Learning to Sing Byzantine Music Online: The Intersection of Rich Content Education and Special Education

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Abstract: *In the majority of scientific fields, as far as instruction is concerned, analysis, synthesis and resynthesis of findings and clues can be conveyed with multimedia enriched e-Learning courses. In other disciplines, however, there is peremptory request for exact appreciation, consideration and acknowledgement for accurate diagnoses from scientific data. Even further, strict accreditation is needed, setting up a blockade in the expansion of on-line teaching. Nevertheless, as interactivity increases the potential for regularly hosted, nearly private sessions over the Internet, with photorealism alongside an immense potential offered by advances in Mobile Communication and Learning, there are hopes that extremely demanding teaching, like musical mentoring, medical training or special education counseling, may become commodities offered by on-line courses, seminars and institutes. As this perspective lies within the intersection of formal and non-formal education, it provides reasonable optimism for a constructive transformation of immature forms of teaching to reliable, accredited nomenclatures of remote tête-à-tête tutoring over the Web.*

Keywords: *On-line Education, Multimedia Learning, Rich-content, Blended Learning, Accreditation and Skills, Educational TV*

1. INTRODUCTION

E-Learning constitutes a very promising continuum for decisively improving modern synchronous or asynchronous education; handling imminently factual content rather than merely stylish in expression texts, it employs cutting-edge technologies, that most of the times are not counterbalanced by classic education initiatives. Therefore, leading the way to offering "rich content" education, it contributes to developing massive multimedia communication structures, in unprecedented size, quality and quantity mashups of related information, typically assessed by a simple point-and-click method.

Particularly, for tertiary education, the asymmetrical growth of information and communication technologies (ICTs) offers a vehicle for providing services that some years ago were thought of as impossible [1]. In every day practices, by digitally combining and synchronizing videos along with texts, sounds, animations, digital libraries and assessment tools, vast repositories have emerged as dominant media for educational purposes in many Massive Open Online Course (MOOC) platforms [2].

Recently, the term "rich content" has been used for describing these commodities, which extend the notion of "learning objects" to highly interactive spheres of influence, as is the case of Mobile Communication and Learning [3].

Learning Object (aka LO) is any entity, digital or non-digital, that can be used, re-used or referenced during technology-supported learning [4]. Examples of learning objects include multimedia content, instructional content, instructional software and software tools that are extensively used by technology transferring methodologies in on-line learning [5].

Patterns of smaller reusable digital resources include digital pictures or photographs, animation and video clips, small pieces of text, simulations and smaller applications available via Web. Examples of bigger reusable digital resources include entire web pages that combine text, pictures and other means, or applications that offer a complete educational experience [6].

Rich content relies on high quality visual components offered via online learning platforms. They are particularly interesting for students who are visual learners and who learn best by watching the short format engaging videos rather

than by just reading or listening to course materials. The paper focuses on the categorization of factors that are responsible for the success/popularity of online learning videos [7].

Rich content, cropping out of high quality multimedia design, is accessed via Content Management Systems and Virtual Learning Environments [3]. The hype for more learning resources ameliorates the quality of the offered services, drives multimedia production close to TV quality standards, and redefines learning communities in a saga for global penetration and distribution (Fig. 1).

Figure 1. *Microsoft technologies for Mobile Learning instruction paradigms*

By exploiting rich content LOs, e-learning pledges to improve the quality of tertiary education and the effectiveness of learning. Due to the ubiquitous use of ICTs in the form of Mobile Communication, e-Learning gives easier and almost instant access to data and information in a digital form, empowering manipulations that are sometimes not possible otherwise. E-Learning can lead to innovative pedagogic methods, new ways of learning and interacting, due to the ease for sharing these new practices among learners and teachers, as well as by easier comparisons between teaching materials and methods [7][8]. E-Learning can also be seen as a promising way to reduce the cost of tertiary education, which is critical for expanding and widening its access worldwide.

E-Learning, and favorably its offspring for Multimedia Learning, is quite wide in conception and even wider in instrumentation. It implies the use of online services along with whatever resources the Web offers. A global societal shift takes place every time the World Wide Web (W3) shifts paradigm, i.e. from Web 2.0 to the current phase of Web 3.0. At the same time, it takes advantage of electronic gadgets and paraphernalia with omnipresent identity characteristics. E-Learning can also provide support services to classic education, like the authorized online distribution of presentations, tutorials, notes, and e-tests. At the other end of the spectrum, it may

become the vehicle for integrated services provision, as is in the case of online universities [6].

