the 2017:

- Increase of the academic performance of each pupil, from the point of view of profit and participation.
- Decrease of the impact of absences on the results obtained.
- Reduction of the phenomenon of school dropout.

2. The winning choice

The sudden arrival of the pandemic, with repercussions on traditional teaching, was a real tsunami that wiped out teaching methodologies consolidated for decades.

In this real revolution of the paradigm, only the schools that, in time, had equipped themselves with innovative tools and alternative methodologies, were able in a short time to react and respond to the emerging needs.

Our Institute, one of the first in Italy to integrate the use of cloud systems into its technical-IT equipment for staff work routines, having invested over the years in designing and training staff, has succeeded in a few days, to transfer all traditional teaching to distance learning and, finally, to find the right balance between the two.

Starting from pilot projects and best practices already illustrated in the paper by the same authors *"A school without borders: solutions for the redefinition of learning in a suburban school"*[1], extending the winning solutions to the entire didactic program, the training proposal for students has not undergone significant changes.

For years the authors, in collaboration with the "Futura" project of the Italian Ministry of Education, have been carrying presentations around Italy to train teaching staff on the use of tools for integrated teaching.

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[1] https://www.aicanet.it/documents/10776/1476921/Didamatica17_paper_14.pdf/

These methodologies had already been put in place to cope with some calamities that have hit Liguria over the years.

Among the most important, which requested to modify the teaching by replacing the on-site one with the remote one, we remember the storm in the Gulf of Tigullio and the collapse of the "Morandi" bridge in 2018.

Figure 1 - Press review Gulf of Tigullio storm

3. From theory to practice

3.1 Integration between learning and logistic

In light of the continuous regulatory changes linked to the pandemic, the timetables of the individual classes (often divided into subgroups) and, consequently, the working hours of the teaching staff, have undergone continuous variations, some with minimal impact (exchange between classes in the management of the entrance brackets), others with effects extended to collectivity such as, for example, the migration from an architecture to entire classes that alternate moments of presence with others of remote activity to one that envisages the temporal contemporaneity of the lessons, but not the spatial one, with a percentage of pupils per class, linked the attendance coefficients indicated by the Government, Scientific Committees and the Liguria Region, remotely linked to the lesson held in the classroom by the teacher and the team ni. The aim of guaranteeing fair rotations for all students and teachers in terms of work in presence / distance and advancement in the individual disciplines has made school time management particularly complicated. In the final balance, numerous versions of the timetables themselves were developed, most of which never came into force, in an attempt to adapt the logistical aspects to the educational paradigm of the Institute, already strongly characterized by the use of integrated digital teaching. The engine of these continuous variations was the search for an optimal solution, which could safeguard the didactic-disciplinary continuity, without distorting the structure of distance learning developed and consolidated in previous years (later taken as a model by many Genoese and non-Genoese institutes), not failing to provide continuous support to staff, students and their families.

3.2 Digital Divide - The Cloudready solution

A need that emerged in adopting Integrated Digital Learning was to find devices on the market.

The *Digital Divide,* as noted by the Italian Institute of Statistics ISTAT, was the main obstacle in the use of education during the pandemic.
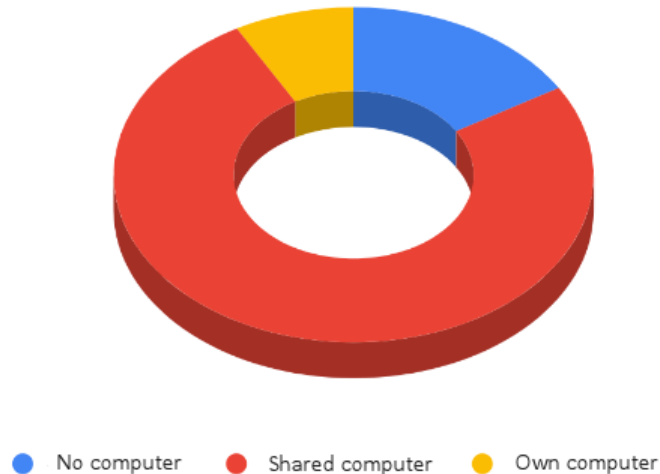

Figure 2 - ISTAT Detection on Digital Divide

The procurement of devices, mainly notebooks, was a problem, not due to financial shortcomings, sufficiently guaranteed by the State, but due to difficulties in supplying them on the market.

