The Design and Development of a Production Studio for Engineering Students

Chenyang Wu
King's College London
London, UK

Wei Liu*
King's College London
London, UK

Abstract: Many Engineering schools require student coursework or design projects to be presented in a multi-mode format. The Covid-19 pandemic has accelerated such changes to be implemented especially when on campus as practical work is limited. Student work in the form of live video and audio production have encouraged academics to continue accepting multi-mode format coursework. However, it has also brought on new challenges for students. It is not feasible to require students to purchase a specific device when students need to complete a video demonstration. A fully equipped and soundproof space is critical for students. It provides sufficient high-quality equipment for students to create and innovate video, media, and audio for engineering projects.

This report focused on the design and development of such a production studio for engineering students at Kings College London. This research adopted interviews, questionnaires and focus group methods to collect data to understand the needs of the students and staff and therefore develop design specifications on the production studio. Over 110 questionnaires, 24 interviewers, and 2 focus groups were conducted. A new production studio was designed and developed.

The production studio is expected to serve as a centralised service space for both students and staff which provides necessary equipment and facilities to support the creation of media, video and audio projects. In addition, this studio can also foster a creative and effective environment that improves the collaboration between students and their project outcomes.

Keywords; production studio, engineering education, engineering students, KCL.

**Correspondence to: Wei Liu, Department of Engineering, King's College London, London, UK.*
E-mail: wei.liu@kcl.ac.uk

1. INTRODUCTION

The production studio is a wide-ranging topic and the importance of using the production studio during higher-education is increasingly being recognized by both academia and students. The Covid-19 pandemic limits on-campus practical work highlighting the significance of the production studio. The production studio is most commonly defined as an environment that allows being for the objectives of photography, animation, filmmaking, radio production, etc (Compesi and Gomez, 2015). This paper introduces the design and development of a new Production Studio at Kings College London (KCL), illustrating the requirements of students and staff as well as the studio which has a broad range of uses as to not restrict the work that students could do in an engineering setting.

2. LITERATURE REVIEW

The production studio is a centralized service space to support service for written or oral communication, research, and teamwork all in one central position. Accordingly, allowing students to recognize their synergistic relationship. A production studio pedagogy appreciates multi-mode communication, interaction, and discussion as well as provides opportunities for students to design effective media works through a supportive, controllable, and cooperative environment and plan (Carpenter et al., 2013). The production studio provides some permanent technical facilities, such as vision facilities, sound facilities, and recording facilities, as well as absolute quiet space. Students can design the ideal scenery and graphics by using these technical facilities and even using post-editing to formulate the corresponding environment. This greatly improves students' work efficiency and reduces working hours (Bermingham et al., 1994).

Additionally, students from underrepresented group may not afford expensive devices. Thus, the production studio provides opportunities for these students, allowing them to experience such devices and design high-quality effective works. They would have chances to compete with their peers in some specific fields. For example, record interviews, and record video projects for class (Mestre and Kurt, 2015). The production studio provides a critical environment for students and staff to discuss and collaborate. In addition to narrowing the gap between them, the production studio provides an opportunity to practice and enhance the self-expression and individuality of students during the project-making process (Park, 2020). By providing collaborative technology space for students and staff, they are able to accomplish many of their research, projects, recreational, and even social needs in one location. The standard service space provides them an opportunity to turn ideas into multimedia projects, visual projects, and sound projects through learning, exploration, and production (Mestre, 2013).

3. RESEARCH METHODOLOGY

To design and develop a suitable product studio, this research adopted mixed methods including secondary data research, interviews, questionnaires and focus groups for data collection.

3.1 Secondary data

In-depth investigations were conducted with 100 studios from 100 universities. The investigated contents include the type, equipment, facility, appointment, and management. At the beginning of the project, the authors firstly explored the basic standards of a production studio. Therefore, a large number of cross-faculty studios were cited. Later, the engineering-faculty studios were researched as a specific focus. The data collection was done by browsing the official websites of the universities. In order to ensure the theme was successful, production studios were purposefully selected using two main selection criteria: (1) the studios in the universities will be investigated by order of QS international University Ranking (if a university does not have a studio, then the investigation will be carried forward until reaching 100 studios) and (2) video-related studios are given priority, followed by media-related and audio-related studios. To organize enormous collected data reasonably, high-frequency vocabularies were merged into a diagram as well as specific device names were unified, such as cameras (see figure 1). In addition, the ‘Equipment’ appeared in figure 1 means a set of tools or other objects used to achieve a particular objective, while ‘Facility’ are services or functions that are provided for a particular purpose.