However, although Rich Content is adding value to high quality educational TV like productions [9] by confiscating all the transactions held between instructors and learners, there is a boundary that is difficult to be surpassed: the accreditation part. Indeed, while e-Learning has penetrated all fields of knowledge, and virtually any whatever Bachelor of Science may be offered more or less in its on-line version from an "Open University" [10], some fields like Medicine, are characterized by educational conflicts, when it comes to inner core nomenclatures: it has not been heard of a patient, yet, entrusting himself to a doctor that has been certified solely with on-line courses.

In this paper, examples from medicine and musicology will be deployed, i.e. from disciplines that manipulate media rich content that has a very low tolerance for misinterpretations (Fig. 2).

The focus of this specific research, however, emphasizes on musical instruction and teaching.
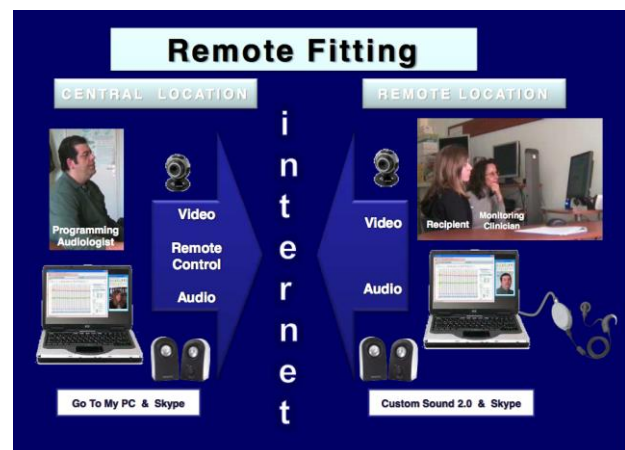
Figure 2. *The remote fitting procedures over the Internet, for cochlear implant recipients, audiologists and their fitting clinicians. Courtesy of Dr. G. Kyriafinis, AHEPA General Hospital Cochlear Implantation Unit, Thessaloniki, Greece.*

Key components of e-Learning that promote knowledge management and performance support are:

– Content development tools and architectures
– Collaborative learning tools
– Assessment tools

As it stands, e-Learning becomes, amongst others, a valuable tool for expanding and widening access to tertiary education.

The degree of its acceptance and adaptation for forming blended learning curricula depends on the positive or negative experience instructors transcribe to the academic community and to the decision-making councils.

When mobile communication applications are well planned and suitable to task, they facilitate instruction, becoming indispensable tools for the delivery of well supported teaching; on the contrary, misfits and unapt remedies provoke embezzlement, and the parties involved, instructors, learners and technical administrators find themselves spending more time on interacting with the IT center particulars than with the content or the learning process itself [10]. In such a situation, especially when LMS and CMS are open source, a drift for extra functionality, for code improvement and plug-in versatility is needed, to adhere adequacy with self-confidence, promoting e-Learning methodologies and remedying aversion.

2. THE SOCIOECONOMIC SUBSTRATE

Although the term "Balkanization" is often used to denote territorial administrative fragmentation or co-existence of mutually hostile groups under one government [11], the Balkans and Europe in general are by far the most advanced regions of this planet in conferring tertiary education skills and accreditations, both in quantity and quality.

However, as one moves eastwards or southwards, the situation deteriorates drastically, as far as education is related to the structure and functioning of localized societies.

Therefore, e-Learning conveys a potential that may extend its benefits, under certain circumstances, beyond segregational lines or exaggerated sectarianism. In a global view of the issue, a "hybrid" form of blended learning emerges as a universal all-inclusive agenda.

Learning (and instruction in general) has undergone rapid changes over the last decade in the way it takes place due to technological advances. New hardware and software tools have revolutionized the available ways that a learning object can be implemented and taught. As a result, open and distance learning is constantly spreading as a suitable and more flexible vehicle for learning in today's fast-paced lifestyle; enjoying the benefits of its ability to extend frontiers of knowledge beyond separating lines, it leads a trajectory of fruitful attainment and gains unprecedented popularity.

2.1. Modern Education Models

The new rising hybrid models for blended learning can be compared and represented as an analogy to the contemporary models of music sharing [12], where music can be replaced by the digitized learning objects (Fig. 3).

