4th International Conference on Higher Education Advances (HEAd'18)
Universitat Politècnica de València, València, 2018
DOI: http://dx.doi.org/10.4995/HEAd18.2018.7891

Digitization of Analog Phonic Archives in a University Lab: A Report on a Young Apprenticeship Initiative

Ludovico, Luca Andrea[a]; and Presti, Giorgio[b]
[a]Laboratorio di Informatica Musicale, Dipartimento di Informatica "Giovanni degli Antoni", Università degli Studi di Milano, Italy [b]Laboratorio di Informatica Musicale, Dipartimento di Informatica "Giovanni degli Antoni", Università degli Studi di Milano

Abstract

This paper discusses an initiative of young apprenticeship for Italian secondary school students, carried out in a university lab rather than in a traditional working environment. The practical aim of the proposal was to make participants digitize phonic archives on analog media, such as open-reel tapes and vinyl records. The goal of the paper is to provide a comprehensive review of this experience, highlighting the educational value of young apprenticeship activities in an academic context and critically analyzing its strengths and weaknesses. The work will also discuss the feedback received from students.

Keywords: *Young apprenticeship; music; audio; digitization; secondary school.*

1. Introduction

Young apprenticeship is an educational approach in which students are trained to consider knowledge and skills (the means) as tools to gain expertise in resolving concrete problems (the goal). During this experience, the professional skills acquired by imitation and manipulative experience are reciprocally subject to self-reflection and critical re-elaboration (the means) in order to enucleate the knowledge and abilities that are implied on an operational level (the goal). The idea is to overcome the traditional assumption "learn first, do later": from this point of view, the school environment should be less distant from real life, as well as work experiences should be part of the development of students. In this vision, theoretical knowledge and practical skills are not antithetical, but they cooperate in the process of teaching and learning (Gentili, 2016).

Apprenticeship can be an experience of high educational value that allows students to reflect on their training and professional future thanks to a controlled and time-limited experience. As stated by Gardner (2010), during secondary school students acquire abstract thinking abilities. This experience let them form an idea of the world of work and of the responsibilities that citizens have, so that they can begin to act accordingly.

In Italy, the exchange between the education system and the labor market is a crucial part of Law 107/2015, also known as the "Good School" reform. This document promotes and introduces in the school system a number of hours (ranging from 200 hours for high schools to 400 for professional and technical institutes) to be spent during the final three years of studies on the workplace, at private or public institutions. The young apprenticeship program, addressing participants aged from 16 to 19, was established to provide secondary school students with the opportunity to gain knowledge, competences, and skills in a specific vocational area and to achieve a relevant qualification outside classrooms. The reform establishes the mandatory nature of young apprenticeship for all secondary-school students, who will not allow to obtain their diploma without completing a 200 or 400 hour-long path. At the moment of writing, in Italy there is a clear discrepancy between supply and demand, which inevitably leads to misconceptions and forced interpretations: examples are professional assignments having very little educational value (e.g., serving in a fast food restaurant) and the promotion of non-vocational initiatives to the rank of young apprenticeship experiences (e.g., classroom presentations by external professionals). These problems have recently led to student demonstrations and strikes, culminating in the marches of 13 October 2017 in 70 Italian cities.

The reform is in its early stages, and in this evolving context a particular role is played by universities and research laboratories that are launching young apprenticeship proposals. Due to the intrinsic nature of these institutions, students' work is not seen as a goal, but rather as a means to acquire scientific knowledge and highly-specialized know-how, using the scientific method to face and solve problems, under the expert guidance of researchers and scholars. This is the case described in the present work, namely an experience of young apprenticeship at the Laboratory of Music Informatics (LIM) of the University of Milan.

Even if the proposal discussed below implies the use of ad-hoc equipment and digital technologies, the purpose of the paper is not to detail technical processes. Rather, our goal is to provide a critical review of an apprenticeship initiative occurring in a university environment, describing both the achieved educational goals and some unexpected practical implications, as well as a number of issues that emerged during the experience.

This paper is organized as follows: Section 2 describes the background of the proposal, Section 3 gives details about the goals of the initiative, Section 4 provides details on the activities proposed and carried out, Section 5 reports student feedbacks, and finally Section 6 summarizes the achievements and draws conclusions.