To overcome this difficulty, our Institute has decided to recycle old devices that have been abandoned due to age.

It was decided to use a derivative of the Chromium OS open source project, called Cloudready, as an Operating System.

This choice made it possible to find, at no cost, about twenty devices to be entrusted, on loan for free use, to students without a device.

Furthermore, with the ministerial grants, packages have been purchased to guarantee Internet connectivity.

In this way, the students were able to use a functional and modern device for the entire school year and enjoy a connection to be able to follow the synchronous lessons online.

3.3 Focus on manual activities

The above processes, linked to organizational aspects as well as strictly didactic ones, were easily metabolized as regards the theoretical disciplines, in which the learning levels achieved

were in line with the theorized estimates. Greater difficulties were foreseen, and the facts have shown the sensibility of this forecast, in laboratory subjects, at the center of the interests of students who choose a path in professional education and, also at the level of literature, considered to be disinclined to a focused digital curvature, also, on activities carried out remotely. Our challenge was to keep the laboratories of the sector (thermo-hydraulic, electrical and mechanical) at the center of the learning processes, bypassing the walls of the "prison" in which they were confined due to the pandemic.

4. Gamification in practical subjects (laboratory is a playground)

The Gamification technique, "*The use of elements, dynamics and mechanics of the game in contexts other than the game*"[2], is increasingly adopted also at company level in employee training, as it is recognized as an extremely effective tool for achieving the following target:

- Increase the ability to use new digital technologies in processes.
- Increase awareness of processes.
- Improve the attitude to search for innovative solutions.

The use of Gamification in school education is extremely incisive, as the *stakeholders are particularly* inclined to the world of games.

The four keywords of Gamification (*Motivation, Involvement, Learning, Research*) are widely reflected in an educational context, focused on the manual skills and competences of learners.

Figure 3 - Words cloud around Gamification

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[2] Deterding et al., 2011

Motivation

The challenge, inherent in the "game", is a very effective means to increase the student's motivation to reach the final goal, deconstructing the concept of grade, transforming it into success and personal satisfaction.

The use of familiar tools, mainly the smartphone, and of comprehensible communication methods, videos and images, make the use of the product pleasant.

Involvement

According to Werbach and Hunter, our brains are programmed to solve puzzles and constantly need the feedback stimuli and experiences that games provide.

The authors state that: *"In study after study, games have been shown to increase dopamine levels in the brain, an organic molecule associated with pleasure, and also found parallels between the brain's response to games and the process of involvement.* "[3]

Learning

Tom Malone[4], considered the precursor of Gamification, was the first, in 1980, to analyze a new application of video games, trying to study its use in the world of education. The author demonstrated how the degree of learning of children increased. exponentially due to the integration of pedagogical exercises through the use of video games.

Research

In any playful context, if the game is exciting and the rules are not too complicated, the participants will be continuously motivated to improve their results, not only through known strategies, but induced to develop new and different approaches to find optimal solutions. This spirit of constant innovation is perfectly scalable in the school environment, as well as at the basis of new research strategies in business contexts.

A fundamental role in achieving the expected learning objectives, is covered by the narrative which, therefore, must be thought and designed with a lot of attention, both in terms of subject and screenplay, and of result.

The strength of gamification is the opportunity to combine content, teaching and learning skills in a familiar environment. The teacher will provide specific content with a process adapted to the learning context and the students' profiles, motivating them and making teaching more attractive and inclusive.

The idea behind this project was to transform a series of laboratory exercises, planned for a mechanical workshop of a professional institute, into a set of a detective film, in which the skills and knowledge of the student are stimulated and strengthened to solve a puzzle.

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[3] Werbach & Hunter, 2012
[4] Malone, TW, 1980. What makes things fun to learn? A study of intrinsically motivating computer games (Doctoral dissertation, ProQuest Information & Learning)

The need to make up for the decrease in hours of laboratory practice, due to the teaching adopted during the pandemic, was the starting point for using a new approach, to guarantee the learning of the fundamental knowledge of technical-practical subjects, central to the educational process of adolescents who have chosen to train as highly professional figures.

