



NYMAZ: Connect:Resound

Research & Development Report

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Executive Summary

The National Plan for Music Education sets out the seemingly simple ambition that all children in England, whatever their background or location, should be able to access a high-quality music education. This includes learning a musical instrument, playing and performing in ensembles and being able to progress in their individual musical journeys.

The Plan recommended the formation of a series of Music Education Hubs, to provide access, opportunities and excellence in music education for all children and young people, and to bring together all formal and non-formal music education providers within a geographic area.

Of the population of England 17.6% live in areas defined as rural.¹ However, for children growing up in these areas, access to music, along with other social, creative and educational opportunities, is adversely affected in a number of ways. Poor public transport infrastructure, high cost and significant travelling distances can limit the musical opportunities, and broader life chances, open to children and young people.² In particular, instrumental tuition requires specialist input, and travel costs for music leaders needing to go to isolated areas can be prohibitive. The delivery of high-quality, yet cost-effective music education to all children as envisaged in the National Plan is therefore a significant challenge to many Music Education Hubs in rural areas.

A specific recommendation (No 33) made by Darren Henley in his 2011 *Review of Music Education in England* was that future research should ‘... examine how technology could enable better teaching of music (particularly in rural communities)’.³ The Connect: Resound project responded directly to this recommendation and to the consistent challenges faced by children in rural areas in accessing music education by trialling alternative approaches.

¹ Census for England 2011 data cited in Department for Environment, Food and Rural Affairs (2014): *Statistical Digest of Rural England*.

² NYMAZ (2015): *Gone in the Air: Young People, Music and Rural Isolation*.

³ Darren Henley (2011): *Music Education in England: A Review for the Department for Education and the Department for Culture, Media and Sport*, p. 30.

Youth music development charity NYMAZ, a key strategic partner in the North Yorkshire Music Hub, collaborated with music education technology specialists UCan Play, research partners the University of Hull, and North Yorkshire County Council Music Service (lead organisation of the North Yorkshire Music Hub), to develop an R&D project. The aim of Connect: Resound was to investigate how video streaming technologies might be used to deliver music education and enrichment activities to children living in rurally isolated areas.

The project presented an exciting opportunity for NYMAZ and the North Yorkshire Music Hub to respond collaboratively to a key strategic issue and to develop a model of good practice, with the potential to rollout to other Music Education Hubs and contexts.

The original research proposition was:

Can internet technologies increase the ability of Music Education Hubs operating in rural areas to deliver a comprehensive, high-quality, yet affordable music education offer to all children and young people?

Utilising multiple approaches to video streaming in North Yorkshire, the project trialled delivery of the following Music Education Hub core and extension roles:

- Instrumental tuition
- Experiencing live music performances
- Continuing professional development (CPD) for staff.

The research proposition was later honed to:

How can existing video-streaming technology be repurposed to deliver online instrumental lessons for learners in remote rural locations?

The project team identified a standard technical setup for all three strands of activity, comprising the Roland VR-3EX video and audio mixer and streamer, three cameras and external microphones. The equipment was used in addition to Skype, in order to maximise the quality of sound and image, and was sourced with best value as well as quality in mind.

We aimed to develop a high-quality remote learning experience for the young people taking part, while also being cost-effective and financially viable for the education sector.

Instrumental tuition

The team recruited seven primary schools to work with on the project, ranging from very tiny and remote rural schools, with as few as 20 students, to the largest, with 230, on the outskirts of a rural town.

Each school selected a sample of ten pupils in total, comprising four individual pupils and two small groups of three pupils each, from year groups 4, 5 and 6, with varying levels of musical ability. Each individual pupil received 14 20-minute lessons and each small group received 14 30-minute lessons.

The first tranche of lessons was delivered from November 2014 to January 2015, and the second from February to April 2015, totalling 196 hours of online instrumental tuition. Pupils learned a range of instruments, including trumpet, clarinet, violin and guitar. Peripatetic teachers working for the North Yorkshire County Council Music Service provided tuition.

The project used a different technical configuration for each participating school in the first cohort of four schools, in order to compare and assess the different setups. The research team also observed a ‘control group’ receiving face-to-face music lessons. For the second cohort of three schools, following a preliminary review of the research, the Skype-to-Skype approach was discarded.

Live music performances and events

Connect: Resound collaborated with Musicport, Grassington Festival, and Harrogate International Festivals, to develop three live music broadcasts during the project. These encompassed live performances of acoustic/folk and classical music, in addition to a live, behind-the-scenes look at life in a band, which provided an insight into rehearsal and recording processes.

Continuing professional development

The project included a trial live broadcast from NYMAZ's Early Years Music Network annual conference, enabling early years practitioners from North Yorkshire and beyond to access remotely the keynote speech by Professor Colwyn Trevarthen. Training on using the equipment and providing music tuition online was delivered to the Music Service and to school staff, equipping the North Yorkshire music education workforce with a skillset that will enable them to continue to deliver and build on the pilot, and to pass on their learning to others.

Results

The research focused on the instrumental tuition strand of project delivery. The key research questions were:

- What can we learn about using online technology to deliver instrumental lessons?
- How have the pupils responded?
- How cost-effective is the approach?

The results of the data analysis demonstrated three major areas of discovery:

- Technology
- Delivery
- Environment.

The challenges found concerning the use of the technology included:

Time lag

The main challenge for all teachers was the inherent time delay using Skype: teachers were unable to count a beat alongside a pupil or to accompany them while playing.

Punctuality

Early on in the project, some lessons started late because of minor technical issues. By the end of the project, confidence and competence appeared to have increased, with all of the final lessons starting on time.

Sound quality

On sound quality, 68.6% of pupils reported that it was ‘good’ or ‘very good’, while 74.6% reported that they could hear what the teacher was saying ‘most of the time’ or ‘all the time’. Teachers provided a median score of 7/10 for sound quality. Specific sound-related challenges included:

- Noise spillage from adjacent areas in schools;
- Amplification of background noise in Skype
- Reflections of sound in larger rooms.

Video quality

In terms of video quality, 86.5% of pupils reported being able to see what the teacher wanted them to do ‘most of the time’ or ‘all the time’. Teachers gave a median score of 4/10 for video quality. However, teachers reported that their view of pupils was sometimes limited. This was alleviated somewhat by the Roland VR-3EX, when employed at the school, as the device enabled multiple camera angles.

Quality of internet connection was variable: 51.2% of pupils described the internet connection as ‘okay’, with 22% ticking the ‘bad’ category, and 21.9% ticking ‘good or ‘very good’. Teachers gave a median score of 5/10 for connection quality. Although superfast broadband was available in most areas the project team targeted some schools experienced connectivity issues. This impacted on pupils’ ability to hear or see what the teacher was trying to communicate.