2. Background

Young apprenticeship has been conceived to make students operate in a work environment, and an experience in an academic context could seem a forced interpretation. Nevertheless, there are good reasons to head in this direction: first, a mutual exchange between secondary school and university can seal the partnership of education and culture. The idea of education as an experience to support culture, and culture as an experience to boost education has inspired the Memorandum of Understanding between the Italian Education and Culture Ministries, aiming to create opportunities to access knowledge through the structural cooperation between education and cultural institutions, in order to develop a society of knowledge. Moreover, a young apprenticeship program within an academic environment is coherent with the emerging trend known as *third mission* of universities, which includes dissemination or outreach activities aimed at promoting their public engagement. This dimension recalls the changing role of knowledge diffusion and circulation in its growth (Laredo, 2007), also in relation to the entrepreneurial model promoted by policy makers and university decision makers (Gulbrandsen & Slipersaeter, 2007). Launching such an initiative in a university implies a vision of apprenticeship as an initiative of high educational value, where young students do not simply acquire practical skills, but they are also administered theoretical and methodological principles, research perspectives and early training experiences.

In this context, the LIM launched in January 2017 a proposal aiming at the digitization of phonic material from analog media, i.e. vinyl records and magnetic tapes. The know-how acquired by the staff thanks to past prestigious collaborations (e.g., Bolshoi and La Scala theatres) and the availability of suitable technologies and devices make this lab a privileged place to conduct hands-on experiences on music equipment, under the guidance of skilled domain experts. Finally, working inside a university lab gives students the opportunity to explore more theoretical aspects, such as the bases of information theory and the historical/technological evolution of music encoding, preservation and experience. In this way, music becomes a bridge towards multidisciplinary educational subjects, including math, physics, history, computer science, and cultural heritage.

3. Goals of the Proposal

Concerning students' growth, the main educational goal [G1] was to provide them with a comprehensive overview of the lifecycle of analogically recorded sound, including physical cleaning and mounting of media over ad-hoc equipment, fine tuning of parameters for analog-to-digital conversion, simple editing operations in the digital domain, file naming policies, and the choice of digital formats to preserve information. In doing so, students were required to adopt scientific methods and approaches, to learn procedures and good practices, to break down single problems into sub-problems (*divide and conquer*), to use self-reflection, peer cooperation and expert assistance, when required. Another goal, connected to the third mission, was to offer high schools and vocational institutions a valid alternative with respect to other working environments, hard to involve in young apprenticeship initiatives [G2].

Finally, within the Department of Computer Science of the University of Milan, the LIM is the reference lab for the three-year degree course in Music Informatics. Despite orientation and dissemination activities, this educational proposal is little known to secondary school students. So, another aim of the initiative is to attract future students, make them experience this environment, and foster the most motivated ones to enroll in the course of Music Informatics [G3]. Moreover, let us mention the need in STEM-related academic world to overcome the gender gap that typically afflicts ICT courses (Sax et al., 2017). Schools were explicitly invited to send an equal number of male and female students. Even if the current proposal was attended by only 30% of female participants, this number is relevant if compared with students' applications to 2016/2017 courses: 115 males (87%) vs. 17 females (13%) in Music Informatics, 190 males (90%) vs. 21 females (10%) in Computer Science.

4. Young Apprenticeship Work Plan

The experience at the LIM was planned to span over 40 hours, including an initial training lesson focusing on three aspects: i) organizational and logistic issues, ii) fundamentals about sound definition, production, digitization, editing and preservation, and iii) explanations and practical demonstrations about the use of available devices. The purpose of the introductory lesson was to give students the scientific background to mindfully accomplish their work. The provided conceptual tools should help them avoid mistakes and handle critical situations autonomously (in any case, throughout the apprenticeship activities, domain experts were always physically present in the lab, and ready to intervene on theoretical and practical issues). The small number of students involved (max. 8 at a time) allowed to turn a traditional lesson into a continuous dialogue among teachers and learners, also encouraging peer discussion. One of the goals of this session was to build a common knowledge base for students presenting heterogeneous backgrounds. As shown by the results of a questionnaire administered to participants, only 62% of them declared to have a musical background, either vocational or non-professional. Concerning their studies, 24% of participants came from musical and vocational institutes, 76% from classical and scientific lyceums; 52.5% of them affirmed to attend the third year (in Italy, superior education lasts 5 years), 42.5% the fourth, and the remaining part other grades. Topics were organized into 6 units, providing in a limited timespan (about 4 hours) an overview of the core subjects of sound music handling: Acoustics; Electronics (transducers, amplifiers, analog recording technology); Psychoacoustics (hearing thresholds, masking effects); Information theory (Nyquist-Shannon theorem, Fourier transform, quantization); Computer science (data formats, statistical compression, databases); Restoration good practices (noise sources, equalization and dynamics compression, spectral processing). Theoretical explanations were interleaved with acoustic experiments and live demos. Besides, some topics encouraged discussions about cultural aspects, such as the evolution of music experience and its transformation.