	Video:				Media:				Audio:				Others:					
No.	Equipment	Freq.	Facility	Freq.	Equipment	Freq.	Facility	Freq.	Equipment	Freq.	Facility	Freq.	Brand	Freq	Software	Freq.	Other facility	Freq.
1	Camera	34	Recording Video	157	Screen	29	Recording	76	Microphone	18	Recording Audio	58	SONY	8	Adobe	10	Booking	7
2	Green background	24	Monitoring	14	Computer	10	Self-media	41	Speaker	8			Chroma	7	Premiere	4	Consultation	5
3	Light	24	Shoot	7	Wireless (Mouse)	10	Editing	40	Stereo	6			Genelec	6	PowerPoint	4	Publish	5
4	LED	12	Interview	7	USB	8	Digitizing	33	Preamp	5			Focusrite	3	Reaper	2	Storage	3
5	Green wall	9	Live Stream	7	Mac	5	Playback	4	Recorder	3			Mackie	3	Microsoft	2	Print	3
6	Network (WIFI)	9	Podcast	6	Laptop	5	Remote work	3	Switcher	3			Crestron	3				
7	Television	7	(Make) animation	5	Accessories	4			Amplifier	3			Vaddio	3				
8	Lightboard	6	Presentation	5	Keyboard	2			Keyboard	2			Blackmagic	3				
9	Curtain	5	Education	5	Headphone	2			Headphone	2			Fireface	3				
10	Grid	4			HDMI	2							Dynaudio	2				
11	Tripod	4			VR	2							Neumann	2				
12	Camcorder	3											profoto	2				
13	Flash	3											Moocs	2				
14	Seats	3											Panopto	2				
15	Fluorscent	2											Nikon	2				
16	Softbox	2											Clavinova	2				
17	Light pipe	2											Auralex	2				
18	Plug	2											Arius	2				
19													Polycom	2				
20													Lavalier	2				

Figure 1: the merged data of QS rank Top-100 university studio.

3.2 On-site visit

After analysing the data of 100 universities, the second methodology is fieldwork, i.e. on-site visits of studios at different universities, allowing practical observations and engagement with the physical enviroment. The authors visited 5 studios in total (see Table 1)

Table 1. Five studios at different universities

Studio ID	The name of studio	University
ID-1	MA Television studio in London College of Communication	London College of Communication, University of the Arts London
ID-2	Photography & Videography Studio	Kings College London
ID-3	Lime Grove studio	London College of Communication, London college of fashion
ID-4	The recording studio	University of York
ID-5	Open space and production studio	University of Westminster

3.3 Interview

Following the on-site visit, in-depth interviews were conducted with 24 students from various universities, who has some experience of using the production studio in their universities. Questions focused on the 14 factors of the user experience of using the production studio. Each interview lasted between 20 to 40 minutes, enabling the students to answer questions comprehensively and the authors to explore these answers for further information.

To explore these topics successfully, student participators were selected using two main selection criteria: (1) the university includes a studio that has been open for several years and successfully operates and provides services to the students and (2) the participant must have experience in using a video-related, audio-related, or media-related university production studio. Figure 2 shows the type and name of the 24 university production studios from the interview data.