5.   An hybrid Learning Unit "Murder in the garage"

To implement what was highlighted in the previous paragraph, a learning unit was designed and built, the final product of which is a Google module suitably equipped with multimedia inserts. To present the activity to the students, a sample form was created, answering the questions of which the student is transported into a role-playing game, in which he plays the role (*identification*[5]) of Josh Ritacchi, a private investigator dealing with a case of murder that took place in a mechanical workshop. The following figure 4 shows the cover image that opens the adventure.

Figure 4 - Murder in the garage

To solve the case, the player will have to rely on his observation skills and his skills in the mechanical-laboratory field.

During the investigation, in fact, Ritacchi will be faced with anomalous situations with respect to the normal functioning of the vehicles present in the workshop and, if able to detect and correct the anomaly, he will obtain clues that will allow him to eliminate, in a sequential manner, the suspects. gradually cleared of the clues themselves.

In this way, those which, in reality, are real disciplinary questions, strictly linked to the subjects of address, are masked as plot moments. These questions have been classified according to their complexity and, consequently, the positive or negative effects associated with each answer are closely linked with the difficulty coefficient of the question. By mistaking the first question, for example, the one classified as the simplest, the killer will be able to escape and the case will not be solved. For the subsequent ones, on the other hand, the investigation continues even in the event of an error but, having reached the end of the same, the investigator will lack some clues necessary to identify the culprit with certainty. For the more complicated questions, however, the protagonist has a sort of "bonus" at his disposal, linked to the possibility of consulting a mechanics manual, before tackling the problem.

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[5] Cohen, J. (2001). Defining identification: A theoretical look at the identification of audiences with media characters. Mass communication & society, 4 (3), 245-264.

Figure 5 represents the first of the puzzles that the protagonist will have to solve. The investigator, after observing the symptoms of the fault on the processing sheet relating to the victim's car, will be called to identify the component of the engine tampered with by the killer. Since this question is classified as "simple", any wrong answer to it would imply the killer's escape and the relative failure of the investigation.

Figure 5 - Disciplinary question

Regardless of the complexity of the question, each proposed solution is followed by a link that justifies the correctness or otherwise of the answer given. In this way, students are provided with real feedback and not just mere performance information. Only by solving all the puzzles correctly, the investigator will have the entire set of clues at his disposal, in order to cross them with the information that characterizes the individual suspects (both relating to their physical appearance and their personal and professional attitudes), to then being able to identify the culprit without the possibility of error. The application provides, in case of uncertainty, the possibility of carrying out a recap of the clues collected, at the end of which, in any case, Josh Ritacchi, nailed to the great responsibilities imposed by his profession, will be called to accuse one of the suspects, as represented in the following figure 6.