After this theoretical part, students were instructed about the use of available hardware and software digitization equipment. Functions and operations (such as calibration, analog media cleaning and mounting) were explained through a hands-on approach, delegating a better comprehension to experiential learning (Kolb, 2014). All devices, grouped into a sound-proof dedicated space, included: two Fostex B 77 MKII and an Otari MX-55 tape recorders; a Thorens TD 166 MKVI turntable; a Digidesign Digi 002 Rack analog-to-digital audio interface; an Epson Expression 10000XL A3 professional scanner for iconographic materials. Concerning software tools, participants mainly had to use: Reaper, a multi-platform Digital Audio Workstation (DAW); iZotope RX, a software suite for audio restoration; PgAdmin 4, an open source management tool for PostgreSQL used to input data and metadata into a database.

The practical goal of this proposal was to make participants produce a number of digital objects from the original analog media, working autonomously but with the possibility to ask for expert support. Järvelä and Järvenoja (2011) and Zimmerman (2008) describe self-regulation as the key for a successful learning process, since it helps students to create their own method and strengthen their skills, to apply the best strategies to reach their goals, to control their performance and to evaluate their progress (Wolters et al., 2011).

The heterogeneity of proposed activities, ranging from media cleaning and mounting to digital restoration and metadata classification, aims at presenting the complete lifecycle of information entities during a digitization campaign. Students were assigned quite general tasks, such as “Today you will focus on vinyl-record digitization” or “In the next hours you will have to improve the organization of the file system”, leaving them free to form groups, identify parallelizable subtasks, and manage their time. When working in specialized subgroups, students were invited to rotate day by day on multiple tasks, to achieve a complete view of the digitization process.

During their apprenticeship period, participants faced numerous critical situations (e.g., broken tapes, scratched vinyl records, overloaded audio levels, mismatch in track lists, etc.). Even if working in unsupervised mode, thanks to self regulation and peer cooperation they were able to manage most situations. The need for expert supervision, usually in the form of additional explanations, emerged above all in the very first days. As some students reported, the occurrence of non-standard situations and critical issues to solve on the fly challenged them, fostering problem-solving skills and making the experience more engaging.

5. Feedbacks from Students

Participation to the initiative was extensive, well beyond the initial expectations of the proponents: in the period from February to July 2017, 14 institutes and 91 students joined the proposal. In order to understand the efficacy of the initiative under various perspectives (improvements in knowledge and skills, interest, suggestions and critical issues, etc.), at the end of the experience a survey was administered to all participants in the form of an anonymous Google form. Where possible, answers were mapped onto a 5-point Likert scale (1 = strongly disagree to 5 = strongly agree); conversely, in some cases, students were encouraged to express their ideas through free-text fields.

Concerning self-assessed computer skills and musical knowledge, declared self-confidence with computer science was 3.1±0.9, the one with music 3.5±1.0. The two resulting Gaussian distributions shown that participants initially felt more confident with music than with computer science. Analyzing the self-attributed scores at the end of the experience, the aggregated result (hardware skills, software capabilities and people interaction) scores a remarkable 4.0±0.8. The duration of the experience was positively evaluated: lasting on average 42.1±7.6 hours, it was perceived as a good choice by 82% of students, and too short by 14%, who would willingly prolong their stay; only 4% found it too long for their expectations. About students' satisfaction, the overall score (available HW/SW tools, location, staff, and proposed activities) was 4.1±0.9. The worst average score (3.7), was assigned to the location, the best one (4.7) to the lab staff. The level of students' satisfaction was impressively high, as demonstrated by the affirmative answers to the questions: "Would you join again this initiative?" (93.8%), and "Would you suggest it to other students?" (95%).

