SUCCESSES & CHALLENGES OF SUPPORTING PRODUCT DESIGN EDUCATION FOR DEAF & HARD OF HEARING LEARNERS DURING A PANDEMIC: A CASE STUDY

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ABSTRACT
The impact of the COVID-19 pandemic on Higher Education has been considerable, none more so for practical/vocational subjects such as Product Design. However, consider being deaf/hard-of-hearing (D/HOH) whilst being forced to study predominantly online, with reduced practical in-person teaching opportunities, being socially distanced, and having to contend with face coverings limiting your ability to hear and lip read. The everyday challenges for D/HOH students in higher education is constantly demanding, but the global pandemic exacerbated this, presenting significant educational challenges. This paper presents a case study focused on the 2020/21 academic year whereby we examine the challenges and successes of supporting a product design student with Auditory Neuropathy Spectrum Disorder (ANSD) and permanent bilateral severe-profound hearing loss. The scope of this paper presents the learner arrangements for their product design education and highlights methods of managing the blended learning/teaching environment in combination with the use of British Sign Language (BSL) interpreters, electronic/handwritten notetakers and accompanying technologies. Numerous challenges were presented ranging from, managing rapidly developing online learning tools, adapting personal protective equipment to facilitate lip reading, managing multiple recording technologies to facilitate captioning/transcription, amongst others. The perspectives of the learner are presented, with reflections on how different session types, timetabling, delivery methods, etc., affected their day-to-day learning. Recommendations are made for improved collaboration with student support staff (i.e., BSL interpreters and electronic/handwritten note takers) and the need to implement digital technologies to facilitate the optimal blended learning and socially distanced teaching environment.

Keywords: Blended learning, collaborative/cooperative learning, deaf/hard of hearing learners, flexible learning, product design education

1 INTRODUCTION & CONTEXT
2020/21 has been challenging across the higher education sector for students and academics alike. The switch to blended learning has presented a substantial number of challenges requiring delivery methods to be overhauled, especially for product design education, where students expect to learn by doing but instead had to learn in online/remote settings and socially distanced face-to-face (F2F) environments. Due to the evolving nature of the COVID-19 pandemic, teaching and learning arrangements would change regularly [1], requiring constant adjustments to online and F2F teaching settings/requirements. This had a significant impact on the Higher Education (HE) sector globally [2], but none more so than for students with disabilities where numerous challenges were encountered [3]. Critically, online and distance learning has been recognized as a difficult and challenging experience that lacked efficient communication channels for D/HOH students during the COVID-19 pandemic [4].
The National Deaf Children's Society identified that the switch to blended learning for D/HOH learners in higher education has undoubtedly brought about many significant challenges [5]. The challenge has not only been for D/HOH learners managing their own education, but also for academics planning and

delivering education to a student cohort with a variety of accessibility requirements. Furthermore, many students had been out of education for at least 6 months before commencing university studies due to the pandemic, thus the product design knowledge base for the 2020/21 cohort was even more varied, posing greater inclusivity/parity challenges. Switching to a blended learning approach meant academics had to quickly adapt and innovate their delivery methods when providing remote/socially distanced education. Factoring in accessibility/disability considerations that differ between students required significant planning and testing to enable D/HOH learners to gain access to the same level of education, regardless of the setting. This paper presents a case study examining the challenges and successes of supporting a student with significant hearing challenges whilst studying product design during the 2020/21 academic year where numerous national lockdowns/sudden changes to learning arrangements had to be made based on the requirements set out by the Department for Education (DfE) [1].

To enable D/HOH learners to make informed decisions on their education/support needs, the Disability Rights UK: Into HE 2019 report identifies the range of support services/arrangements on offer [6]. Supporting D/HOH learners in any education setting poses many challenges [7], however by implementing a number of critical accessibility strategies, these challenges can be mitigated when delivering synchronous teaching both F2F and online [8]. Furthermore, evidence shows that D/HOH learners benefit in some settings when undertaking blended learning courses [9], as the use of technology can not only overcome a number of communication issues, but it also can provide opportunities for greater personalized interaction with peers and faculty, leading to increased overall satisfaction.