Participant ID	Name of University	Studio name	Type
ID-1	University of Arts London-LCF	Lime Grove Studio	Video
ID-2	University of Arts London-LCC	MA Television Studio	Video
ID-3	Boston University	Photography studio	Video
ID-4	Tongji University	Jiyu studio	Video
ID-5	Syracuse University	Photography studio	Video
ID-6	University of Creative Arts	UCA TV studio	Video
ID-7	School of Visual Arts, New York City	Video studio	Video
ID-8	Hsuan Chuang University	Photography studio	Video
ID-9	Beijing city University	Dynamic Studio	Video
ID-10	Rice University	DMC video and Photography studio	Video
ID-11	University of Southampton	Photography studio	Video
ID-12	University of oxford	Video production	Video
ID-13	The University of Warwick	Video production	Video
ID-14	University of Leeds	Photography studio	Video
ID-15	University of Birmingham	Digital creation studio	Video & Media
ID-16	University of Arts London-LCC	Flove studio	Media
ID-17	University of Arts London-LCF	Media studio	Media
ID-18	University College London	Media production	Media
ID-19	University of Glasgow	Video editing	Media
ID-20	University of York	Recording studio	Audio & Media
ID-21	Communication university of China	Recording studio	Audio & Media
ID-22	Kings College London	KCL DJ society studio	Audio
ID-23	University of Bristol	Music studio	Audio
ID-24	University of Sheffield	Sound studio	Audio

Figure 2: the type and name of 24 universities' studios.

3.4 Questionnaire survey

Finally, a questionnaire survey was conducted with 116 KCL engineering students, exploring the specific requirements of students from an engineering setting. Questions focused on 15 factors of the production studio. Each survey lasted 30 minutes on average. Participants were purposefully selected using two main selection criteria in order to explore these themes successfully: (1) participants must study at KCL and (2) participants must learn engineering-related majors.

4. FINDINGS

4.1 On-site visit findings

The scene layout, backdrop, equipment, lighting grid system (Wang et al., 2020), soundproof, and functional considerations were the factors that have been considered in design. The backdrop is divided into three types: portable, curtain, and the entire wall as a backdrop. Studio ID-1 and studio ID-2 use a black curtain, studio ID-4 utilizes the entire white wall, while studio ID-5 uses a white portable backdrop. Furthermore, studio ID-1 has a lighting grid system that covers the whole ceiling, which is convenient for students to change the position of the lights as well as save space. The equipment including a laptop, cameras, microphone, a headphone, mixer, softbox (Brooks et al., 1980), reflectors (Stroebel and Zakia, 1993), beauty dish (Detonnancourt, 2015), tripod, 3D scanner (Cui et al., 2010), audio interface, and loudspeaker was found in these five studios by the author. However, except for the studio ID-4, the remaining studios' function is single, taking photography.

4.2 Interview findings

To aid the implementation of the production studio during the design process, the data collected and analysed from the interviews has enabled the development of an initial framework. This initial framework illustrates the basic functions, beneficial and unsatisfactory aspects, improved points, managers, facilities outside the studio, equipment, and layout of the studio. Throughout the interviews, participants indicated that although the studio has complete equipment, these devices are old and even many plugs of devices were rusty. Furthermore, more than 80% of participants stated that the studio contains controllable lights, air conditioning/heating, professional staff/professor teaching, and needing appointments, while only 13 (54%) students stated that the

studio limits the number of people using. Moreover, students indicated that using the studio is convenient as well as the workspace is fully equipped, while the types and quantities of the equipment are not enough, small space, and non-updated devices are unsatisfactory aspects.

4.3 Questionnaire survey findings

The data collected and analysed from the questionnaire surveys have enabled the development of a further framework focusing on the engineering setting and engineering education needs. This further framework illustrates the main functional and non-functional projects, modules, activities, devices, software, technology level, space type, managers, running hour, time slots, and specific training. Throughout the surveys, the main functional projects that participants chose are photography, filmmaking, making of music, sound recording, and editing, while the main non-functional projects are social activities, for student organizations, demonstrating production results, and career application. The modules students would potentially use in the production studio are taking photographs and individual projects (final projects). The activities included photography exhibits, and making videos (to YouTube). Additionally, participants indicated that the software including Adobe creative suite, Premiere Pro, Solidworks, Fusion 360, and Davinci Resolve are necessary as engineering students would develop 3D digital prototypes or 2D creative ideas. Furthermore, more than 65% of participants indicated that the technology level biased toward the students (easy to operate) instead of the professional equipment. More than 75% of participants preferred a specific room rather than an open space. More than 55% of participants indicated that the studio is managed by technicians, and stated that 24-hour running time is better as well as the time slot is 3 hours per slot. More than 90% of students indicated that specific training in advance before using the studio is necessary.