Delivery

The research team discovered:

- Pupil distraction was not an issue during online delivery, with teachers reporting good concentration among participants
- Beginner technique demonstrated well via online delivery
- All pupils reported enjoying the instrumental lessons, with 70.1% saying they enjoyed them ‘very much’, 16.4% ‘quite a lot’, and 13.4% ‘a bit’

- Parents' reports of their children's enjoyment were slightly lower but still very positive: 57.1% of parents/carers said their child enjoyed the lessons 'very much', 24.5% stated 'quite a lot', 14.3% suggested 'a bit' and 4.1% 'not much'
- Assembly of instruments presented a potential challenge but was circumvented by teachers establishing their own protocol
- Tuning instruments presented issues but again teachers developed strategies to deal with this
- Where internet connection was poor difficulties were encountered in teaching particular instrumental techniques such as violin bow hold
- Face-to-face delivery was seen as preferable to online remote delivery by children and parents, though 39.0% of children and 29.2% of parents wanted the lessons to continue over the internet
- The project enabled children to receive music tuition who would otherwise not have had this opportunity: 79.5% of parent respondents would not have otherwise sought out instrumental lessons for their child
- Teachers integrated the use of different camera angles into their teaching during the course of the study and by the end were using the different angles for a similar proportion of teaching time. This suggests they became more comfortable with the technology.

Environment

There were a number of environmental issues that arose, including:

- Need for a dedicated teaching room: rooms with multiple functions in small rural schools caused disruption to online tuition
- Room size: small rooms were unable to position the cameras far enough away to fully see the pupil, while larger rooms had reflections that reduced audio quality
- Noise spillage from break time or adjacent rooms affecting delivery.

Impact

Overall, the project received a positive response from teachers, pupils, and head teachers.

Teachers reported that pupils made good progress in their lessons:

'Really good, actually...the individuals got further than they would in a normal lesson. I think it was because of the kids, I think they really liked doing it over the internet.'

Parents gave positive feedback about children's progress with 24.5% stating it was 'very good', 46.9% indicating it was 'good', and 28.6% that progress was satisfactory. Most of the pupils (74.1%) and many parents/carers (68.2%) wanted them to continue to learn their instruments 'quite a lot' or 'very much'.

Teachers felt there were significant benefits in not travelling long distances to teach, but some suggested that the nuances of face-to-face learning may be lost with an online approach.

The issue of rural schools' access to instrumental music lessons prior to Connect: Resound was touched on a number of times:

'Because we're so very small and rural and I think it's important to give every child that opportunity to have instrumental lessons and that's what's so very difficult in a small school.'

Conclusions

Although there were some technical issues during the project, many minor problems were eradicated during the trial period. The time lag for the audio stream presents an ongoing challenge but other applications are under development to minimise and eradicate this problem.

Teachers' flexibility in adapting their methods to suit online instrumental teaching was particularly encouraging.⁴

⁴ Audio only apps addressing issues of latency include <https://ccrma.stanford.edu/groups/soundwire/software/jacktrip/> and <https://jammr.net/>. Research underway into audio and video latency can be found at: <http://www.waikato.ac.nz/fass/about/staff/musik>.

Four technology approaches were trialled during the project, and two approaches are recommended by the research team for schools and Music Hubs to adopt:

- 1 Skype (school) to Roland VR-3EX (Music Hub); or
- 2 Roland VR-3EX (school) to Roland VR-3EX (Music Hub).

Although the cost of purchasing the Roland VR-3EX technology and related equipment is relatively low it could still prove prohibitively expensive to schools with small budgets. A simpler two-camera setup, (as opposed to the three cameras used in the pilot – one overall view of the teacher, and the other enabling close-ups) would still be an effective way to deliver an instrumental lesson. The use of just Skype with one external webcam and microphone at the school end, with a Roland VR-3EX at the Music Hub end, offers a possible alternative to effective tuition for learners.

Where it is possible for schools to invest in the technology the flexibility of having multiple camera angles (especially for group lessons) is clearly beneficial in terms of increasing the depth of experience.

Music Hubs could be delivering a greater number of online lessons from their geographical base and therefore investment in VR-3EX technology could prove a cost-effective option.

Information provided by North Yorkshire County Council Music Service indicated that:

- £77,000 is spent annually on mileage allowance for teachers
- In a typical teaching week, 980 hours were spent on face-to-face delivery of instrumental lessons
- A further 139 hours per week were spent on teachers travelling from school to school. This equates to 4.2 full-time members of staff.

There are potential savings both in terms of economic costs and time spent by teachers travelling between schools. Currently, lessons take place at a school only when a certain group size has been achieved, because of economies of scale. The approach used in this project means that even if a single child wants to study a particular instrument it

would be no less cost-effective than a face-to-face instrumental lesson in a school with multiple pupils. Therefore, access to music can be increased in these remote areas.

However, consideration must be given to the need for a fibre-optic broadband connection, and to the environment that the lessons are delivered from to ensure reasonable acoustics.

Both in terms of technology and pedagogy, the remote learning sessions were delivered successfully, with participants making progress comparable to face-to-face lessons. Feedback from stakeholders indicates this has been a welcome addition to music learning for the schools involved.

Were Music Hubs across the country to be set up with appropriate facilities in this way, they would have the potential to reach a greater number of pupils and widen access to music education for all, as envisaged in the National Plan for Music Education.

Insights

Selection of equipment

Bearing in mind budgetary considerations and the ambition to identify a cost-effective solution for future rollout, UCan Play, for example, chose a significantly cheaper camera which would normally be found in CCTV networks.

Use of equipment

The use of Skype caused a number of issues throughout the project. Despite the relatively low up-stream requirements of VR3-EX (less than 1Mbps), the large demands made on wireless networks within schools caused problems in broadcast transmission and reception.

Moving forwards and making recommendations for others

We reviewed and evaluated the tools used within the existing project's technical solution. The choices made were with consideration of the end user in mind: instrumental teachers have precious little time to set up technology in advance of teaching, they often have minimal technical skills in areas outside of basic music technologies, and the equipment itself needs to be robust and easy to manage.

Working with busy schools

Although commitment, timetabling, space and staff support all presented potential challenges to the research project, the teachers we worked with were unfailingly flexible, collaborative, enthusiastic and excited about participating in something they feel could make a real difference to the issues they face in providing music-education opportunities to young people.



Figure 1: North Yorkshire school students

Source: Sam Atkins

Future

Connect: Resound has demonstrated that online peripatetic music lessons can provide a quality and cost-effective way to increase children's access to music. The head of the Music Service in North Yorkshire reflected the positive feedback from many of those involved, suggesting a blended approach incorporating both online and face-to-face tuition as a future model for delivery.

Access to adequate internet connections remains the key challenge for further dissemination of the Connect: Resound approach. The government's Superfast Broadband programme (part of the wider Broadband Delivery UK programme) aims to provide superfast broadband (speeds of 24Mbps or more) for at least 95% of UK premises by 2017, and universal access to basic broadband (speeds of at least 2Mbps) by 2016, with a total public investment to date of around £1.7bn.⁵

There has recently been significant press coverage about the frustrations of those living and working in rural areas about limited access to high-speed broadband compared with the ambitions and projected delivery dates of Superfast Broadband.

A new inquiry by the House of Commons Select Committee for the Department of Culture, Media and Sport (DCMS), 'Establishing world-class connectivity throughout the UK', has been launched to look at the coverage, delivery and performance of superfast broadband in the UK, and what needs to be done in order to connect the most remote areas – the final 5% of premises.⁶

There could also be wider implications for schools by increasing access to specialists in other areas through virtual means.

The screen-casting software used by the research team could provide an opportunity to expand the approach used by teachers when using online delivery. The ability to capture a live lesson so that both teacher and pupil had a video record could serve as a practice aid for pupils and a reflective tool for teachers.