In Fig. 3, two major factors mainly affect the models of learning: the *classroom* (whether it is a physical space with the presence of both teacher
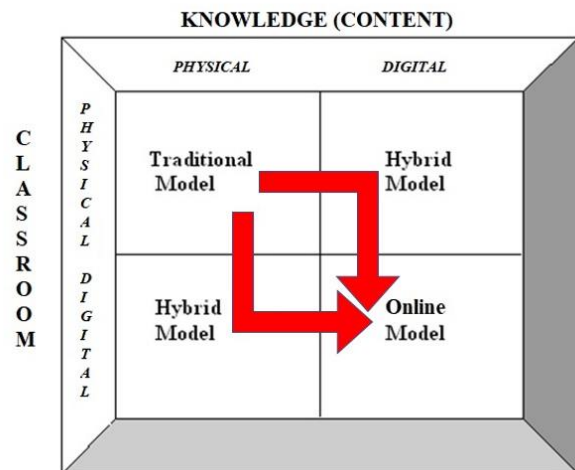
Figure 3. *A framework for learning models. The arrows show the transition from the traditional model to the online model through hybrid and blended forms.*

and student or a digital environment with no actual face-to-face meetings) and the *knowledge* to be transferred itself (learning content). On the axis of knowledge, the content is actually divided into the limited *physical* materials of a course (textbooks, notes, exercises on the blackboard and slides) and the unlimited *digital* resources that can be created for the course's needs or already exist in the web (multimedia, digital libraries, resources on demand, synchronous and asynchronous communication tools etc.). In the case of a course delivering all or most of its content (over 80%) online, it is considered to belong to the pure online model. The intermediate ways of mixing elements from traditional and online learning are considered to belong to hybrid or blended models. Another model of learning (following the online advent of mobile devices) is mobile learning (*m-learning*), which has yet some drawbacks if used as a stand-alone model but will soon be an essential extension of e-learning [13]. In addition, mobile devices can well be used for entertaining serious games to enhance the learning experience.

Moreover, these learning models can be provided either for free (by public bodies or dedicated web portals for learning) or via some business models (e.g. subscription or a-la-carte model) [14]. Whatever the case, the successful completion of the learning process requires some form of assessment and certification of the learner. Typical forms of assessment are: written examination (live in person), online tests, the successful elaboration and submission of a project.

Open universities worldwide tend to provide open and distance learning by using hybrid or purely online models. Following the social constructivist approach, instructors in such structured have to

adapt to the role of facilitators / counselors and not teachers [15].

2.2. Technologies and Learning Methods

An online learning environment should provide as many assistive tools for the needs of a course as possible. An e-class portal usually provides personalized spaces for each profile depending on the role (teacher or student) with several subsystems serving the learning process: event calendar, documents space, systems for projects submission, announcements space, forums, offline video-lessons, file exchange space, discussion groups etc. Moreover, specialized systems for teleconferences with desktop sharing and whiteboard functionalities allow real-time interaction and the virtual metaphor of the traditional classroom-style way of teaching.

Current research [16] has shown that appropriate social networks (Facebook™-style) can provide additional benefits to the learning process, particularly through the communication channels between remote groups of learners and teachers.

Hybrid learning models that are being developed seem to be increasingly appealing to adult learners and find application already in academic (postgraduate and undergraduate) courses.

2.3. Online Learning and Music

Online education systems serve mainly distance learning and can be proved as extremely helpful and successful in many disciplines, especially of theoretical nature. Another area with high rates of success in online learning is computer science, where programming languages and special purpose software can be mastered in their 'natural environment'. In general, studies show that online learning is modestly more effective, on average, than the traditional face-to-face instruction [17].

With the use of technology, Internet and multimedia dynamics, any course of theoretical nature can be presented in multiple desirable levels of complexity and accuracy, maybe even more effectively that its presentation in the traditional way of teaching. However, is this also true for music education?

Music contains many different aspects and considerations (history of music, morphology, harmony, performance etc.), which cannot be integrated into the same context. For instance, history of music could well be taught with an on-line model with good results, as it is a theoretic course. There are already such online courses available [18]. However, performing a musical instrument (or vocal/singing performance) does not belong to this category. In fact, there could be a parallelism with the science of medicine. Would it be possible for somebody to be certified as a doctor (e.g. a surgeon) only from an online distance-learning program? The answer is rather negative for obvious reasons. The main reason is: practice.