CHI E' IL COLPEVOLE ? *

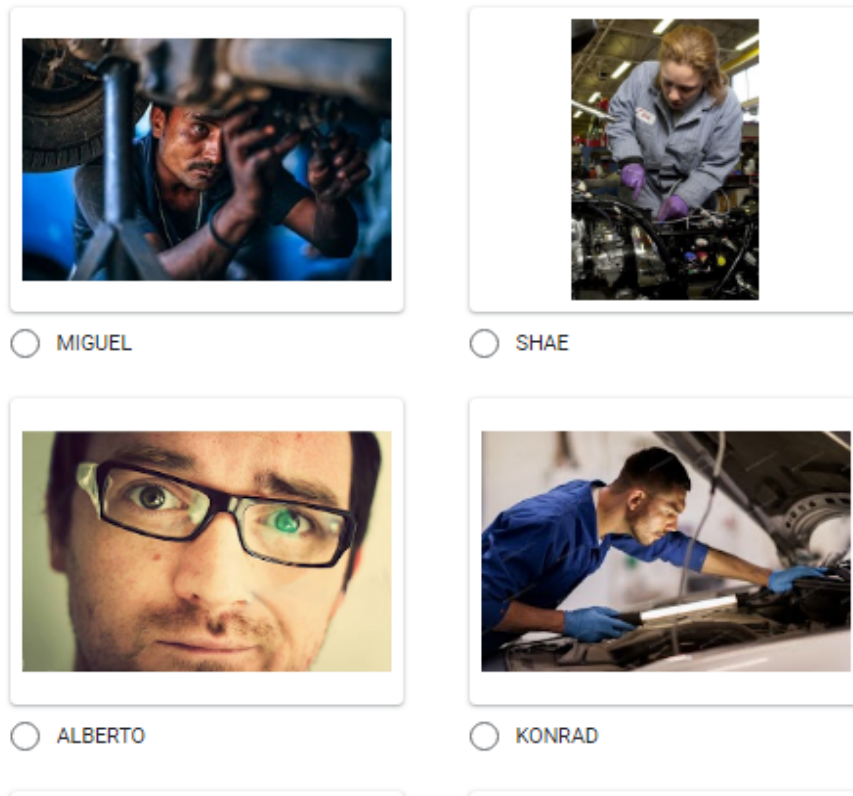○ MIGUEL

○ SHAE

○ ALBERTO

○ KONRAD

Figure 6 - Guilty accusation

The following figure, on the other hand, represents an extract of the graph on which the adventure was modeled, relating to one of the questions with a high coefficient of difficulty and to the player's possible choice to rely on a manual before choosing the answer.
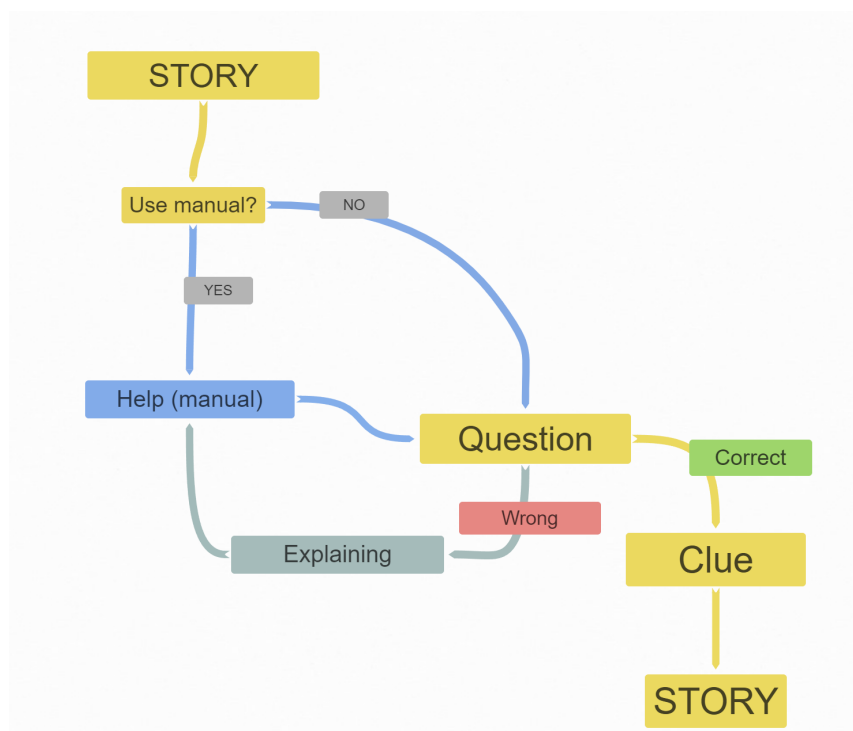

Figure 7 - Tree-lined graph extract

After presenting the prototype to the students, they were entrusted with the delivery of a dedicated learning unit. The assignment of activities within the working groups, managed independently by the students, was based on the transposition of what was proposed in the setup phase into a cinematic environment. The adventure starring Josh Ritacchi, in fact, can easily be imagined as the plot of a film noir and, consequently, the activities in which to outline the realization of the finished product can be compared to the various stages of processing a film. With this in mind, the following tasks were assigned to each working group, so that the members could divide into subgroups with a specific target:

- Subject - Choice of the context in which to play the story, of the characters and of the main events (Sessions brainstorming of the entire group)
- Direction - Transposition of the plot of the story onto a graph and creation of the module that reproduces it
- Screenplay - Writing of the textual parts
- Scenography - Research and creation of multimedia elements to accompany the work
- Assembly - Insertion in the module created by the subgroup " Direction "of the contents found and created by the groups" Screenplay "and" Scenography "
- Post Production - Test of the connections between the various sections

From the details of the assigned tasks, the hybrid characterization of the proposed learning units emerges, as the completion of the individual activities both the use of digital tools and "unplugged" work moments. By way of example, the directors will work both with pen and paper, to trace the graph of the story, and with digital devices, for the electronic drafting of the final version of the graph and for the creation of the module that replicates the planned paths.