2 LEARNER ARRANGEMENTS

As universities are increasingly aware of the varying needs of students with disabilities, especially audio and visual disabilities, support services are provided to enhance the learning experience. This case study focusses on a student who has Auditory Neuropathy Spectrum Disorder (ANSD) and permanent bilateral severe-profound hearing loss. They joined BSc (Hons) Product Design SW at Nottingham Trent University (NTU) during the height of the COVID-19 pandemic providing details of their disability based on a Disabled Students' Allowance (DSA) assessment in preparation for the commencement of their studies. In addition to acquiring student finance, the DSA service supports/covers study-related costs incurred by any mental health problem, long term illness or disability and is allocated based on the individual's needs [10]. The learner's needs were defined by a statement of access (SOA), this identified that the student wears hearing aids in both ears due to hearing loss (deafness), requires sessions where possible timetabled in rooms with induction loops, and transcripts of all audio visual materials.

Environmental factors also needed considering as the student uses radio aids requiring lecturers to wear a supporting microphone. The student uses British Sign Language (BSL) interpreters therefore requiring lecturers to speak at a reasonable pace to allow for accurate translation. All sessions/meetings with the student required an interpreter present. Interpreters were required for field trips with advance notice required. The student could request copies of lecture notes/reading materials in advance of sessions. Additional information about how to access school-based support was provided. Discussions regarding placements/external trips must take place in advance to ensure access requirements are met. The student is allowed to demonstrate a preference to sitting in a particular location to facilitate lipreading. Lecturers must ensure they face the class when speaking and repeat any questions asked during teaching sessions where the person speaking is not in the student's direct line of sight. To allow comprehension/processing of academic feedback, the student receives specific feedback identifying key areas of improvement and allowed one-to-one inductions for specialist services i.e., libraries, workshops etc. In addition to the SOA, to aid the planning/delivery of sessions the student was provided with an extensive range of specialist one-to-one support including a specialist notetaker for HOH students (448 hrs/yr.), a specialist support professional for HOH students (36 hrs/yr.) and a BSL Interpreter (840hrs/yr.).

3 COURSE OVERVIEW & SESSION ARRANGEMENTS

Over the course of the academic year, 1st year BSc Product Design students undertook three, ten-week, forty credit modules. This followed the structure of two full day online design studio sessions on Mondays and Thursdays, in combination with in-person design sketching and CAD sessions on Tuesdays, online context and materials workshops on Wednesdays and in person electronics and online mechanics sessions on Tuesdays or Fridays. Each session type has its own syllabus/learning outcomes and was suitably adapted to facilitate optimal learning for D/HOH students. Guidance from the National Deaf Children's Society on supporting deaf young people in education informed session design [11].

3.1 Design studio & workshops

Twice weekly online design studio sessions facilitate project/portfolio development work. Students are briefed at the start of the day with the program of activities which often includes an individual/group tutorial, a self-directed study activity and a live studio activity which often incorporated the use of Miro (a visual collaboration platform). Miro was used to facilitate sharing of information for all students, but also allowed the D/HOH student to fully understand the activities to be undertaken through the use of well-planned instructional focused Miro boards (Figure 1). The daily ordering of activities was important in order to facilitate D/HOH student optimal concentration times. Online resources required meticulous planning with all presentations/resources needing to be 100% accessibility compliant with all images requiring ALT text. All pre-recorded self-directed study activities required full captions with supporting worksheets that helped facilitate student comprehension of subject topics, skills, and software literacy. Group work was limited to five people to facilitate optimal learning environments.
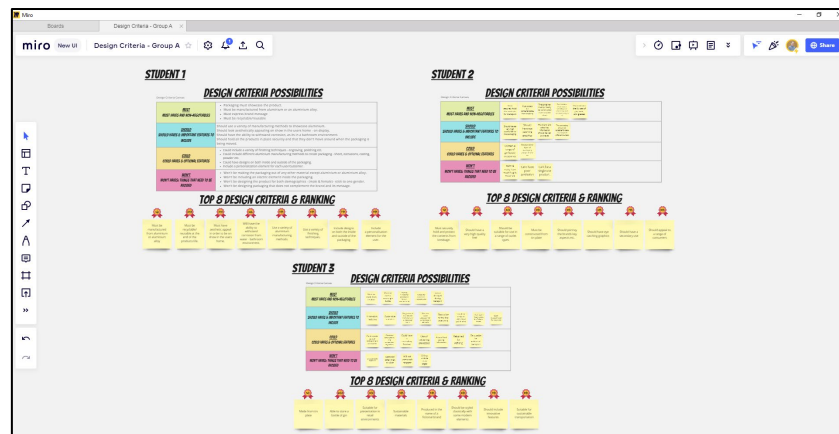