The same stands for music too. Learning how to play a musical instrument or how to sing needs a lot of practice time (apart from understanding the theoretical rules). Consequently, this kind of learning requires cultivating specific skills. If a student is left alone learning how to play the piano or sing in an autonomous and remote way, it is most likely not to perform well and eventually fail in the course. There are two reasons for that: technique and aesthetics. There is absolutely the need for guidance in person by the teacher possessing the specific skills and relevant experience. Even in the case of evaluating some kind of distant learning for such a discipline like music, there must be systems of special requirements to support it: high fidelity sound and a sense of space, fully synchronized supervision of the technique and bi-directional functionality. Mislearning of such a discipline may lead to repeated mistakes during practice by the learner. As a result, not early corrected mistakes may lead to bad habits of practice, and, thus, improper performance.

Of course, the audience that needs to learn a new skill (e.g. playing a musical instrument) should be taken into account. In case of beginners or people that want to learn something just for hobby, even YouTube™ videos with instructions prove to be adequate [19] (non-formal/amateur learning). This method, however, is not suggested for an academic course or for advanced studies at a professional level.

Although not much research is available in the literature concerning the effectiveness of a purely online model for teaching music performance, it seems that a blended approach to teaching music may be an effective solution that addresses the feedback component essential in performance-based courses, while retaining the benefits of an online-learning approach [20].

3. MUSIC INSTRUCTION OVER THE INTERNET: THE CASE OF BYZANTINE MUSIC

The term "music training" engulfs all the procedures aiming to develop such skills through practice and instruction, over a period of time, so one may be able to recognize by hearing, notes, tones, pitches, intervals, melodies, chords, rhythms, tempo, and other musical elements. In other words, music training combines theory (scales, notes, chords) with an adequate understanding of the music sounds listeners perceive in a daily basis. The more a recipient's hearing is capable of categorizing combined vocal or instrumental sounds, the better it morphologically apprehends the beauty of form, harmony and aural expression.

Ear training, one of the constituents of music instruction, is analogous to dictation in language training [18]. Once mastered, it is helpful for solfège, i.e. exercises in singing using solmization syllables.

The upmost stage for ear training is the capability to write in semantics a melody or a song heard. It is a remarkable step in the direction of musical education.

Ear training facilitates music categorization and reproduction of the melody based on hearing, without any help from semantics or musical score utilization. This capacity is crucial for composers who conceive a melody through "internal", esoteric hearing. Perceiving the acoustic dimensions of this melody, they can reproduce it either instrumentally or in writing in some form of semiotics.

Even musicians who perform already fixed up music can benefit from this rather difficult to acquire skill. It allows them to reconstruct, or as it is set-up in music terminology, to "remix" performances and produce variants. Overall, in practical terms this is the case with the American national anthem, perhaps the most frequented such clip in the virtual sphere of social media. Written and orchestrated some two centuries ago, it could not consider the potential of singing it solo in front of huge live audiences, and therefore it leaves plenty of room for variations, ameliorations and performer-centric adaptations.

Figure 4. *Left, the Aristotle University of Thessaloniki orchestra performs in the campus's open space an operatic song. The leading singer uses a microphone. Right, a well-known singer, Lady Gaga, sings solo the American national anthem, in front of a huge crowd; the lady on the left transcribes the televised event using the sign language for the deaf*

Indeed, the use of microphone alongside equipment for the electromechanical amplification of sound waves to unprecedented hearing levels has reshaped overall the field of music. As seen in Fig. 4, it allows musicians giving solo performances to address themselves to vast live or televised audiences in an immediate manner.

Even further, the use of multimedia LOs in TV style footage delivers multiple channels of communications. On the right of Fig. 4, at least four parallel channels for tranceiving the musical message are simultaneously effectuated:

1. acoustically, an excellent performance

2. for the deaf or impaired in hearing, a sign language interpretation

3. for the huge crowd that attends interactively, the lyrics roll in at the back in scrolling panels

4. the video LO conveys synchronization of bodily and kinesthetic elements with the music itself.

In a parallel manner, a music master class teacher, using the Internet based multimedia learning potential of online instruction, can address himself to remote students that would never dream otherwise of having such a privileged education.