We have become increasingly aware that many of the tools, technologies and approaches we intended to explore had applications beyond the initial scope of the project. By developing the confidence and capacity of arts leaders and schools to engage in learning online, including developing their familiarity with specific technologies, there are many possibilities for adaptation in other artform contexts – and beyond, into other subject areas.

⁵ <https://www.gov.uk/broadband-delivery-uk>

⁶ <http://www.ispreview.co.uk/index.php/2015/07/select-committee-starts-inquiry-into-uk-superfast-broadband-strategy.html>

Through delivering the live broadcast strand, we have also become aware of the growing interest in and capacity for live-streaming arts events among smaller arts producers and venues. There is potential to look at how connections between organisations and audiences can be facilitated, utilising the technology and specialist support that made these pilot broadcasts possible.

The project partners are currently looking at engaging more Music Hubs operating in rural areas so that the Connect: Resound approach can be rolled out further. A toolkit has been created to accompany this report and provide guidance to schools, Music Hubs and others wishing to implement the techniques piloted by Connect: Resound.

Background

Our vision is to enable children from all backgrounds and every part of England to have the opportunity to learn a musical instrument; to make music with others; to learn to sing; and to have the opportunity to progress to the next level of excellence.

The Importance of Music, a National Plan for Music Education, DCMS

‘The true beauty of music is that it connects people. It carries a message and we, the musicians, are the messengers.’

Roy Ayers

Learning a new musical instrument is an exciting journey of discovery, from learning how to assemble, hold and tune your instrument, to tentatively starting to play notes, melodies and scales, to participating in performances, ensembles and orchestras. For many children, their first – and often only – experience of this will have traditionally been via skilled and experienced instrumental teachers employed by the local authority music service.

In an area like North Yorkshire, covering over 3,000 square miles, with a very dispersed population, delivering a diverse music education to every school in the county presents particular practical, cost and transport challenges. North Yorkshire is classified as predominantly rural, with five of its seven districts classified as Rural-80 (districts with at least 80% of their population in rural settlements and larger market towns) and the remaining two classified as Significant Rural.

NYMAZ’s 2015 report into young people, music and rural isolation, ‘Gone in the Air’, notes the number of ways access to music education (along with other social, creative and educational opportunities) can be adversely affected for those growing up in rural areas:

‘The necessity of travelling considerable distances to access most amenities and activities, limited bus and train services (including schedules which stop running in the evening or at weekends) and the high cost of public transport combined with

lack of disposable income are all significant factors affecting the lives of children and young people in rural areas, presenting barriers to accessing services, education, training, employment and friends.⁷

The National Foundation for Youth Music reports that rural isolation is the challenge reported most frequently by their grant holders, with 22.4% of participants in 2013/14 (an increase from 18.1% in 2012/13 and 16% in 2011/12):⁸

'[Grant holders] demonstrated that local music-making opportunities were patchy or non-existent and that in-school provision was often very limited (and being further reduced) in the rural areas targeted.'

Music Education Hubs

Another important part of the context for the Connect: Resound project is the creation of Music Education Hubs,⁹ following the publication of the National Plan for Music Education in 2011. A total of 123 Hubs were created and started work in 2012, with the aim of providing access, opportunities and excellence in music education for all children and young people, and to bring together all formal and non-formal music education providers within a geographic area.

The North Yorkshire Music Hub aims to ensure that all children in the county have access to music education in and out of school, through organisations (led by North Yorkshire County Council Music Service) working in partnership to create joined-up, high-quality provision. This collaborative way of working enables gaps in music provision to be more easily identified, and responsive activities and solutions developed. One outcome of this collaborative process was the development of the Connect: Resound project.

Youth music development charity NYMAZ, a key strategic partner in the North Yorkshire Music Hub, linked up with music education technology specialists UCan Play, and with researchers from the University of Hull,

⁷ NYMAZ (2015): Gone In The Air, Young People, Music and Rural Isolation.

⁸ The National Foundation for Youth Music (2014): Impact Report <http://www.youthmusic.org.uk/our-impact/youth-music-impact-learning-reports-2014.html>

⁹ Abbreviated to Music Hubs for the rest of the document.

to develop an R&D project to investigate how digital technologies might be used to deliver music education and enrichment activities to children living in rurally isolated areas.

The Connect: Resound model proposed to respond to consistent challenges to accessing music education among children in rural areas by trialling alternative approaches. The project set out to discover in what ways video-streaming technology could increase the ability of organisations working in rural areas to deliver high-quality and varied music education for children and young people, and whether software could be developed to enable effective two-way flow of information between teachers and pupils.

The partners developed a model that would trial cost-effective video-streaming technologies and online communication tools to deliver instrumental tuition and music performances to pupils in primary schools in North Yorkshire, as well as access to online CPD for music leaders.¹⁰ The aim was to identify a new delivery model for music education, in which digital delivery complements live instrumental lessons, which could be shared and incorporated into Music Hub business plans and music development organisations nationwide.

We saw this as a crucial opportunity for the North Yorkshire Music Hub, as well as for other Music Hubs across the country, where delivery of high-quality, cost-effective music education to children, as envisaged in the National Plan for Music Education, is a significant challenge, especially in rural areas.

Living in a rural area means that transport times and costs can often limit the musical opportunities and broader life chances open to children and young people. Instrumental tuition, in particular, is expensive, requiring specialist input. This was again demonstrated in *Gone in the Air*:

‘Lack of specialist music leaders often means that choice is limited in rural areas – young people may be confined to learning certain instruments by the availability of teachers in the local area, or there may be no ensembles accessible to them which specialise in different musical genres – which in turn can hamper

¹⁰ Abbreviated to CPD in the remainder of the report

their further musical progression compared to their urban counterparts.'

Travelling times and costs are also real barriers to young people accessing instrumental tuition and live music performances:

'A small survey of young people engaging in participatory music activities in North Yorkshire found that on average participants travelled 15.5 miles to attend music sessions [although distances can be much longer]...Participants are often reliant on parents, carers and other relatives to transport them to music activities, which can mean that those in challenging circumstances who aren't supported by their families to engage with such activities can miss out.'

A specific recommendation made by Darren Henley in his 2011 Review of Music Education in England was that future research should 'examine how technology could enable better teaching of music (particularly in rural communities').¹¹

Connect: Resound presented an exciting opportunity for NYMAZ and the North Yorkshire Music Hub to respond to a key strategic issue that the new model of collaborative working had identified, and to develop a model of good practice with the potential to rollout to other Hubs and contexts. The partners felt the project had real potential to drive innovation in the way that music education is delivered.

In most cases, Music Hubs are led by local authority music services, which may have had little historical impetus to innovate. As yet, many Music Hubs operate fairly traditional business models. Although there are pockets of excellent practice, many Hubs are still negotiating new governance models and ways of partnership working, and are dealing with severe local authority cuts and the need to raise additional income, leaving them little time to explore innovative delivery methods for core roles. In this context of policy changes, local authority restructures, reported increased difficulties in recruiting and retaining good quality staff, and budgetary constraints, it can be difficult for new approaches to be developed and then disseminated and embedded. Developing a

¹¹ Darren Henley (2011). Music Education in England: A Review for the Department for Education and the Department for Culture, Media and Sport, p. 30.

model that could be easily understood and adopted by other Hubs across the country was therefore an imperative for this project.