5. DESIGN

5.1 design specification

After analysing the data, the requirements from students become apparent. Combined with these requirements, the design specifications are shown below, see figure 3.

Elements	Requirements
Functional projects	Photography; Graphic design; Filmmaking, Animation, Radio or television production; Live television or live Broadcast; Sound recording; Making of musical; Tuning; Editing; Tale photo; Presentation; etc.
Non-functional projects	Student organization; Social activity; Career allocation; Demonstrate product results; Photograph exhibit; Self-introduction short film; Propaganda; etc.
Video-related Equipment	Backdrop; Flash; LED; Movie light; Camera; Lens; Professional Camcorder; Flash head; Beauty dish; Tripod; V-flat; Reflector; Lightboard; Curtain; Grid; Fluorescent; Softbox; Light pipe; Locker; Video tape; 3D scanner; etc.
Media-related Equipment	Mac; Wireless keyboard and mouse; Headphone; Display screen; External HDD; USB; HDMI; VR; Calculator; Plug; Printer; etc.
Audio-related Equipment	Audio interface; Microphone; Mixer; Sound card; Amplifier; Patch bay; Headset; Loudspeaker; Preamplifier; MIDI keyboard; etc.
Software	Adobe creative suite; Premiere Pro; Fusion 360; Davinci Resolve; 3D Scanner-related software; Solidworks; Animation-related software; Workshops; Kicad; CAD; etc.
Target product cost	£11132 ~ 18859
Quality and reliability	Medium-biased equipment
Life Expectancy	3 to 5 years
Maintenance	Each year
Space type	Specific room
Size of Space	About 30 square meters
Reservation time slot	Up to 4 hours
Reservation policy	Once a week per student
Running hour	Monday ~ Friday: 8 am ~ 17 pm; Saturday ~ Sunday: 12 am ~ 17 pm

Figure 3: the design specification.

5.2 design iterations

The authors invited six engineering students to join in a focus group to review the initial design specification and encourage idea generation for planning. Consequently, participants suggested four non-functional projects which could be done in the production studio. (1) Presentation for module assessments, (2) application materials for career, (3) demonstration for student competitions as well as (4) social media content development. Furthermore, participants recommended using portable backdrops and maneuverable devices. The lighting grid system

would not be considered. Moreover, two students provided two user cases about using the production studio. Firstly, student-1 participated in a robotics competition, he shot a video about his robot using a video studio. Student-2 helped graduates to shoot compulsory graduation photos at a video studio. Additionally, the operative policy was improved, shown in figure 4.

Studio policies:	Describe:
Booking	Studio time is booked by appointment only. One person can only appoint 3 times a week, and the students' number will be recorded for every appointment. If it is a team appointment, in order to avoid the reservation of each student, each person's number will be recorded. For example, if it is a three-person team appointment, everyone's number will be recorded, and this team can only appoint 3 times a week.
Studio Time	At least one day in advance to reserve, and the maximum time for the reservation is 4 hours.
Payment	All equipment and facilities in the studio are free.
Foods	Any food or drinks can not bring into the studio.
Damage & Breakages to Studio Equipment	Any damage caused to studio equipment due to misuse, abuse or negligence will be charged to the client. Until damages are paid or repaired, sessions will not continue. When leaving and entering the home studio, please remember that the main door must be kept shut and locked at all times. Any theft or damages that occur as a result of the door being left open or unlocked will be chargeable to the client.
Personal Items/Lost Property	Any personal items left unattended are the responsibility of the owner. Please ensure that you take all of your belongings with you when you leave.The studio is not responsible for any personal items that are lost or damaged on the premises.
Drugs Are Strictly Prohibited	Refuse to access the studio and equipment under the influence of drugs or alcohol
Smoking	Smoking is prohibited inside

Figure 4: the operative policy of the studio.

The second focus group involved two academic staff and one technician as well as one IT consultant, focusing on the expectations of staff as well as technical review on specific equipment. An updated equipment list was provided, shown in figure 5.

