Adapting Recording Studio Audio Technologies for Language Labs

Rachida Salama Primov and John Czechowicz
University of Miami

"Language learning laboratories and media centers are being thrust into an increasingly central role—they are being transformed from support facilities to ...integral venues for foreign language acquisition. In this new role, [they] are now trying to meet much greater ...demands for new services as well as for ever-improving levels of quality."

The technologization of foreign language instruction, especially at the university level, has advanced with great speed during the last few years. As new hardware and software are developed, new pedagogical techniques and strategies are uncovered; these, in turn, stimulate the desire for even faster, better or more versatile technological infrastructures. All this has served to transform foreign language instruction into a dynamic and increasingly complex endeavor that is more and more reliant on technological support and multisensory environments. In short, we have an ongoing paradigmatic revolution in foreign language instruction.

In this new paradigm, language learning laboratories and media centers are being thrust into an increasingly central role—they are being transformed from support facilities to a new central role as integral venues for foreign language acquisition. In this new role, these facilities are now trying to meet much greater demand; demands for new services as well as for ever-improving levels of quality.

Levels of performance that were widely acceptable a mere five years ago are now deemed unsatisfactory. This dynamic of ever-increasing expectations is largely driven by succeeding cohorts of students who have been systematically exposed to continued technological breakthroughs and improvements in everyday life and for whom state-of-the-art has become a normative expectation.

For many reasons, language labs have had a late start and have faced a rocky road in becoming "hi-tech", not the least of which is the technological naivete of most of us who are responsible for managing them. Understandably, the most frequent strategy for "technologizing" has been to choose the equipment offered by commercial vendors—in short, to select from among "off-the-shelf" technologies. While in the beginning this was satisfactory, at the present stage in the technological evolution of language labs, hardware needs have become much more complex and are not so easily met by packaged solutions designed for generic purposes. However, opting for custom-designed technological solutions can be a bewildering and fear-inspiring task.

Nevertheless, it can and must be done. In the future, most technological improvements in language labs will probably be made more frequently with custom-designed solutions than with "off-the-shelf" hardware. In this paper, we want to share a modest example in this direction by detailing a successful effort to identify audio technologies developed by the music recording industry and adapt them for use in a language lab. The strategy used in this effort was to rely on the expertise of one of our lab's technical staff (a student tech assistant) in audio technology and to follow standard technical practices within the recording industry in order to enhance the lab's audio capabilities.

The Foreign Languages Laboratory

In 1997, most of the equipment in the Eleonore Graves Tripp Foreign Language Laboratory of the University of Miami was totally upgraded and re-configured. Under the new configuration, twenty Windows 95 workstations (later converted to NT) were networked to an NT server. The lab now provides students with language-based computer software programs that contain both interactive audio and video formats, as well as traditional cassette tape-based audio programming. Each computer workstation is interfaced with a cassette deck and is equipped with a set of headphones and a microphone.

After the upgrading process was completed, the lab surveyed students regarding their satisfaction with the new equipment. Students were uniformly favorable to all aspects of the new services and equipment except for audio quality. They consistently complained that it was difficult to hear or to understand the sound material from the tapes and/or the computers; they also reported that they could not control the volume adequately.

Resolving this problem became the lab's top priority. The first task was to determine the specific reasons for the poor audio quality. The technical staff diagnosed the problem as audible distortion or clipping caused by a high input gain that overloaded the small four-watt amplifiers supplied with the sound cards for computers. This over-driving of the amplifiers produced cracking and break-up of the sonic material being amplified. The only way to correct this problem is to use a higher-powered amplifier that allows higher output levels with lower input gain, resulting in crisper and clearer audio signals.

Potential Solutions

After evaluating the off-the-shelf audio equipment available for language labs, the staff concluded that the audio hardware readily available for PC-based computer platforms was inadequate for our lab's needs and would not satisfactorily resolve its audio problems. Therefore, we surveyed various other technical possibilities and identified four possible strategies for resolving this problem.

The options identified were:

- Replacing the current headphones with amplified headphones.
- Replacing the current sound cards.
- Adding an in-line amplifier in the signal path to the headphones.
- Establishing a distributed headphone amplification system.

"After evaluating the off-the-shelfaudio equipment available for language labs, the staff concluded that the audio hardware that is readily available for PC-based computer platforms was inadequate for our lab's needs and would not satisfactorily resolve its audio problems."

We evaluated the cost effectiveness and practicality of each of these strategies and opted to implement the fourth strategy: the distributed headphone amplification system.