Connect: Resound provided an opportunity to explore, refine and test approaches to online music teaching, and ultimately to diversify, extend and enrich music education locally and nationally. With the addition of live broadcast performances and CPD opportunities we also aimed to explore the possibilities for broadening access to high-quality music performances and training events, especially to those whose rural locations restrict such access.

The project had a very specific focus, and testing the capacity of digital and online tools to deliver high-quality music education was our core priority. However, we were also aware that many of the tools, technologies and approaches we intended to explore had potential applications beyond the initial scope of the project. By developing the confidence and capacity of arts leaders and schools to engage in learning online, including developing their familiarity with specific technologies, the possibility for adaptations within other artform contexts has greatly increased.

The growth of live streaming

In terms of live broadcasts, there is a sense that the sector is on the cusp of a breakthrough as the technology and skills to produce high-quality performances for new audiences become more widely available and affordable. The same is true for CPD, as more arts professionals are able to access webinars and online training, and view and interact with live broadcasts of conferences. High-profile organisations such as TED have normalised this method of learning and within the cultural sector a number of trailblazers are setting the pace. For instance, the two day HI-ARTS' 2010 Culture and Social Enterprise conference was presented live online at <http://northythings.com/webcast/>

In the music world, internet technologies are transforming the way musicians learn, collaborate and perform. The BBC's Arts Technologica series, hosted by Martha Lane Fox, recently highlighted some examples of how faster internet speeds are enabling innovative approaches:

- Eric Whitacre's Virtual Choir, featuring singers from countries as diverse as Syria and Cuba
- Former 10CC musician Kevin Godley's Whole World Band App, which allows anyone to make music with musicians anywhere on the planet
- Musicians at Edinburgh Napier University and the Royal College of Music in London using new technology on high-speed research networks, which allows them to play together with musicians in other countries in real time.

Many high-profile arts organisations are using new platforms to livestream performances and/or make available for download, from the New York Metropolitan Opera to the London Symphony Orchestra.

Moreover, the use of internet technologies for instrumental teaching is growing rapidly in the private sector. The National Piping Centre has a well-established Skype-based teaching programme, enabling learners all over the world to access tuition from specialist musicians in the learner's home country.¹²

As yet, there are far fewer examples of these technologies being used in instrumental tuition in state education of the under-18s, a notable exception coming from Dumfries and Galloway, where since 2004 the education service has been trialling teaching via video conferencing technology. Another exciting example is the Online Orchestra project, in which the Cornwall Music Education Hub is working with academic partners and the Philharmonia Orchestra to enable children and amateur musicians living in isolated rural communities in the South West to play in an online orchestra. As with Connect: Resound, these projects set out to explore the qualitative and technological factors that affect the delivery of collaborative, online music making and teaching in remote rural areas.

As access to faster internet connections improves, and the technology enabling lessons to offer more than a basic screen-to-screen interaction becomes more affordable, and as Music Hubs are being required to

¹² Project funded by the National R&D Fund for the Arts in Scotland
<http://www.nesta.org.uk/blog/digital-rd-arts-scotland-case-study-1-national-piping-centre>

become more innovative and flexible to changes in the way music education is supported, it is a good time to start exploring whether these kinds of solutions can be made more widely available.

The Project

The objective of the project was to identify a cost-efficient, high-quality method of enhancing the music education opportunities on offer; a business model that can then be shared with Music Hubs across the country.

In order to investigate this question, an R&D project was developed, which would work with primary schools across North Yorkshire to test different methodologies for delivering online tuition, the key differences being the equipment used at the school and teacher locations.

The overall research proposition was:

Can internet technologies increase the ability of Music Hubs operating in rural areas to deliver a comprehensive, high-quality, yet affordable music education offer to all children and young people?

In order to explore this proposition, we developed a set of research questions, which underpinned the project design and delivery:

- What can we learn about using online technology to deliver music lessons and enrichment opportunities, such as live performances?
- What technology exists to facilitate online music education and how cost-effective is it?
- How are other people using online technology to deliver music education and what research exists in this area?
- How reliable is the technology? How do the different configurations of technology being tested compare?
- How do pupils and teachers respond to using technology for teaching music and delivering music performances in this way?

Management

The project was delivered by a four-way partnership, led by NYMAZ on behalf of the North Yorkshire Music Hub. Technical direction and support

was provided by UCan Play, while the University of Hull led on the research elements of the project. North Yorkshire County Council Music Service (Music Hub lead) provided music tuition.

The partnership board comprised:

- Heidi Johnson, director, NYMAZ
- Ian Bangay, head of service, North Yorkshire County Council Music Service
- Dr Andrew King, senior lecturer in music and technology, University of Hull
- Dr Jonathan Savage, managing director, UCan Play

The delivery team included:

- Project management: Emily Penn, Millie Watkins (NYMAZ)
- Technical advice and training: Chris Bowes, Richard Llewellyn (UCan Play)
- Research and data analysis: Dr Robert Mackay, Dr Helen Prior, Dr Daniella Fountain (University of Hull)
- Marketing strategy: Elizabeth Parbutt, Jane Thomas (Made By Marketing)
- Instrumental tuition: Emma Calvert, Anne Heaton, Chris Hirst, Jonathan Hill, Andy Morgan, Daniel Timmins (all North Yorkshire County Council Music Service), and Alison Goffin (freelance)
- Live broadcast partners: Musicport, Grassington Festival, Harrogate International Festival (Producers); Maia, Hope & Social, Martin James Bartlett (Artists).

The project team was dispersed geographically and the full partnership met quarterly to oversee the project and review progress. Day-to-day delivery was enabled by using online and file project-management tools such as Basecamp and Dropbox, in addition to email, phone and Skype. Sub-teams met more regularly to deliver training, undertake site visits, plan and implement marketing campaigns, and keep the project to schedule.

NYMAZ and North Yorkshire County Council (NYCC) Music Service have a long history of collaborative working on music education activities, both preceding and following the advent of Music Education Hubs. NYCC Music Service is the lead organisation of the North Yorkshire Music Hub and NYMAZ is a strategic partner. UCan Play and University of Hull had had some contact prior to Connect: Resound due to similar research interests but this was the first time they had formally worked together. NYMAZ and NYCC Music Service had not worked with either UCan Play or University of Hull before the start of this project.

Project delivery

There were three key strands of activity:

- Instrumental tuition
- Access to live music performances
- Training and CPD.

The project team identified a standard technical setup that was to be used across all these strands of activity, based on the Roland VR-3EX video and audio mixer and streamer as the core component. To this we added three cameras and separate microphones. Pupils were also provided with headphones for use in the lessons. A full list of equipment is provided in Appendix 1.



Figure 2: VR-3EX,

Cameras and microphones, in use in an online instrumental lesson

Source: Sam Atkins

The equipment was to be used with live-streaming software Skype, in order to maximise the quality of sound and image, and was sourced with best value as well as quality in mind. We hoped to develop an approach focused on excellence of experience and learning for the young people undertaking distance learning of musical instruments, while also being cost-effective and within reach of the education sector.

Instrumental tuition

Connect: Resound recruited seven primary schools to work with on the project. North Yorkshire is a two-tier county, divided into seven districts, and we worked with a school from each district. The schools ranged in size and situation from very tiny and remote rural schools, with as few as 20 pupils, to the largest, with 232, on the outskirts of a rural town. Each school serves communities affected by rural isolation and that lack the services afforded to larger and more urban areas.