Item	Number to purchase	Specific model
(Green) Background	1	Streamplify SCREEN LIFT 200cm x 150cm, Hydraulic Rollbar Green Screen
(White) Backdrop	1	Walimex pro Roll-up Panel
Camera	1	Canon EOS 90D and EF-S 18-135mm IS USM Lens
Beauty dish	1	Godox AD-S7
Tripod	1	JOILCAN Camera Tripod for Canon
Reflector	4	Neewer 32-Inch 80CM Portable 5 in 1 Translucent, Silver, Gold, White, and Black Collapsible Round Multi Disc Light Reflector
Softbox	1	EzyLite Softbox Single Continuous Lighting Kit with 85W Bulb
3D scanner	1	3D Scanner
Chair	2	Evdano Chair
Computer/Laptop	2	Customise your Blue 24-inch iMac, 8GB unifield memory, 1TB SSD storage with Magic Mouse and Keyboard
Headphone	1	HyperX Cloud Stinger Core
HDMI	1	Basics High-Speed, 4K Ultra HD HDMI 2.0 Cable / Cord, 60 Hz, 2160p, 48 bit, 18 Gbps, 3D, male-to-male, 0.9m (2.9ft)
Audio interface	1	Focusrite Scarlett 2i2 Audio Interface (3rd Gen)
Microphone	1	BLUE Yeti USB Streaming Microphone - Blackout
Loudspeaker	1	Logitech Z150 PC Speaker

Figure 5: Device list.

5.3 *Final design*

Following the above procedure, the authors created 3 versions of the production studio based on the room blueprint provided by the university, see figure 6. (1) The first version has a problem: the green backdrop is situated next to the double doors which would cause interruptions from people entering (the first version was developed before the visit of the actual construction site). (2) The second version of the layout is shown in the middle of figure 6. This version replaces the locker with a box, since the ceiling is not high, and changes the position of the backdrop to close to the left wall. However, the natural light through the window would be blocked by this backdrop. (3) The third version is shown in the right of figure 6. The portable backdrop was put closer to the opposite wall. Thus, the natural light issue was solved. The construction of the studio is still undergoing, which is expected to open in October 2022.

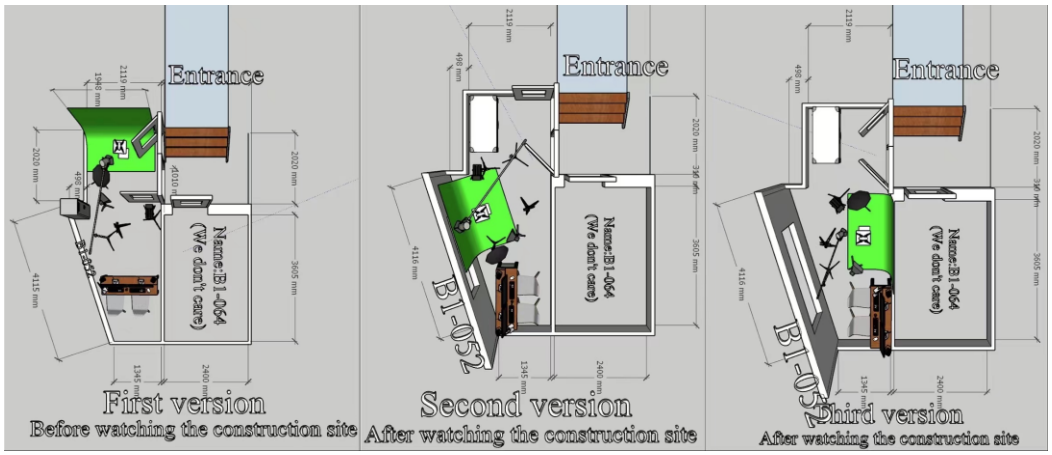

Figure 6: three versions of the floor plan of the production studio 3D model

Figure 7(a) and figure 7(b) present two directions of the 3D model with a ceiling. The studio is undertaken within the engineering faculty. Both engineering students and staff can use the studio. Some requirements like KiCad (CAD) software will be considered. Students can use their own university accounts to log the system, and all their work will be preserved in the Cloud.

