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Case Study of Curriculum Development for Technical Listening Training for Employees of an Acoustic Related Company

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ABSTRACT

This is a case study of curriculum development for technical listening training. Technical listening training is a systematic education program designed to allow prospective acoustic engineers and sound designers to enhance their auditory sensitivity. University based authors established a training strategy in an acoustics related company; Yamaha Corporation. We re-organized existing, and developed new, curriculum for a training suite for company employees. Discrimination, level difference identification and frequency identification training were classified as 'beginners training'. Identification of reverberation time and some application specific training were classified for 'expert training'. The company successfully conducted 9 days of training for freshman engineers. Trainee learning curves shows auditory sensitivity was improved.

INTRODUCTION

The Department of Acoustic Design of the Kyushu University provide an education program for acoustic engineers and sound designers. The students in this program wish, for example, to become recording engineers, design concert halls, make musical instruments or develop new audio technology.

Such sound experts must have a basic and broad knowledge of sound and the latest information on audio technology. In addition, professionals in this field are required to have special auditory sensitivity. Skilful acoustic engineers and creative sound designers have acquired special auditory sensitivity through various experiences during their careers. Generally, improving auditory sensitivity requires a great deal of time. Moreover, this improved sensitivity is thought by many to be obtainable only through experiences on the job.

Technical listening training[1] is a systematic training program designed to improve auditory sensitivity. Through this program, students can obtain the necessary auditory sensitivity before gaining work experience on the job. The type of auditory sensitivity acquired through experience depends of course on the occupation. In contrast, Technical listening training provides a wide variety of experiences, so that students can obtain auditory sensitivities associated with various fields and easily adapt to new auditory environments.

In Acoustic Industry, some companies carry out technical listening training for in-house education. Potentially, a lot of companies have interested in introducing technical listening training. But they has no experience to conduct technical listening training. They need technology transfer from university. In other aspect of current industry, using Computer Aided Design(CAD) technology is getting popular. CAD is useful for rapid development. But engineers lose opportunities to listen real sound while they develop new products. Then it is hard to share auditory impression words among employees in a company. To align words of auditory impression, technical listening training will be reasonable training.

This paper reports a case study of curriculum development for technical listening training for employees of an acoustic related company: Yamaha corporation..

Through technology transfer with two phases of trial trainings and training system development, we developed training curriculum for freshman engineers.

TECHNOLOGY TRANSFER

University based authors transfer technology on conducting technical listening training to the company in following steps.

Trial training phase 1

University based authors made 5 days demonstration training to company engineers. The training menu was picked up from the course for freshman training in university. Company based authors gather impressions from the participants to develop curriculum in the company.

System development

With advice of university based authors, company based authors developed system for technical listening training by their own hands. System includes sound presentation PC software, PDA response terminal software. Audio system, loudspeakers and amplifiers, are carefully selected. A meeting room was remodelled as a sound proof room for technical listening training.

Trial training phase 2

We organized 11 days technical listening training to evaluate curriculum and debug PC system. Ten young engineers participated this trial.

From Figure 1 to 3 show some typical learning curves in this trial.

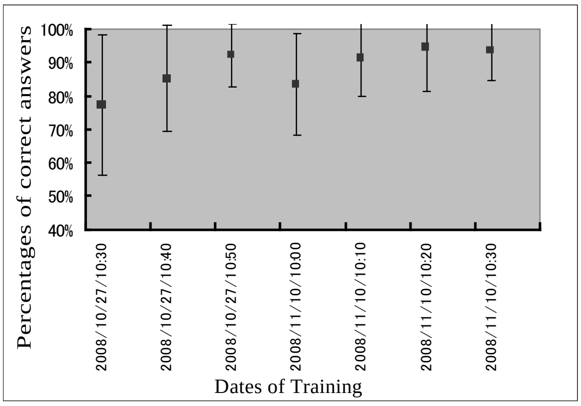

Figure 1. Learning curve of sound level difference identification (5dB step). (■:Percentages of correct answers with standard deviations)