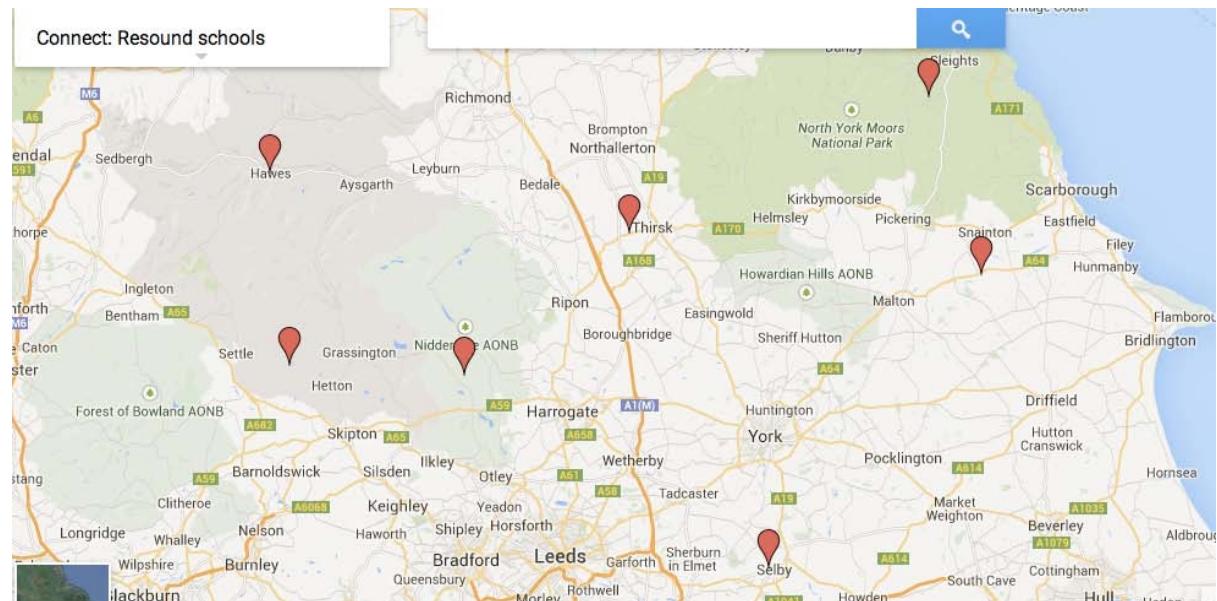


Figure 3: Locations of participating schools in North Yorkshire

Source: Google Maps

The schools were selected in consultation with the North Yorkshire County Council Music Service, and represented a range of experience and provision in terms of music education and instrumental tuition. We also worked with schools in areas where superfast broadband was available, with upload speeds of at least 1Mbps, to enable streaming of lessons. It is important to note that this minimum proved barely viable and, where better speeds were available, the experience was much improved. Not all rural schools have access to superfast broadband, so significant access issues to digital streaming remain.

Schools identified an appropriate space within their buildings with access to a computer and wired internet connection, and a member of staff (or in some cases a volunteer such as a parent governor) to set up equipment and sit in on lessons. Spaces varied depending on the size of school. For example, in the smallest schools we had a choice of just one of only two classrooms, whereas the larger schools offered the opportunity to test the technology in spaces such as school halls and libraries.

Each school selected a sample of ten pupils in total, comprising four individual pupils and two small groups of three pupils, from year groups 4, 5 and 6, with varying levels of musical ability. In one school, this cohort grew by one to include all the pupils in the relevant age group in the school. Pupils received two lessons per week, of 20 minutes duration for individuals and 30 minutes for small groups, over a period of seven weeks.

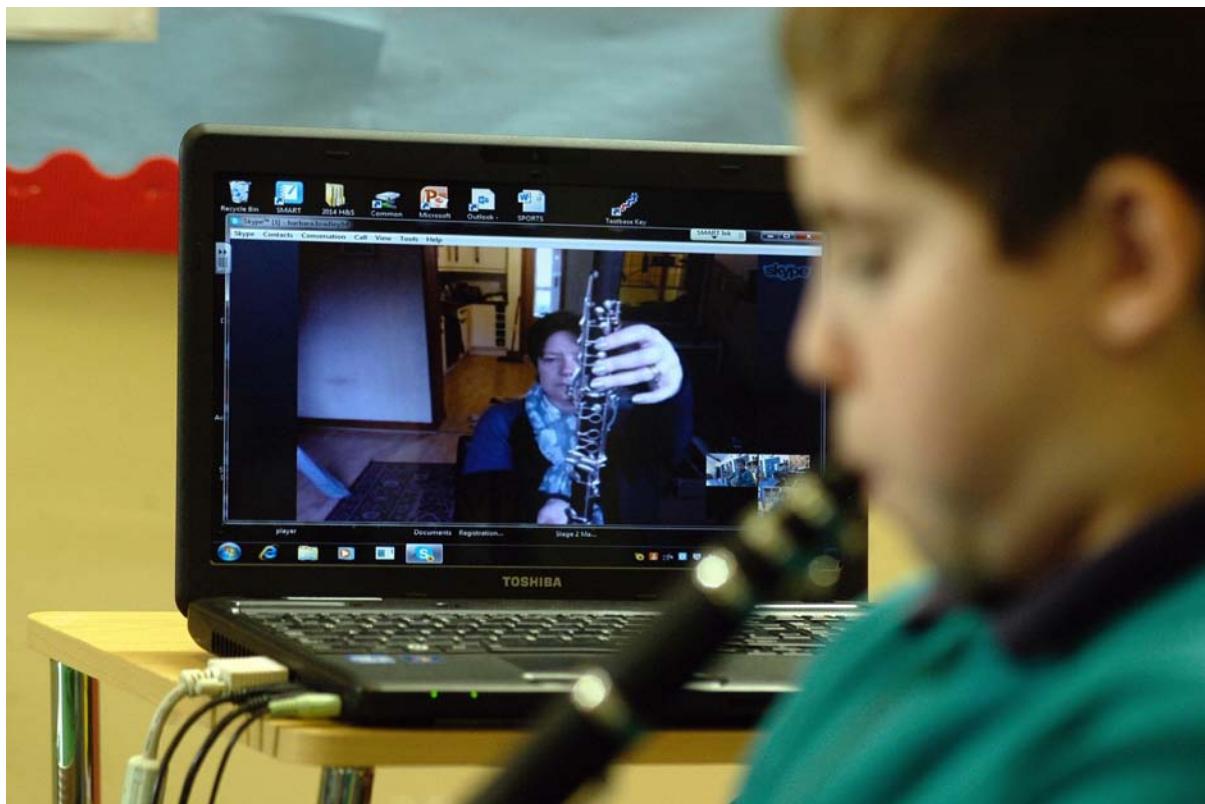
The first cohort of four schools received lessons from November 2014 to January 2015, and the second from February to April 2015 (each included a two-week break for school holidays), totalling 196 hours of online instrumental tuition. Pupils learned a range of instruments, including brass, woodwind, strings and guitar. A single group vocal lesson was also delivered to a full class of 30 pupils in order to assess the suitability of the techniques for larger groups.

Tuition was provided by skilled and experienced teachers working for the NYCC Music Service, enabling the Connect: Resound approach to be compared against decades of conventional face-to-face delivery. These peripatetic music teachers (including a number of senior staff and managers from the Music Service team) would normally travel the

county to deliver instrumental lessons to schools in person, but for this project would be based in a single location, delivering lessons to pupils via the internet using Skype.