A methodologically relevant in-depth study started from the identification of two groups: highly-engaged students (HES) vs poorly-engaged students (PES), defined as follows. The former group included participants whose overall appreciation was equal or greater than 4, and answering affirmatively to the general questions: 1. "Would you repeat the young apprenticeship at the LIM?"; 2. "Would you suggest it to other students?"; 3. "Do you feel that this experience enriched you from the scientific and/or cultural point of view?"; and 4. "Do you feel that this experience enriched you from a professional point of view?". The HES group was composed by 69% of the participants; the PES group was formed by all the other students (31%). Considering only the answers with statistically significant differences (effect size $\theta > 0.8$) between HES and PES, what emerges in the latter group is a poorly perceived usefulness for theoretical aspects and some practices (tapes and scans).

Probably, the most interesting evaluations have been expressed as free-text suggestions. Unfortunately, reporting them entirely would go beyond the scope of this work. In our analysis process, we tried to group them by subject. The proposed tasks raised interest, both from a cultural and from a scientific point of view, and our staff emerged as the added value of the initiative. Students appreciated to feel more responsible in a self-regulation context, and some of them asked for more computer-related activities, such as coding. Among the downsides, some participants found activities too repetitive and boring, the dedicated space too dirty and crowded, and asked for a better organization. These issues will be addressed during a future re-design of the experience.

6. Achievements and Final Remarks

With respect to the aims listed in Section 3, goal G1 was successfully achieved: almost all students, after 40 to 80 hours of hands-on activities dealing with phonic material, showed a sufficient degree of competences and skills in mounting, ripping, and restoring analog phonic materials. Digitized media (more than 250 vinyl records and 50 magnetic tapes) were progressively published on line in a reserved section of LIM web site, thus increasing the motivation of students. During their daily activities, young participants demonstrated responsibility, willingness to cooperate with peers and with the lab staff, and even interest towards other research subjects. Although students worked in an isolated sound-proof room, their behavior was irreproachable: timetables were respected, no equipment or media was damaged, no theft occurred, and the assigned tasks were successfully carried out. Goal G2, i.e. involving local institutions and creating synergies, has been achieved too, as demonstrated by the high interest raised in the first year, by the renewal of collaborations during this school year, and by the request for additional dissemination activities. Finally, as it concerns goal G3, the consequences in terms of an increased enrollment to our courses, more realistic expectations towards the disciplinary context, better motivation, and the reduction of gender gap cannot be evaluated after a one-year experience, rather they have to be monitored in the medium and long term.

In conclusion, thanks to this initiative we have been able to engage about 100 young students, providing them with insights on scientific research, intangible cultural heritage, and professional skills; we obtained some practical results, by an extensive digitization campaign lasting about 3500 hours; and, finally, we revitalized activities, competences, and equipment that once characterized our lab making it an international point of reference. But a young apprenticeship initiative does not come at no cost: integrating young and inexperienced students has a profound impact on available resources in terms of time, space, and equipment, and it involves a rethinking of consolidated logistical processes and resource management.

References

Gardner, H. (Ed.). (2010). Responsibility at work: how leading professionals act (or don't act) responsibly. John Wiley & Sons.

Gentili, C. (2016). L’alternanza scuola-lavoro: paradigmi pedagogici e modelli didattici. *Nuova secondaria, 10*, 16-37.

Gulbrandsen, M., & Slipersaeter, S. (2007). The third mission and the entrepreneurial university model. *Universities and strategic knowledge creation*, 112-143.

Järvelä, S. and Järvenoja, H. (2011). Socially constructed self-regulated learning and motivation regulation in collaborative learning groups. *Teachers College Record, 113*(2), 350-374.

Kolb, D. A. (2014). *Experiential learning: Experience as the source of learning and development*. FT press.

Laredo, P. (2007). Revisiting the third mission of universities: Toward a renewed categorization of university activities? *Higher education policy, 20*(4), 441-456.

Sax, L.J., Lehman, K.J., Jacobs, J.A., Kanny, M.A., Lim, G., Monje-Paulson, L., & Zimmerman, H. B. (2017). Anatomy of an enduring gender gap: The evolution of women’s participation in Computer Science. *The Journal of Higher Education, 88*(2), 258-293.

Wolters, C. A., Benzon, M. B., & Arroyo-Giner, C. (2011). Assessing strategies for the self-regulation of motivation. *Handbook of self-regulation of learning and performance*, 298-312.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American educational research journal*, *45*(1), 166-183.