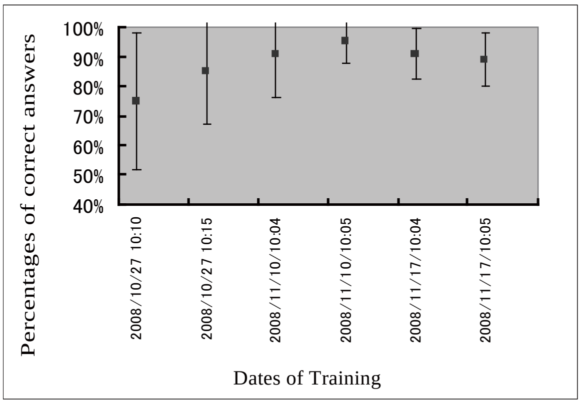

Figure 2. Learning curve of equalizing frequency identification (Rock music, Low frequency bands). (■：Percentages of correct answers with standard deviations)

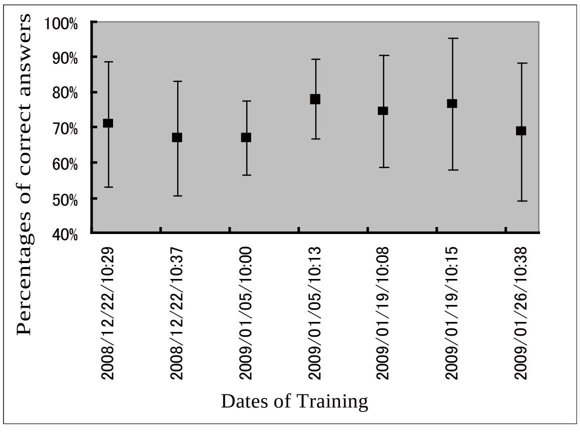

Figure 3. Learning curve of equalizing frequency identification (Orchestra, All frequency bands). (■：Percentages of correct answers with standard deviations)

Figure 1 shows sense of 5 dB difference is easy to understand. Three or four times training is enough. But easy to lose this sense when training days have a long interval. Because in ordinary working process, engineers care less about sound pressure level, they care more about frequency.

Figure 2 shows learning curve of equalizing frequency identification of Rock music. Music was characterized 10 dB boosted in one-octave frequency region. Answer categories are five. From 125 Hz to 1 kHz in octave interval and “original”. From this learning curve, four times training is enough.

Figure 3 shows learning curve of equalizing frequency identification of Orchestra music. Answer categories are eight. From 125 Hz to 8 kHz in octave interval and “original”. This training is difficult, because the number of answer categories are greater than low frequency bands.

CURRICULUM DEVELOPMENT

We re-organized curriculum existing in university and developed new for a training suite for company employees. We also classified trainings into 'beginners training' and 'expert training'. Until now, Technical listening training is introduced to engineers. But company based authors intend to Technical listening training for all employees in the company in near future. So we classified trainings into those two categories.

Table 1 shows curriculum and training classification and target percentages of correct answer. In this case study, training sound source of “Equalizing frequency identification of Train Noise”, “Mixing level balance” and “Reverberation time using Popgun” are newly developed. Training of Train Noise equalization was positioned to improve sensitivity of frequency characteristics using not musical sound but environmental sound. This ability was thought to be needed in architectural acoustic application. Training of reverberation time using popgun was developed to improve sensitivity of reverberation time using impulsive sound. This sensitivity is also useful in actual architectural acoustic work. Training of mixing level balance was simulated work in a recording studio. Trainee identify the mixing balance vocal level of back band accompaniment from standard mixing. For this training, the song and music was composed by an alumni of university and played, recorded and mixed by university students in university recording studio.

Table 1. Training curriculum of Technical listening training developed in this case study

Training and answer categories	Trainee	Iteration of training	Target ratio of correct answer
Pitch discrimination (Higher, Lower)	Beginner	2	90%
Loudness discrimination (Louder, Softer)	Beginner	3	85%
Timber discrimination (Same, Different)	Beginner	3	80%
Sound Pressure Level difference (10dB step) (0, -10dB, -20dB, -30dB)	Beginner	2	90%
Sound Pressure Level difference (5dB step) (0, -5dB, -10dB,	Beginner	4	90%