We used a different technical configuration for each participating school in the first cohort in order to compare and assess the different setups. The research team also observed a 'control group' receiving face-to-face music lessons.

Table 1 below shows the technological setup used for each school. For School 1, for example, the teacher used a simple PC and webcam from their teaching base in Harrogate, linking up via Skype to the rural school, which was also using only a PC and webcam, to send sound and images of the pupils back to the teacher. Meanwhile, for School 4, the teacher used the VR-3EX audio-visual mixer, plus three additional cameras and microphones, and the school had the same setup. This enabled both teachers and pupils to switch between different camera angles, zoom in and out, and significantly increased the audio quality at



each end.

*Figure 4: Still of programme in use***Source: Sam Atkins**

School	Music Hub technology	School technology	Instrument
1	PC & webcam	PC & webcam	Violin
2	PC & webcam	Roland VR-3EX, 3 cameras, 3 mics	Clarinet
3	Roland VR-3EX, 3 cameras, 3 mics	PC & webcam	Guitar
4	Roland VR-3EX, 3 cameras, 3 mics	Roland VR-3EX, 3 cameras, 3 mics	Clarinet
5	PC & webcam	Roland VR-3EX, 3 cameras, 3 mics	Guitar
6	Roland VR-3EX, 3 cameras, 3 mics	PC & webcam	Woodwind (clarinet, flute, saxophone)
7	Roland VR-3EX, 3 cameras, 3 mics	Roland VR-3EX, 3 cameras, 3 mics	Trumpet

Table 1: Technical setup for each participating school

In week 1, the research team observed 13 individual lessons and 11 group lessons. The final lessons were also observed and captured.

The purpose of capturing of the first and last lesson was twofold:

- 1 To explore how the teachers used the technology and taught in the first lesson.
- 2 To understand how the use of technology and teaching approach had developed by the final lesson.

Post-project interviews took place with all the instrumental teachers, and feedback was sought from pupils, carers/parents, and school staff, including music coordinators and head teachers.

The instrumental teachers volunteered to take part in the project with a great deal of interest and enthusiasm. Training in using the equipment, and delivering instrumental tuition online, was provided by technology and music education specialists from UCan Play, who were also responsible for installing the technology in each location.

School recruitment, teacher training and delivery planning took place in a short period of time and there was very little scope for slippage in the timetable. One unforeseen issue during delivery with the first cohort was around permissions to use Skype.

This matter had been anticipated, with the Connect: Resound team working closely with the education authority's technical support team to ensure all necessary permissions were in place for schools. However, the Music Service itself connected to the internet via the county council's internet connection, which had different restrictions in place to the schools network. By working closely with the local authority, which was quick to find a solution, we resolved the situation, but the resulting delay affected the start and finish times of subsequent delivery, telescoping the available time for the research data to be collected, transcribed and analysed.

There is still variation across local authorities as to whether Skype is enabled for general use – some may have firewalls or IT protocols in place which specifically disable it – and it is a factor that Music Hubs would need to research when scoping a project of this kind, as many will be based in and teaching from local authority premises.

Access to live music performances

In addition to delivering instrumental tuition, Connect: Resound used the same technology setup developed for the schools programme to live-broadcast music performances and events online. Access to these broadcasts was offered to all schools in North Yorkshire.

Connect: Resound worked with Musicport, Grassington Festival, and Harrogate International Festivals, to develop a diverse programme of live music broadcasts. These encompassed live concert performances of acoustic/folk and classical music, in addition to a live, behind-the-scenes look at life in a band. This broadcast provided an insight into

rehearsal and recording processes and helped pupils to understand the link between learning an instrument at school and the range of professional, creative and social opportunities afforded by this experience in later life.

These performances were recorded and broadcast using the same technology setup developed for the schools-based instrumental tuition, with the addition of an extra camcorder to enable tracking and mobile shots. We broadcast using both wired internet connection and 4G signals, and made the performances available via YouTube.



Figure 5: Live broadcast in partnership with Grassington Festival: Behind the scenes with Hope & Social
Source: Grassington Festival

As well as being valued by schools, there is increasing interest among smaller arts organisations in live streaming and/or recording their performances for online broadcast. There is potential to look at how connections between organisations and audiences can be facilitated, using the technology and specialist support that made these pilot broadcasts possible.

A total of 124 people watched the performances during the live broadcasts, while a further 827 have watched them subsequently. This may suggest that the market for online content in this case is larger than for the live event and bears further investigation.

Training and CPD

NYMAZ already produces regular webinars on aspects of music education and was keen to develop the scope of CPD opportunities offered through this project.

A live broadcast from our NYMAZ Early Years Music Network annual conference was trialled, enabling early years practitioners from North Yorkshire and far beyond to access the keynote speech by Professor Colwyn Trevarthen, a renowned expert on music, child psychology and psychobiology. There was a great deal of interest displayed on Facebook groups and other fora from the music and early years community in this event, but the broadband connection at the venue was lower speed than required, and much of the live broadcast was not available. However, 138 viewers have since accessed the archived presentation.

The Music Service and schools involved in the pilot were given training on how to use the equipment and to deliver music tuition online, thus equipping the North Yorkshire music education workforce with a skillset that will enable them to continue to deliver and build on the pilot, and to pass on their learning to others. This process culminated with a sharing event at the end of the project, in which everyone involved in delivery of any aspect of the project was invited to come along and share their learning and experiences, and collaboratively plan for where we can take learning next.

Marketing and communications

We needed to communicate with a variety of different people over the course of the project, from schools and parents to Music Hubs and arts organisations.

Our first priority was to generate a sense of community among all participants and partners. A visual identity was commissioned and used to lead the design and development of a mini-site hosted on the main NYMAZ website. The site carries everything from details of the schools involved to project insights and blog posts – www.nymaz.org.uk/connectresound.

It was also important to establish and maintain awareness of the project locally. Extensive media relations and social-media activity ensured that Connect: Resound was on the county's radar, and we also achieved national coverage in the music education press.

As the project progressed, we commissioned high-quality photography and video to document and celebrate the project, and to help us to share the story with the media and people who want to learn about and from the project. Following completion of the research, the focus is on disseminating the results to stakeholders across the country, via media, academic journals, conferences/events in the music, arts, academic and education sectors, as well as directly via our social-media channels and website.