Figure 1. Example of a student collaborative design activity Miro board workspace

3.2 Electronics & mechanics sessions

Six weeks of introductory product design focused in-person electronics and online mechanics sessions were run. A key challenge was to communicate new terminology and the Arduino programming language which added extra complexity for the BSL interpreter. Electronic and mechanics kits were provided to the BSL interpreter/notetaker to provide context, but also to aid communication. One-to-one sessions with the BSL interpreter/notetaker had to be arranged to first ensure their comprehension of the subject was accurate thus to allow for accurate translation. A key challenge during live sessions was maintaining a static position while sharing instructions/demonstrations. Demonstrating circuits under a visualizer was challenging as the student would have to look at multiple sources of information, as the tutor would often have to look down to demonstrate circuits and mechanical movements; a view of the tutor's lips was therefore limited, thus requiring accurate BSL communication. Delivery of session slides required content adjustment to ensure effective visual graphics/ALT text. Extra resources were prepared to support student learning at home, utilizing loan kits. Adjustments for the BSL interpreter was challenging as the interpreter had no BSL signs available for terminology of electronics or Arduino coding. Furthermore, a live glossary needed to be prepared in advance to help student preparation.

3.3 Design sketching & 2D/3D Computer Aided Design sessions

For the twenty-four-week design sketching syllabus and twenty-six-week CAD syllabus over the 2020/21 academic year, sixteen/eighteen weeks were delivered in-person in a socially distanced design studio setting and eight weeks were delivered online due to a UK lockdown. All sessions were also pre-recorded and available with full captions (Figure 2) and located in the VLE learning room to accommodate any absences, COVID-19 self-isolations, or session recaps. A steady pace of narration for demonstrations was provided to encourage supportive learning, with pre-recorded videos providing an independent learning experience; this was the biggest challenge, but this has now benefited our practice for all students. Where possible, the lecturer's face/lips were also shown within the videos to facilitate lip reading. Extra tutorials were also made available when requested. The teaching spaces were set up for both the student's visual access of presentations, but also supported with both a BSL interpreter and notetaker who were strategically located to allow for optimal communication. For computer-based work,

dual screen setups were provided to aid more efficient working. Teaching complex computer software can be a challenge, so for live sessions, pace of delivery was slowed down to ensure the BSL is provided with time to communicate effectively. A pre-recorded copy of the session was given to the BSL/notetaker 48 hours in advance therefore, it was important not to go off topic to ensure the BSL was always able to follow along. Copies of any handouts were also made available and were supported by a live document with terminology and definitions to allow for accurate BSL translation. For design sketching, visualizers were linked to large display screens for live demonstrations to be viewed by all. The visualizer quality provides scope for demonstrating clear, detailed drawing and related applications.
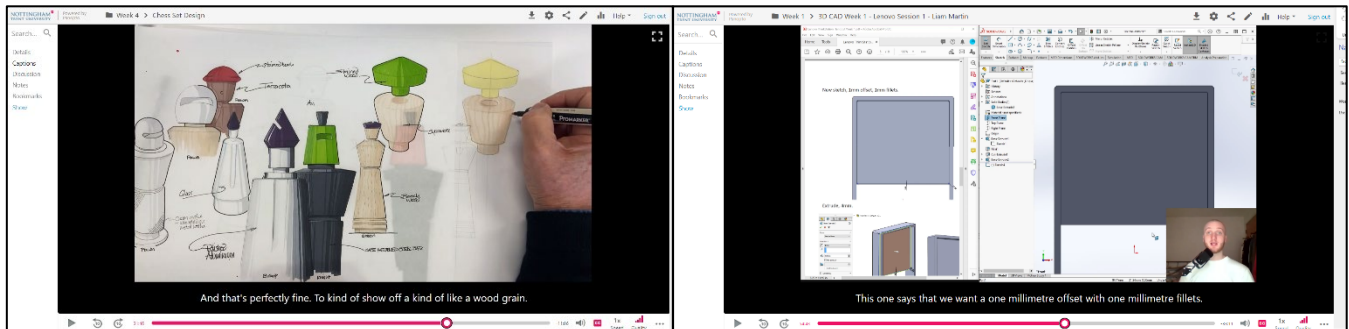