3.1. Byzantine Music Learning distinctive features

As it is the tradition with singing, Byzantine Music mastering requires the student to develop a close mentoring relation with his or her teacher. After the basic levels, taught in amphitheaters with big audiences, a master class instructor gathers his students around him in small groups and monitors each ones individual features with every detail.

Figure 5. *Professor N. Paris instructs his choir during a mass service at the Vlatadon Monastery, Thessaloniki, Greece*

Teaching may take place in anechoic chambers or quiet offices in one-to-one, usually, or one-to-few sessions. As students advance, they participate as disciples in their master's choir, typically performing regularly in public church services (Fig. 5). Little by little, they increase their contribution to the choir's output and their ability to carry out the singing of certain hymns alone.

The major problem with Byzantine Music lies in its geographical dispersion. While the field of its exertion is highly decentralized, covering provincial parishes and congregations in remote communities, high-level instruction is available only in metropolitan areas [21][22].

Even further, as is the case with medicine, acquiring a good level of performance in singing is

not merely the case of obtaining a four- or five-year training at BSc and MSc levels, notwithstanding how talented and suitable for the task a learner may be. It requires constant practice in the field, empirical and theoretical engagement with ceremonial observances, and an overall maturing process that correlates phonetic features with neurological control over the quantitative and qualitative characteristics of the type of tone with which a person sings.

3.2. Interacting online with an AI agent

To remedy this situation, an online portal has been set-up for offering self-contained instruction over the Web at master class levels (http://byzmusiconline.ddns.net).

Although in its initial phase, it has already developed its first complete LOs (Fig. 6).
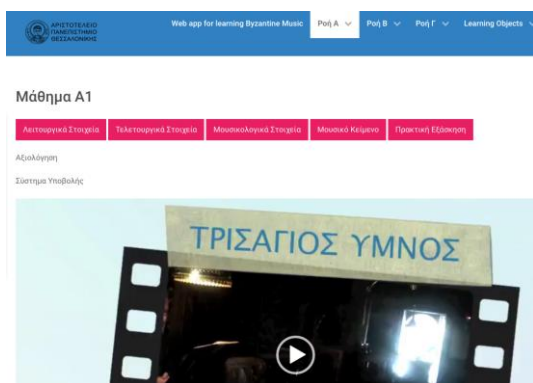
Figure 6. *An interactive LO for a Eucharist canticle in Greek*

For the learning phase, apart from the multimedia material, it is important to have a handy, library-like online assistant that serves as a "study tool".

At the first stage, there is theological and ceremonial documentation about the hymn sung. Although the learned scholar will catch up with most of the rituals seen as musicokinetic events in the main video of the LO, for most students there is need for a theoretical foundation refurbishment that will propel their awareness (Fig. 7).


Figure 7. *Online study tools for the envisaged hymn LO in the form of "learning cards". Left, a liturgical concordance elements, and right ceremonial ones*

Of course, the most difficult part lies on the musicological understanding of the singing substrate. In fact, there is ample insight on the special scales and modes used for its proper rendition. The concept of chromaticism is strongly associated with the perception of music for the peoples living in the Balkans and around the Mediterranean basin. Musical chroma is mostly associated with the music intervals [23]. The interval sizes may cause a chromatic perception in a melodious piece, which is the notion of somehow different from mainstream Western style hearings, "Eastern" in its ethno-musicological orientation, and by any means idiomatic of the great civilizations that have flourished around the Mediterranean Sea and Middle East.

The musicological insight is presented in details, as seen in the snapshot in Fig. 8.
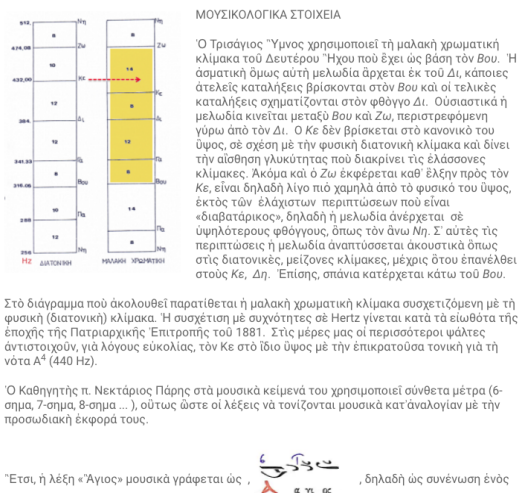
Figure 8. *Part of a musicology specific "learning card" for the hymn in perspective. It has detailed description of the chromatic substrate of the mode used*

Once the remote learner has become familiar with the theoretical foundations in ceremonial, ecclesiological and musicological matters, he may proceed with the main learning element, the video lesson of the LO. He or she will hear the prototypal performance, see the musicokinetic elements in practice and predominantly, will have always in front of him or her a link of the score sung (Fig. 9).


