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Practical Report on Game Audio Development Education - A Case of Tokyo University of Technology -

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ABSTRACT

This paper reports on a practical case study from Tokyo University of Technology, which has more than 20 years of experience in education and research in game development, a field in which there are few examples in Japan. One of the factors that has contributed to the high regard in which our educational programs are held by the partner universities in these international collaborations is that the team always includes a faculty member with expertise in music composition, game sound design, and audio implementation. Although these academic results have only been published in Japanese, there have been more than 20 of them over the past 10 years, including those with and without peer review. Through 20 years of game development education, 10 years of game sound education, and five years of game audio education, two sound designers, two game sound programmers, two game planners, and one technical audio designer have entered the industry as new graduates. The number of graduates more than doubled if we include those who entered the game industry after changing careers from IT and other industries.

1 Introduction

This paper reports on a practical example from the Tokyo University of Technology, which has more than 20 years of experience in game development education and research, of which there are few examples in Japan. Game audio education at the Tokyo University of Technology is positioned within this program and linked to ongoing research activities. As a background to the development of this educational environment, the unique history of the school as a whole and the management concept of the School of Media Science based on this history are explained. Furthermore, the specific curricular structure of the project-based workshops, which form the core of this educational and research activity, will be described. Then, after reporting on the history of

education and research in game sound production techniques in general, including interactive music production and sound effects production, we will discuss the results and challenges of activities to expand into the field of audio, which has been in full swing in recent years.

2 Historical background of the educational environment

The parent organization of Tokyo University of Technology was Japan's first technical college for training television engineers, officially accredited in 1956, and has sent many practitioners to the media content industry in Japan. The university was established in 1986 as a single faculty of engineering,

but only promoted research specializing in mechanical engineering. A new faculty of media science based on information science and engineering was established in 1999. The Faculty of Media Studies began operating in 1999 based on a concept as shown below that was extremely rare in Japan at the time.

- Coverage of Wide Spread Academic Terrain of media; Media Contents Producing, Social Issues of Media, Media Technology
- Industry-Academia Collaboration in content production
- Existing the special organization for College-University differentiation and synergy
- Pop Culture Oriented
- Academic Digital Music Creation is involved in Media Contents Producing domain

Specifically in the area of media content production education, the original plan for the establishment of the faculty was that the main research focus would be to contribute to the digitization of animation, television, and film in Japan. In addition, it is extremely rare in Japan to have a composer on the full-time faculty of an information science department.

Throughout the period from the TV engineering college to the establishment of School of Media Science, the school had fostered the following special circumstances.

- Well understanding of media content production education in school management
- Encourage faculty collaboration across disciplines
- Atmosphere of willingness to make pop culture a subject of study in academia
- Digital music producing education involved deeply in engineering based department

3 Establishment of Project Based Workshop Curriculum

From the very beginning of its existence, the Department has carried out distinctive educational and research activities in the field of content production, which were not bound to the existing framework of university education.

These efforts were well received by the students, who were enthusiastic about them. However, because these activities were not tied to university credit, it

was difficult for either students or faculty to gain official recognition. To remedy this situation, the project-based workshop was adopted as a formal undergraduate curriculum in 2003.

In the beginning, only topics related to digital animation production, Internet broadcasting, and music composition were offered, but 20 years later, the program has expanded to include some 30 topics, including media technology, content distribution, and community service activities, and has become a hallmark of the department.

The undergraduate curriculum adopts a step-by-step learning method, with topics separated by semester and academic year. On the other hand, the project-based workshops are designed to provide a consistent and sustained experience throughout the three years from freshman to junior year. This allows for a great deal of trial and error through production activities with personnel of diverse skills and experience, and learning of advanced content through experience.

Around 2001, when the digitization of existing analog media content began to be promoted mainly through animation, preparations began to extend this educational approach to the field of digital games. The author participated in the planning of this educational plan and was involved mainly from the point of view of game music composition education.

4 3 years game development workshop

In 2004, the game development education program proposed by School of Media Science, Tokyo University of Technology had been adopted MEXT (Ministry of Education, Culture, Sports, Science and Technology Japan) educational grant[1]. This workshop based education program was the first case of game development education project certificated by Japanese government. Game development requires the involvement of experts in many fields including game design, high-end interactive graphics and programming. Each faculty member has used this collaborative educational program as a lever to deepen their own laboratories' research themes. The author has continued to be in charge of the sound department in the implementation of this educational program up to the present. This article reports on the interactive audio development and sound design research that has been underway in earnest since 2018, centered on this educational program.

The project-based game development workshop consists of two activities. One is a two-and-a-half

year long workshop, with the goal of exhibiting at the Tokyo Game Show. The second workshop, which will last only six months, is a scrum iteration type exercise for the Global Game Jam.

The basic skill trainings including interactive music composition, sound effect production, foley recording and sound implementation are conducted in former long-term workshop. More specialized audio engineering, such as interactive mixing and audio level adjustment, is taught in a separate exercise outside of this game development workshop. The School of Media Studies considers online live game broadcasts and e-sports audio to be equally important areas of game-related audio, as well as interactive audio in game titles. In the latter, short term workshop, In the latter short-term workshop, students take the lead in producing and live-streaming a live event program for the Global Game Jam in parallel with the game development workshop.

Throughout the approximately 3 years game development workshop, students are required to independently set various challenges in game development. Some students choose to continue their production activities in order to challenge themselves with more advanced production techniques, while others begin working on research topics that may lead to academic papers.

There is no department at the university that teaches and researches only game development, and each faculty member has his or her own area of specialization and runs his or her own lab. For this reason, both faculty and students collaborate across disciplines in the Game Development Workshop. The faculty involved, as of 2024, come from the following disciplines.