-15dB, -20dB)			
Sound Pressure Level difference (2dB step) (0, -2dB, -4dB, -6dB, -8dB, -10dB)	Beginner	6	75%
Equalizing frequency identification of Music (Lower bands) (Original, 125Hz, 250Hz, 500Hz, 1kHz)	Beginner	4	90%
Equalizing frequency identification of Music (Higher bands) (Original, 1kHz, 2kHz, 4kHz, 8kHz)	Beginner	4	85%
Equalizing frequency identification of Music (All bands) (Original, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz)	Beginner	6	80%
Equalizing frequency identification of Train Noise (All bands) (Original, 250Hz, 1kHz, 4kHz)	Expert	6	85%
Identification of frequency of pure tone (125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz)	Beginner	6	90%
Identification of center frequency of octave band noise (63Hz, 125Hz, 250Hz, 500Hz, 1kHz, 2kHz, 4kHz, 8kHz)	Beginner	6	90%
Harmonic number(fundamental 200Hz) (1, 2, 3, 5, 7,10)	Beginner	8	70%
Mixing level balance (vocal and accompaniment) (+4dB, +2dB, 0dB, -2dB, -4dB)	Expert	8	80%
Reverberation time (Popgun) (0.7s, 1,4s, 2.1s, 2.8s, 3.5s)	Expert	6	80%
Reverberation time (Dry music) (0.7s, 1,4s, 2.1s, 2.8s, 3.5s)	Expert	8	70%

TRAINING FOR FRESHMAN ENGINEERS

The company conducted technical listening training for freshman engineers in 2009 business year. company based authors organized training in 9 days all. Training were scheduled 2 or 3 days in a week. And the duration of lesson on each day was about one hour . In this training, beginners training and expert training were mixed. Figure 4 and Figure 5 show typical learning curves freshman engineers. In Figure 4, at level difference identification training of 5 dB steps, ratios of correct answer were converged in target ratio 90%. In Figure 5, at equalizing frequency identification training of all bands, average correct answer ratio reached to the target ratio 85%. The standard deviations decreased with iteration of training.

From interview of trainee, trainee were positive to participate Technical listening training. They thought it was good opportunity think about listening. Almost of all trainee felt change in their listening attitude after training. They also thought technical listening training is good educational program to understand physical sound property and sound sensitivity. In business management aspect, for freshman engineers, Technical listening training helped supporting their confidence and loyalty of working at an acoustic related company.

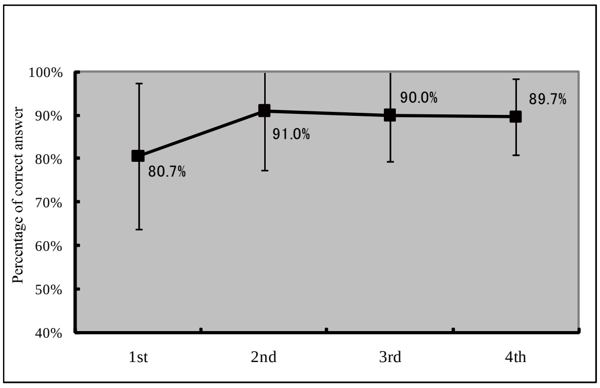

Figure 4. Learning curve of sound level difference identification (5dB step) of freshman engineers (■：Percentages of correct answers with standard deviations)

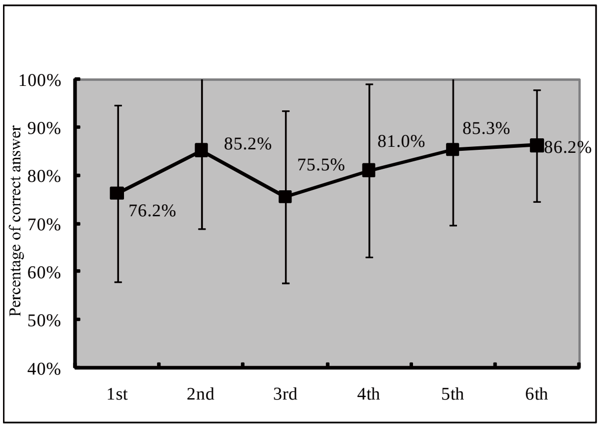

Figure 5. Learning curve of equalizing frequency identification (Rock music, All bands). (■：Percentages of correct answers with standard deviations)

SUMMARY

University based authors and company based authors collaborated to develop curriculum for Technical Listening Training suite for the company in-house education. The curriculum was based on existing university curriculum. We classified training into 'beginners training' and 'expert training'. This concept was based on future development to all employee in the company. Company based authors successfully conducted 9 days training for freshman engineers.

Trainee learning curves showed auditory sensitivity was improved.

REFERENCES

1 Shin-ichiro Iwamiya, Yoshitaka Nakajima, Kazuo Ueda, Kazuhiko Kawahara and Masayuki Takada, "Technical Listening Training: Improvement of sound sensitivity for acoustic engineers and sound designers", *Acoust. Sci. & Tech.* **24**, 1, pp. 27-31 (2003)