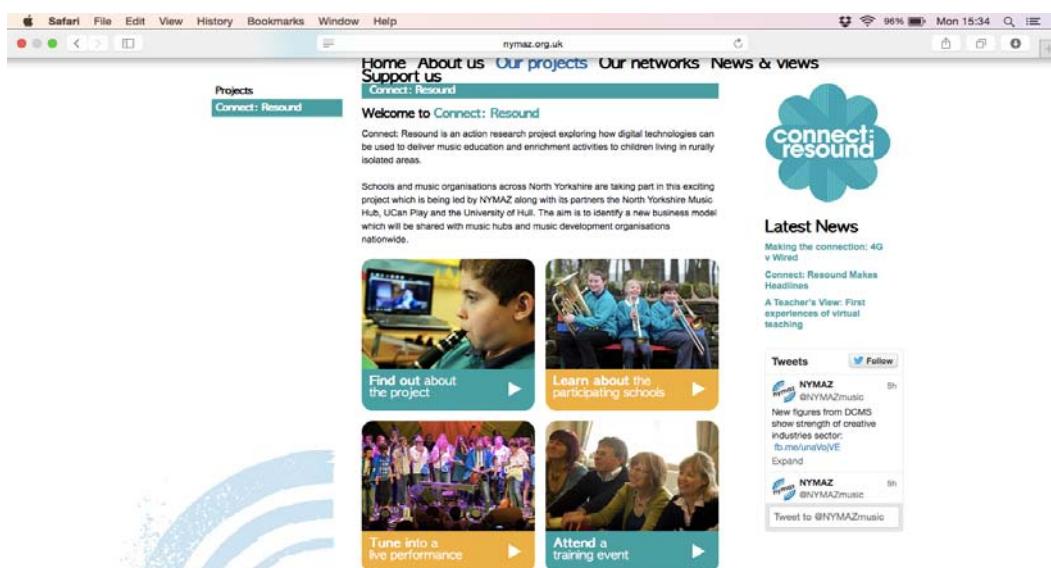


Figure 6: Connect: Resound webpages

Source:

www.nymaz.org.uk/connectresound

Costs

The total budget for the project was £112,705, broken down into:

- £15,221 – technical fees
- £9,341 – hardware
- £38,700 – research and evaluation
- £23,350 – project management and administration
- £7,700 – marketing, print, design and web
- £8,526 – music tuition
- £4,500 – live streamed music performances
- £5,367 – contingency.

The budget was delivered as anticipated. The main area where contingency funds were required was in technical support – we had underestimated the preparation time that would be required to deliver the three live broadcasts, with additional site visits and testing required for two of the three events.

Results

Connect Resound explored how online technology could be adapted to provide peripatetic music lessons to remote rural communities for those at the start of their musical journeys. The testing and modification of the approach used was integral to the project.

Research findings

The results of the data analysis demonstrate three major areas of discovery for the research team. These are based on the themes of:

- Technology
- Delivery
- Environment.

The areas are not equally weighted in terms of significance but capture the essence of what was discovered by the research team.

Technological findings of the research

The research was able to uncover a series of challenges concerning the use of the technology. These can be categorised as:

Time lag

It is not possible to reliably count a steady beat for pupils to play along to. In addition, accompanying students was an issue. However, in group lessons this was overcome by asking peers at the same location to provide a beat or an accompanying part.

The research and technology teams investigated a number of applications developed to overcome this latency issue, which is a very live topic in the area of online music collaboration in professional as well as educational contexts, with no entirely reliable or user-friendly solution available as yet that will enable one person to play easily in real time and in sync with another person online.¹³

In the case of the setup we used with Connect: Resound, delay was added to the sound (300ms) to keep the audio and video from the VR-

¹³ Audio-only apps addressing issues of latency include:

<https://ccrma.stanford.edu/groups/soundwire/software/jacktrip/> and <https://jammr.net/>.

3EX in sync. But even without that delay and with a fast internet connection at either end, it wasn't possible for teacher and pupils to play together in time.

Technical problems

Some sessions in the first lesson capture started late because of minor technical issues. However, all of the final lessons started on time, suggesting that these problems had been overcome.

In addition to what was discovered through video observations, questionnaires were also given to all participants, with 70 pupils and 46 parents/carers completing feedback questionnaires.

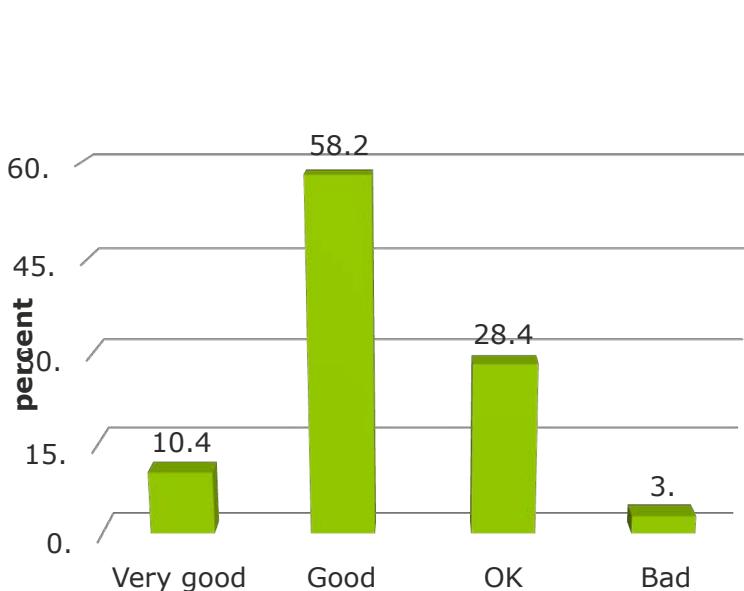


Table 2: How good was the sound quality?

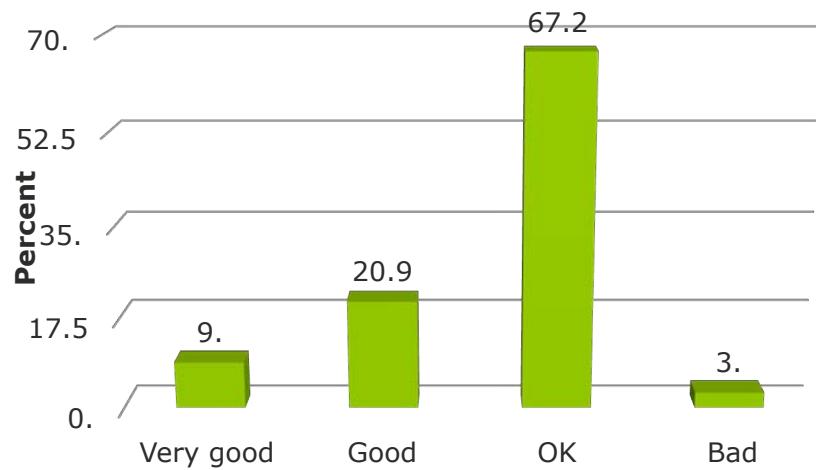


Table 3: How good was the video quality?

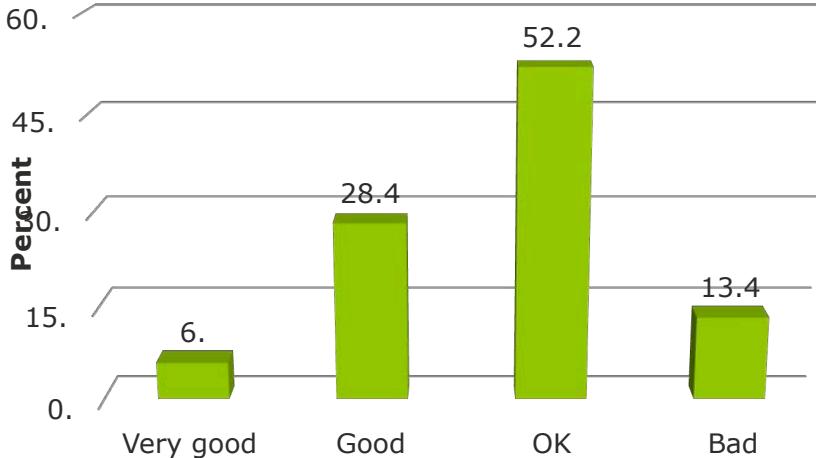


Table 4: How good was the internet connection?