Figure 2. Pre-recorded design sketching & 3D CAD videos with fully embedded captions

4 LEARNER PERSPECTIVES & REFLECTIONS

Before commencing any sessions, the tutor team arranged an online meeting to identify how my needs could be best met. Across all sessions, all of the tutors were provided with a radio aid (Roger Select) and was worn by each speaker and passed between staff. All the lecturers understood that face coverings did not allow for lip reading; clear visors were worn. The year leader ensured all lecturers/guests were made aware of my needs and regularly checked with me to make sure I was on track. All sessions were supported by a pre-recorded video/live recording. A notetaker was present in all the sessions and content was always provided in advance to allow for accurate recording of notes. Across the year I took part in a wide range of different sessions; my reflections on my regular timetabled sessions are below:

4.1 Online design studio & workshops reflection

Design studio sessions ran for the entire year online. With it being a design course, there was a lot of unavoidable group-work. At the start of the year, I met with the year leader to discuss the best learning arrangements. The first issue we identified with online calls was the quality of lipreading and background noise. All sessions were recorded and although live captions were available these were not always correct. I utilized the live captions on MS Teams and used this in conjunction with my notetakers notes for clarification on topics. Pre-recorded sessions/activities were used too and were fully captioned. Where issues occurred with captions from videos, this was reported to the year tutor and resolved quickly. Another issue with online calls and with the quality of lipreading and sound was group sizes. After discussion with the tutor, I was placed in groups no bigger than five people. Where possible, the tutors were careful not to place me in groups with fellow students who had strong accents, which could hinder my understanding, as accents often took a while to get used to.

4.2 Electronics & mechanics reflection

For the electronics sessions, delivery was a short but intense six-week introduction and therefore a fast pace of delivery. A printout of the lesson was provided in advance, to allow me to familiarize myself with all the terms and language to be used. This was also provided to my BSL and notetaker to allow for consistency in the notes provided. The notes also provided a useful backup in case I missed anything during the in-person session. If I was unsure of anything, extra time was made available on a 1-1 basis, to clarify anything that I did not understand. An interpreter was also present in all of these sessions to support my learning. The mechanics sessions took place online, as such a BSL interpreter was not required and live captions on MS Teams could be used; a notetaker was still required. All session content was uploaded to the VLE or sent via email prior to the session to allow me to familiarize myself with all the terms and language to be used. In addition, small electronics and mechanics kits were provided to all the students but also to my notetaker to allow for accurate notetaking and recording.

4.3 Design sketching & 2D/3D Computer Aided Design reflection

Sketching classes were held in a large design studio room, unfortunately with poor acoustics. This was unavoidable due to class size/social distancing. An interpreter was always present at all of the sessions. I always sat at the front of the class, near the lecturer, in range of the radio aid. A general overview of the lesson was always provided, if any further information was needed in the session, the tutor came over to me and provided me with additional demonstrations/guidance. The tutor was always available outside of the sessions for additional one-to-one sessions to be organized. At the start of the year, the CAD tutors arranged a pre-term meeting to organize my needs and communicate how the lessons would be taught. 2D CAD (Adobe Creative Cloud Suite) was mainly delivered by supporting video, whereas 3D CAD (SolidWorks & Keyshot) was conducted via visual demonstration. A problem that came up in tutorials was live demonstrations not always being supported by videos/worksheets. Where students would usually be expected to follow a spoken tutorial/set of instructions demonstrated on the screen, this often-required specific values to be inputted into the CAD programs. As one cannot look at the main screen, work on a computer, as well as look at a BSL interpreter at the same time, this resulted in missed information. The tutor adapted their approach by slowing down, repeating the demonstration or the tutor temporarily pausing to allow the values to be input before moving on. A live vocabulary spreadsheet was produced to support my notes, this was important where terminology and abbreviations were used.