Figure 9. *Many concurrent channels of musicokinetic, ceremonial, singing and ecclesiological communication are present in the main event of the LO, the video lesson*

The remote learner is encouraged to repeatedly indulge himself or herself in the multimedia

material of the LO. Once one has become familiar with the level of instruction supplied, he or she may proceed with practicing alone.

Out of the many liturgical books, the learner will be provided with the exact musical score performed by the choirs (Fig. 10).
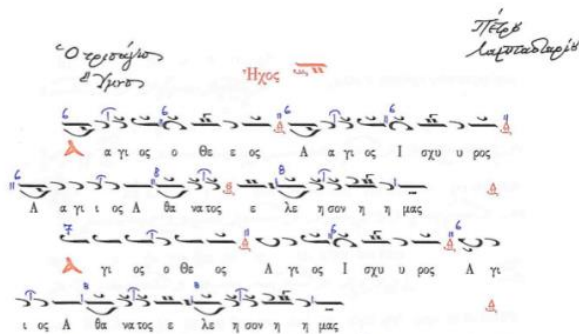
Figure 10. *Part of the complete music score of the hymn, originating from a 1760 AD grand master score, as transcribed in a modern rendition by Professor N. Paris*

The remote disciple is advised to spend ample time in practicing the musical composition. When confident enough, he may interact in a karaoke style with a multimedia support system for his learning. While playing the video, he is advised to watch carefully the moves of the hands of the instructor, as if he or she was participating in his choir, and to synchronize his or hers singing, in terms of compression, with the strong, regular, repeated patterns of knocks that form the arrangement of musical meters. At the same time, the learner hears the first syllables of each rhythmic entity encountered in composite music meters within the hymn, 6 and 8 rhythmic units for the specific two words in perspective (Fig.11).
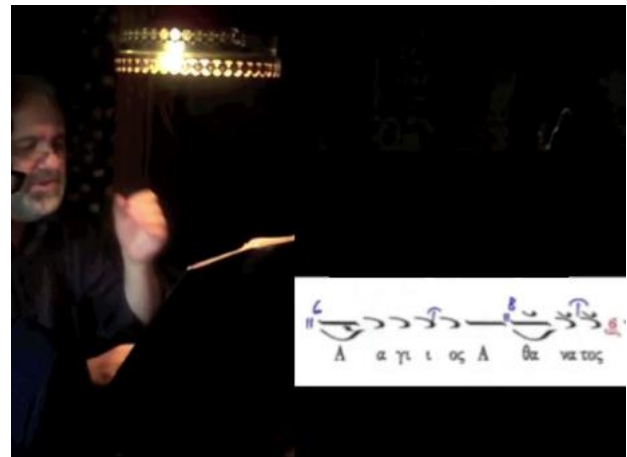

Figure 11. *The karaoke style self-practicing agent for the remote learner*

After that, he or she may invoke the second-level agent. It encourages the learner to practice having less support. He or she hears the knocks of each strong rhythmic unit in a 2/2 mode and has guidance for the beginning of each composite measure of 6/4 and 8/4 hearing a drum like knock and nothing more.

The learner is directed to repeat this stage many times so to match the compression and timing of his phonation and his breathing with that of the performing master. For women performers there is bigger margin for tolerance, since they have different tonal, phonological and breathing functional characteristics.