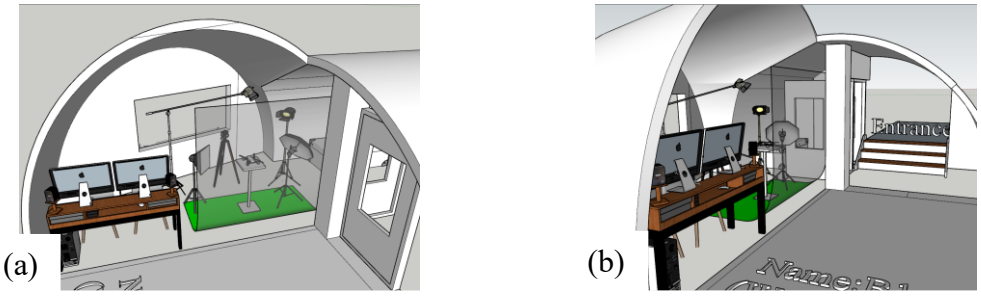

Figure 7: (a) the wall containing the window and (b) the entrance and the stair

6. CONCLUSIONS

Academics and Universities both acknowledge that the significance of the production studio and actively trying to design and develop related studios to aid students and staff in better completing the task during the period of the Covid-19. The production studio as a centralized service space can provide opportunities for students to communicate, collaborate, and interact with their peers or staff in one central location, allowing students to create and innovate media projects while being aware of the importance of collaboration. Because of the permanent technical facilities, students can create a variety of scenes, and produce media works by using high-quality equipment, which enhances working efficiency while reducing working time. Additionally, underrepresented students would also have opportunities to experience the devices and produce high-quality media products, as well as compete with peers. The production studio provides an interactive environment for students and staff to produce media projects. In addition to being able to cultivate their personality, their self-representation ability will also be improved.

7. REFERENCE

Bermingham, A., Talbot-Smith, M., Angold-Stephens, K., & Boyce, E., 1994. *The Video Studio*. 3rd ed. Taylor & Francis.

Brooks, D., Shipman, C., DiSante, T., 1980. *How to control & use photographic lighting*. Tucson, Az: H.P. Books.

Carpenter, R.G., Valley, L., Napier, T., Apostel, S., 2013. Studio Pedagogy: A model for Collaboration Innovation, and Space Design. In: R. Carpenter, eds. Cases on Higher Education Spaces: Innovation, Collaboration, and Technology. PA: IGI Global, 313-329.

Compesi, R.J., Gomez, J.S., 2015. *Introduction to Video Production: Studio, Field, and Beyond*. 2nd ed. Taylor & Francis.

Cui, Y., Schuon, S., Chan, D., Thrun, S., Theobalt, C., 2010. 3D shape scanning with a time-of-flight camera, *2010 IEEE Computer Society Conference on Computer Vision and Pattern Recognition, San Francisco*, CA. 13-18 June 2010.

Detonnancourt, G., 2015. Beauty Dish Photography: The Essential Guide (+5 Lighting Setups), *Digital Photography School*.
Url: https://digital-photography-school.com/5-ways-to-use-a-beauty-dish-light-for-portraits/

Liao, CW., Tien, LC., Lin, Sy., 2011. An Analysis of the Function and Training Strategies of Teaching Assistants at Technological and Vocational Colleges in Taiwan, *International Conference on Computer Science, Environment, Ecoinformatics, and Education*, Springer, BE. 21-22 August 2011.

Mestre, L.S., 2013. Media Commons: The process and value of centrealizing services. *Library Hi Tech*, 31(4), 669-687.

Mestre, L.S., Kurt, E., 2015. Excuse Me. Is that a Video Studio in Your Library, *Re-think it: Libraries for a New Age - Conference proceedings 3*, Allendale, MI. 10-12 August 2015.

Park, S., 2020. Rethinking design studios as an integrative multi-layered collaboration environment. *Journal of Urban Design*, 25(4), 523-550.

Stroebel, L., Zakia, R.D., 1993. *The Focal Encyclopedia of Photography*. *3rd ed*. Focal Press.

Wang, P., Brambley, M., Poplawski, M.E., Myer, M., Lian, J., Lutes, R., Huang, S., Vlachokostas, A., Characterization of Connected Lighting System Potential for Grid Services Under Real-Time Pricing, *ASHRAE Topical Conference Proceedings*, Chicago, IL. 29 September - 1 October 2020.