4.4 Course arrangements & reflection

The use of Miro worked much better than expected, providing me a collaborative online working space to interact with my peers. It provided the opportunity to read over any points that I may have missed during group discussions. What didn't work as well as hoped was online group work. Large, randomized groups were used initially meaning when part of larger group activities, I would struggle in the unknown circumstances, with people talking over each-other. With the variety of different accents and limited quality of MS Teams captions, following conversations became close to impossible. After notifying my tutor, we decided that five people in an online environment was the maximum group size I should interact with, this made a huge difference when engaging with activities. In an online environment, the biggest issue that couldn't be overcome was the ability to lipread consistently. Camera/internet connection quality was a detrimental factor. The return to 100% F2F teaching has now allowed me to fully interact with my peers and reduced my anxiety of missing out on conversations/discussions.

5 CONCLUSIONS & RECOMMENDATIONS

Although as staff we were used to working with support services based on various student learning needs (Dyslexia, ADHD etc.), we found working with the disability team eye opening/inspiring. We strongly recommend embedding a consistent BSL interpreter and notetaker within the academic team for the period of a D/HOH student's degree. This allows for consistency in student delivery and optimal communication for session planning/delivery. This also normalizes the learning environment and ensures a supportive space for all learners. The support team helped provide an understanding of the many complex learning and educational issues that D/HOH are exposed to, which resonates and connects to all student learners needs. It is essential that careful session planning for a D/HOH students and support staff is imperative. D/HOH students benefit from a regular timetable of sessions earlier in the day with frequent breaks to allow for optimum concentration. Their increased workload due to constantly looking between different resources i.e., lecture slides, screens, support staff, lecturers, captions/transcripts on resources etc., can be very tiresome. BSL interpreters can only sign for a period of 45 minutes before being given a break due to the high intensity of the communication activity.

Working with D/HOH students means sessions needs to be planned well in advance to ensure the delivery of each session is properly resourced and rooms set up appropriately. Content must be produced and uploaded to online VLEs 48 hours prior to the sessions start time; this allows for suitable time for caption correction and adequate time for BSL/notetaking preparation. To facilitate optimal comprehension for the student, creating live documents for glossary of terms/definitions helps with content lost in translation. For specialist subjects BSL interpreters need to create new signs and then communicate these to the student in advance of the sessions, to allow for effective comprehension.

Whilst socially distanced teaching meant that all teaching spaces needed to be carefully designed to provide a suitable environment for all students to be appropriately separated, it was critical to also consider the D/HOH learner requirements. Even though F2F teaching has resumed, groupwork arrangements still need to be setup in a semi-circle configuration to allow for D/HOH learners to be

suitably positioned in the room to see their peers, the tutor delivering the content and the students support staff. Each D/HOH learner is unique, however from our experience groupwork needs careful planning and limiting, where possible to five participants. Consideration should also be made regarding the D/HOH learners' comprehension of accents when lip reading. The learning time of accents related to lip patterns must be carefully considered, therefore consistency in group allocation is critical.

A key dimension to the delivery of effective learning for a D/HOH learner is their pastoral support. At NTU first year students receive three personal academic tutorials (PATs) whilst having the opportunity to arrange further PATs as required. During our D/HOH learners first year, PATs were scheduled at the beginning of each new module to identify any possible issues and to confirm support staff arrangements. This was followed up with a meeting at the end of the first week of the module to assess the suitability of arrangements. This was followed up by short PATs (10-15 minutes in length) in weeks 3, 6 and 9 of modules. More regular, shorter PATs meetings scheduled over the academic year (minimum of twelve meetings) ensures the students wellbeing is carefully monitored and learning issues are resolved quickly/effectively, thus reducing the likelihood of other wellbeing issues having an impact.

Effective use of online resources for D/HOH students is imperative. Even though we have now returned to 100% F2F teaching, live/pre-recorded content is still provided for all sessions. This allows accessibility for all students whereby they can re-wind sessions, use closed captions etc., to help them facilitate/appreciate the skills/applications within their studies. Within recordings we strongly encourage the video of the lecturer's face to be embedded into the video to help facilitate lip reading where captions are not 100% accurate (Figure 2). In conclusion, every D/HOH student is unique and will have individual needs/requirements dependent on the severity of their condition. Some staff have been empowered to learn BSL to help with their communication. The recommendations above are now used as best practices within NTU to help facilitate optimal learning/teaching regardless of the setting.

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