The first two solutions were discarded because they simply compensated for, but did not address, the real problem. Replacing the existing headphones with internally amplified headphones would have been the quickest and easiest solution. Placing amplifiers directly inside the headphones would have prevented the need for any major re-wiring of the existing systems and would have decreased the number of connections required; this, in turn, would have enhanced the possibilities for improving audio quality.

This approach was discarded because of the limited availability of internally amplified headphones, which makes their maintenance and repair very difficult and costly. Headphones are the one piece of equipment in any lab system that undergo the most use and abuse. For these reasons, and because amplified headphones are relatively expensive due to their electronic amplification circuitry, the staff felt it was economically inefficient to make a sizeable investment in an item that undergoes extensive wear and must, therefore, be replaced periodically.

Replacing the standard sound cards included with the computer systems with higher quality sound cards initially appeared to be the simplest and most viable option. This solution would have allowed the lab to retain the existing equipment infrastructure, including the headphones and the wiring. After evaluating many different sound cards from numerous manufactures, we determined that there were not any sound cards on the market that produced the required output levels.

By this point, we concluded that the audio hardware currently available for computer-based platforms was inadequate for its needs.

The third solution—in-line amplifier signal paths to the headphones—represented a technically viable option that has previously been used as a solution for audio problems in language labs. An in-line amplifier is much like a pair of amplified headphones, except that the amplifier is external and is located between the computer and the non-amplified headphones.

The staff ended up also dismissing this option for several reasons:

- These devices are designed for very specific purposes and are difficult to adapt to any future equipment or application changes.
- Their installation and operation can be problematic because of the limited amount of space available in the workstations.
- In-line amplifiers are powered by AA batteries and that makes it cumbersome and expensive to monitor them and to keep them working.
- They are relatively costly and can be very easily stolen.

"As a consequence, the lab staff decided to capitalize on the experience of one of its members in the professional studio recording industry to explore the possibility of adapting a distributed headphone amplification system (DHAS) for use in the lab."

As a consequence, the lab staff decided to capitalize on the experience of one of its members in the professional studio recording industry to explore the possibility of adapting a distributed headphone amplification system (DHAS) for use in the lab. The staff reasoned that this equipment, originally designed for use in settings where audio quality is the primary operational consideration, represented a promising source for a viable solution.

Upon researching this possibility, it was determined that the studio and language lab audio technical applications are essentially similar in some relevant aspects and, consequently, that they require very similar technical solutions. This approach promised the following advantages:

- It allowed for the inexpensive amplification of all the workstations from a central location.
- It allowed for future expansions of the system.
- It appeared easier to implement and use.
- It provided greater control over physical resources.
- It permitted a higher level of control and security.

The system that was eventually built is comprised of a centrally located amplification system consisting of numerous studio-grade headphone amplifiers and a custom-manufactured military-specification patch bay (see Appendix A). By locating the amplifiers in a central location away from the computer workstations, we were able to achieve greater expandability, plus simplified installation and ease of use. We also had five "drop" or interface boxes built to our specifications (see Appendix B). These boxes interface with the headphone amplifiers through the patch-bay with multi-pin connectors (originally developed by the computer industry to connect peripherals to a personal computer). The studio-grade wiring used to connect these boxes to the patch-bay plays a crucial role in the system by rejecting the interference produced by the twenty computer workstations connected to the system.

Each workstation has a microphone and a cassette deck that are tied into the computer, which acts as a centralized control platform. This summed audio signal is then routed, via the aforementioned drop boxes, to the patch bay. From the patch bay the signal is sent to an amplifier, where it is boosted, and then returned through the patch bay back to the drop box. A pair of headphones is then connected to this amplified signal. The result is a clearly and accurately amplified audio signal that contains program material from both the cassette deck and the computer programs.

"Because of the extensive interference that is produced by the computers, the major consideration in selecting the cables was to procure a model that was extremely well shielded. The staff eventually opted for selecting a "military specification" model because it provided the best shielding characteristics."

The basic system that was adapted consisted of three major components:

• ***Distribution Center (Patch-bay)***

The distribution center was custom-built in accordance to the specifications drawn by the lab's technical staff; the builder was a commercial firm that specializes in producing customized audio devices for the music industry.

The staff considered two factors in designing the distribution center:

1) The center had to be easily interfaced with the existing system in the lab.

2) Its design had to be highly modular, so that it would be relatively easy to upgrade or reconfigure in the future.

• ***Amplifiers***

The amplifiers required were standard studio-grade headphone multi-channel amplifiers, which are available in most professional music stores. The model that was selected had six channels, so we had to procure four of them in order to service the twenty workstations. These multi-channel amplifiers allow each channel to function separately, thus allowing each workstation to operate independently.