In the following figure, the applications made by some students.

From the discussion to understand the effectiveness of the proposed teaching method, it emerged that the students felt more motivated in learning, in light of their direct involvement, conveyed by the game mechanism.
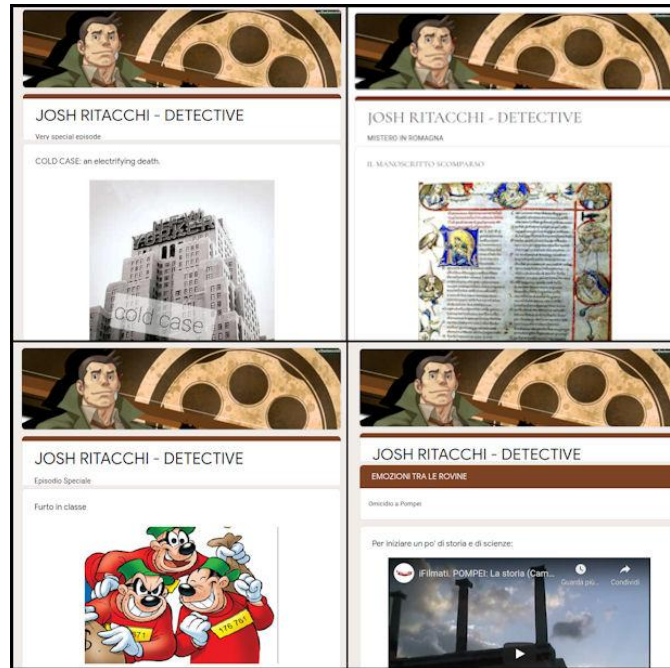
Figure 8 - Adventures made by students

6. Conclusions

The Odero Institute has always placed the needs of students, who are often hindered in the learning process by affective, socio-economic and cultural at the center of the educational paradigm on which the educational offer is sufficient.

The explosion of the pandemic has accentuated the discomfort of users, with the risk of increasing the rate of early school leaving, due to impediments in the use of digital content and, more generally, of everything related to the concept of integrated digital teaching . In response to this, a group of three teachers acted as a flywheel in a process of deconstructing and reconstructing the learning units linked to the practical disciplines, restoring the balance necessary to achieve academic success for young people who have chosen an education path that privileges learning by doing.

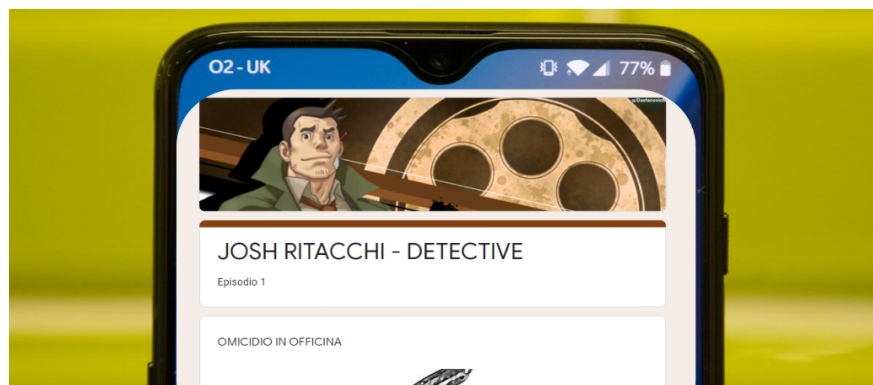The following figure shows the display on the mobile device of the application created, accessible at the link: https://forms.gle/P5hr4JDAQtQnXp8A7

Figure 9 - Application on mobile device

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