- Team management and Production pipeline
- Game and graphic programming
- Game and UI/UX design
- Game graphics and middleware operation
- Game music composition, sound effect with sound programming and audio implementation

Reports on the practical application of the game development research methodology, which combines long-term continuing education with short-term iterative education, were written as academic papers[2,3] by the faculty members who conducted the education. This effort attracted international attention and developed into a collaborative project with the University of Harz in Germany[4] and an

international collaborative project with six other countries[5], primarily Poland. One of the factors that has contributed to the high regard in which our educational programs are held by the partner universities in these international collaborations is that the team always includes a faculty member with expertise in music composition, game sound design, and audio implementation.

5 Composition, Sound Design to Audio Engineering

The author was involved in planning the music and acoustics areas of the 2004 workshop educational program, formulating the practical facilities, educational environment, and areas of instructor expertise needed. However, due to staffing constraints at the university, the author did not join the members of the Undergraduate Education Implementation Team because of other responsibilities at the institute. The department has had one full-time academic computer music researcher and one full-time traditional handwritten composer and theory researcher for the decade beginning in 2004. For the past ten years, students involved in music creative education have only been involved in game development projects as sub activities and just underscore composition.

During this time, a computer music faculty member left the university, and the author became an adjunct faculty member teaching methods of using digital sound creation for game sound effects. In addition, the author applied audio programming and music information processing techniques to music composition, and began researching adaptive music composition techniques as a lab assistant to the full-time classical composition faculty. From 2014, the author officially returned to the Game Development Workshop as an adjunct instructor in the sound department, primarily responsible for teaching asset creation and implementation in games.

The author was hired full-time in 2018 and began running an independent lab. The lab conducts sound design research that is not limited to game audio but also includes music information processing, history and production technique of traditional film sound, and anime sound with a uniquely Japanese expression. In 2020, the author began research on spatial audio perception in a Ph.D. program at Tokyo University of the Arts, and simultaneously started research on spatial audio production and perception in TUT's laboratory.

Although these academic results have only been published in Japanese, there have been more than 20 of them over the past 10 years, including those with and without peer review.

6 Interactive audio engineering and multi-modal perception research in Sound Design Lab.

The author has been involved in the workshop since 2004, primarily as an educator and instructor; since 2018, the author has been running the Sound Design Lab. as the lead researcher.

This laboratory is involved in a wide variety of research themes related to sound and music, including not only game audio, but also interactive music composition techniques, music theory, spatial audio production methods, sound effect production, and perceptual cognition research on images and sound. In the area related to interactive audio, some students has worked on sound localization measurement user interface research using head-mounted displays, and user interface sound attention and awareness research for sound effects and user feedback in xR environments.

More game-oriented research included a comparative study of whether players could correctly understand game mechanics by combining vertically presented reverb sounds and game screens presented in the forward and inverted directions. In addition to these studies, we have been conducting perceptual studies that assume a game. Unlike general audio engineering and acoustic perception studies, we have confirmed that subjects' responses tend to be bimodal when they are given the context of a game.

7 Education and research activities in audio engineering related to the peripheral fields of games

Demand for games as Internet-distributed content has also increased. E-sports is emerging entertainment event format; multiple people form teams and compete in digital games in large venues, distributed via Internet video. The video and audio engineers for this require the same high level of skill as the actual live sports broadcasting staff. Sound reinforcement in venues, live announcing, management of players' voices and feedback sounds, and adjustment of sound for distribution all need to be done in real-time, and sound management is much more complex in the new live content formats that have emerged in recent years.

Sound management is one of the most complex live content formats in recent years.

Furthermore, the audience segment that prefers subcultures, especially in Japan, is no longer interested in simple gameplay but rather in a style of expression that combines real-time animation, known as "VTubers." Such content, with its complex visual and audio layers, can be delivered from the average home with a simple system, but high-quality sound delivery is required, and it is clear that there is a need to train staff with advanced sound engineering skills who are knowledgeable in both games and computer graphics.

As part of our efforts to develop human resources capable of responding to this situation, we have had students manage an online program that broadcasts the Global Game Jam since 2012. In response to the Global Game Jam and Tokyo Game Show's inability to be held in 2020 due to the threat of infectious diseases that have struck humanity, we have also tried our hand at live broadcasting gaming events in the Metaverse system.

In Japan, most students interested in audio engineering generally want to work only in music recording and live music events. Once they enter university, most students get involved with ADR and sound effects production, which are required for cinema audio and other applications. By participating in a project-based workshop, students also have chances to work on the distribution of live games, including e-sports and VTubers. As a result, we have empirically confirmed that the program has had a specific effect on generating interest in game development and the game industry itself.

The science and technology of interactive and spatial audio is advanced. Given the resources of Japanese university education, it is tough to guarantee that students will reach this level through curriculum alone. Working on sound production for broadcasting and distribution as a peripheral area of game culture indirectly contributes to developing human resources for game audio.

8 Conclusions

Through 20 years of game development education, 10 years of game sound education, and five years of game audio education, two sound designers, two game sound programmers, two game planners, and one technical audio designer have entered the industry as new graduates. The number of graduates

more than doubled if we include those who entered the game industry after changing careers from IT and other industries. In the video distribution industry for entertainment content centred on games, more than half of the students involved in game sound training found jobs in video and audio production. Other students have also been recognized and worked in different fields as engineers and managers with expertise in sound production.

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Although no other university in Japan has been providing education for such a long time, it has yet to directly produce a high percentage of human resources for the game audio industry. Our university will continue its efforts in the future.

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