3.3. The research potential

For the ones that are at MSc level or further, there are, apart from the learning cards, ample theoretical treatises, in English most of the times, offered for in depth analyses of the performed hymn (Fig. 12). They provide deeper knowledge than the learning flashcards that readily appear.
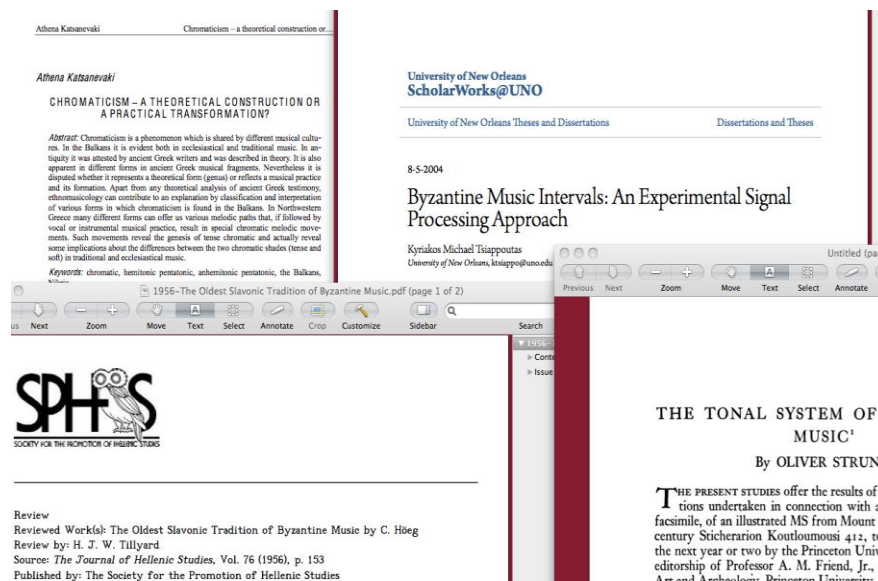
Figure 12. *Exemplar treatises suggested for further study as far as a certain LO is concerned*

They sum up to some hundreds of pages and provide grounds for comparisons between neighboring countries traditions or phonological variations that incur when the melody is sung from one language to another.

At the moment, complete support is offered for renditions in Greek. On the contrary, for the research part of the video lessons, most of the studies accompanying the video lessons are in English and a few in other European languages. However, the system envisages its core transition to languages spoken in areas like the Balkans and Middle East. English is a good option [24].

3.4. Online mentoring for personal evaluation

At any point of his online interactive navigation, the learner is provided with the means to

- send his queries to the online system supervisor
- to ask for a Skype™ session with his online mentor
- to submit his recordings so to have an evaluation of his advances in singing

as seen in Figs. 13 and 14.
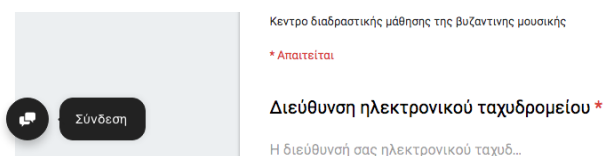
**Figure 13.** *Interacting online with the learning portal supervisor*
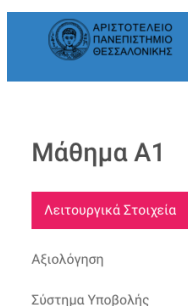
Figure 14. *Submitting one's recordings for personal evaluation and assessment*

4. CONCLUSION

To remedy the "Balkanization" effect [11] in education, the case of learning to sing Byzantine Music hymns was used as an exemplar paradigm for developing online mentoring tools and machine learning support.

As a prototypal paradigm for the development of AI support in learning to sing served the back-up system of special education counselling deployed for the rehabilitation process of cochlear implant users at the AHEPA University Hospital, Cochlear Implantation Unit, Thessaloniki, Greece.

At that center, Play Audiometry is committed with young children with and without hearing aids. It relies on techniques developed with the use of audiometric equipment. In addition, Operative Speech Therapy is carried out, and more importantly, language assessment tests are performed on a regular basis.
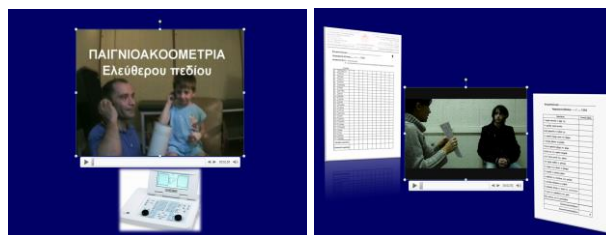
Figure 15. *Audiometric (left) and Speech Communication (right) assessments used in the rehabilitation processes of cochlear implantations*

Phonological, linguistic and musical training involves professionals and scientists activated in diverse interest groups. It seems that, after all, physicians, sound engineers, videographics producers and musicians share a common background, when demanding and vigorous education is encompassed, characterized by extensive observation, analysis and reconstitution. Assessing after all the potential of a learner to sing (as is in parallel the case of a student in medicine or special education) is a far more complex phenomenon than simply evaluating written examinations and oral tests [25].

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