• ***Cables***

Because of the extensive interference that is produced by the computers, the major consideration in selecting the cables was to procure a model that was extremely well shielded. The staff eventually opted for selecting a "military specification" model because it provided the best shielding characteristics.

The cables were pre-cut, and custom-built interface boxes (drop boxes) were attached to them by the commercial supplier.

By building this system (see Appendix C for product information), we were able to establish an infrastructure that will allow us to expand the lab's audio-based services in the future. A major improvement that this infrastructure will allow us to make is the transition from a monaural audiocassette source to a standard stereo format. Other possibilities include a headphone-based intercom system in which a staff member would be able to address the students at all or just one of the workstations. This type of system might see possible applications for audio-based drilling and testing.

By adapting technologies from applications as different as the professional sound recording industry and national defense technologies, the lab was able to create a system that allows full and efficient use of its audio-based foreign language instructional programs.

Results

Once installed, the system performed quite well and provided a drastic improvement in audio quality. There were some minor operational problems associated with the new system, but they were relatively minor:

- Once the new system became operational, it became evident that it required better headphones than the ones that had been in use at the lab. This problem was partly caused by the fact that even the highly shielded capacity cables are unable to reject all of the interference produced by the computers (the cables themselves had to be placed as far as possible from the computers).
- A second operational problem was created when students inadvertently disconnected cables and the staff had difficulties in re-connecting them correctly. This problem was eventually solved by color-coding the cables. A similar problem occurred with the drop boxes, some of which were also sometimes disconnected by students.

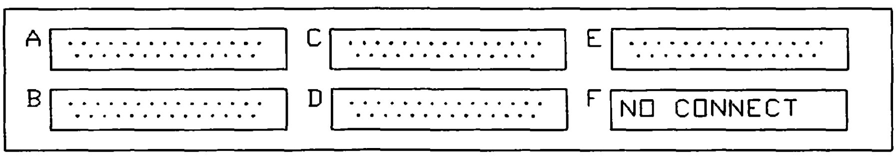
These problems arose primarily because the installation of the DHAS was a retrofit in the lab. Had DHAS been originally installed as a component of the lab's overall audio and video system, these problems could have been eliminated.

Students appear to be pleased with the new system. In the first evaluation of the lab after the DHAS was installed, very few students expressed any negative remarks regarding audio quality.

Our experience with DHAS speaks to the feasibility of expanding the technological horizons of language labs by adapting from other industries and application sectors. In retrospect, adaptations such as this one appear to be so obvious that one wonders why they have not been attempted before on a broader scale. We hope to have encouraged others to undertake similar initiatives and to share the results of their efforts.◆

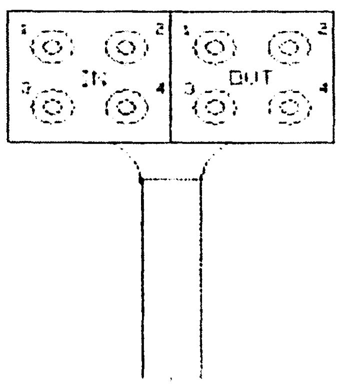
Appendix A
Patch panel diagram

Fig. 2 Patch Panel. *Wired directly to the patch bay. Each port connects to an interface box.*



APPENDIX B:
Interface box diagram

Fig. 1 Interface box. Each of the five interface boxes is connected to a port in the patch panel.



APPENDIX C:
Technical Specifications

Patch bay: 3 52 point mil-spec ¼" connector (Redco Audio in Bridgeport, CT).

Patch panel: 3 Custom-built multi-pin breakout with DB25 multi-pin connectors. (Redco Audio in Bridgeport, CT).

Wiring: 3 REDCO TGS-8, oxygen-free, multi pair cable (8 channel, 25 gauge) (Redco Audio in Bridgeport, CT), 3 Mogami shielded, 25 gauge, oxygen-free, microphone cable (Guitar Center in Miami, FL) 3 ¼" mil-spec patch cables. (Redco Audio in Bridgeport, CT).

Amplifiers: 3 Rolls RA62HA 6 channel, headphone amplifiers (Musician's Friend in Medford, OR).

Interface boxes: 3 Custom-build 8 channel, ¼" TRS "drop box" (Redco Audio in Bridgeport, CT).

Connectors: 3 ¼" and 1/8" TRS (All Electronics in Van Nuys, CA) 3 DB25 multi-pin (Redco Audio in Bridgeport, CT).

Rachida Primov is Director of the Eleonore Graves Tripp Foreign Languages Laboratory at the University of Miami. rprimov@miami.edu. John Czechowicz is lab technician in the Eleonore Graves Tripp Foreign Language Laboratory at the University of Miami. j.czechowicz@umiami.edu.