The figures above refer to the sound, video, and quality of the internet connection based on responses from the pupil questionnaire.¹⁴

- 68.6% of pupils said that sound quality was 'good' or 'very good'
- 29.9% of pupils said the video quality was 'good' or 'very good'

¹⁴ See Appendix 2 for full data tables.

- 34.4% of pupils said that the internet connection was ‘good’ or ‘very good’
- In post-project interviews, the five peripatetic teachers provided a median score of 7/10 for sound quality.

Specific sound-related challenges included noise spillage from adjacent areas in schools, amplification of background noise in Skype, and reflections of sound in larger rooms. Headphones were sometimes reported to be problematic for younger children – the connecting wires restricted their movement – particularly for those using bows with stringed instruments.

The quality of the video and the internet connection seemed to show a similar result in the questionnaire data. This is reflected in the teacher interviews where a median score of 4/10 for video quality and 5/10 for connection quality was noted.

Teachers’ views of pupils were sometimes limited: they were not always able to see the whole of a pupil or a group of pupils, or to see the detail they required. This was alleviated somewhat by the Roland VR-3EX when it was employed at the school, due to the multiple camera angles and zoom options available enabling a more flexible and responsive approach. Similarly, teachers using the VR-3EX device were able to show pupils closer views of specific parts of their instrument. Although the different camera views were not always explored fully in the first lessons, by the end of the set of lessons, teachers and pupils seemed to have established specific positions for cameras and to have switched between the different views easily.

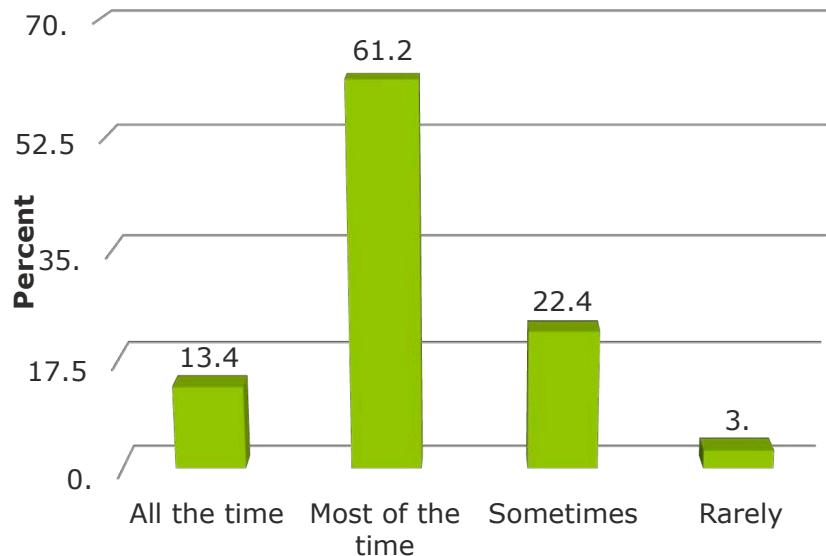


Table 5: Were you able to hear what the teacher was saying?

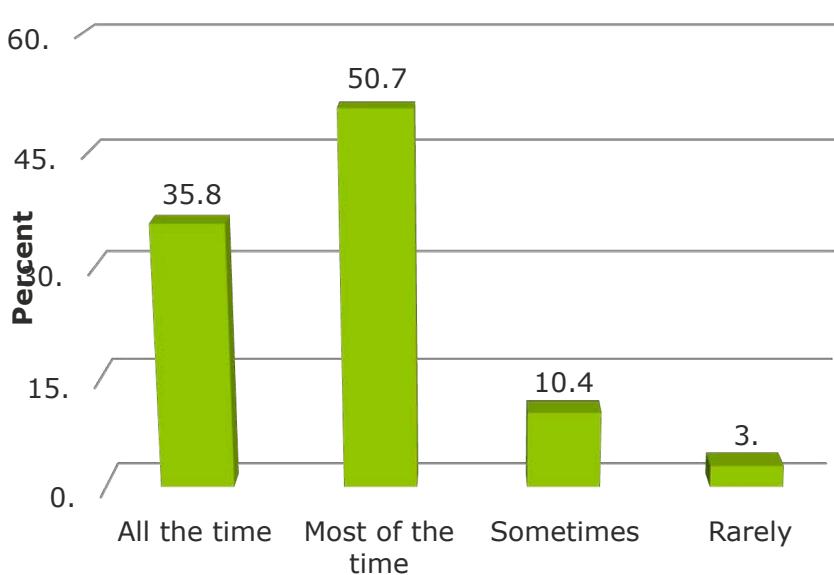


Table 6: Were you able to see what the teacher wanted you to do? (See previous page).

There were concerns over the video quality and connection: it would appear 74.6% of pupils could ‘hear what the teacher was saying’ and a further 86.5% ‘were able to see what the teacher wanted [the student] to do’. It would seem that although superfast broadband was available in many of the areas the project team identified an issue with connectivity for schools. This can impact on the pupil hearing or seeing what the teacher is trying to communicate.

Delivery

In this section we will discuss the pedagogical implications of the project. First, this section highlights some of the main findings:

- Teachers often need to view the pupil as a whole
- Poor-quality internet connection affecting Skype caused difficulties in teaching instrument technique
- Assembling instruments was a potential issue
- Tuning instruments
- Technical problems with instruments
- Beginner technique demonstrated well via online delivery
- Pupil distraction was not an issue.

The ability to switch camera angles or at least view the pupil as a whole was demonstrated as important to a successful lesson. Problems assembling instruments only arose for the clarinet teacher and this was remedied by establishing a written protocol for assembling the instrument that was sent to the school prior to the lesson. The online delivery required ownership for tuning the instrument at the start of the lesson to rest with the learner, which can be a challenge for beginners. However, free apps have been found that help students tune their musical instruments. The only issue concerning difficulties teaching technique arose from the Skype-to-Skype method, which is one of the reasons this was dropped for the second cohort. Although the project was novel which may have impacted on pupils’ ability to concentrate, all teachers agreed that pupil distraction was not a concern.

Earlier in the report it was outlined that different schools and teachers had access to different technology for the project. This involved the use of Skype and the Roland VR-3EX; the latter is a basic audio-visual mixer that can broadcast direct to the Internet. When a simple Skype setup was used at either end, only one camera angle was possible. However, the use of the Roland VR-3EX allowed up to three different camera angles to be used at either the teacher or pupil location, depending on the approach used. Figure 7 below demonstrates: an overall view of teacher or pupil (T), a mid-range view (U), and a close-up view (V).



Figure 7: Three possible camera angles of teacher/pupil using an audio/visual mixer broadcasting to the Internet.

In addition to this approach, sometimes one camera angle was used to show the musical score (Figure 8a) or a side-view of a teacher or pupil (Figure 8b).



Figure 8a: Mid-range view changed for view of musical score



Figure 8b: Side-view of teacher or pupil

Teachers typically used the various camera angles in different ways. Our first teacher 'Alison' had access to the Roland VR-3EX that allowed: a full view of the teacher, a mid-range view, and a close-up view. In both the first and last lesson we sampled, Alison only used the overall view of the teacher and the close-up view. The amount of time spent using the close-up camera view was only 1% of the total first lesson time but this increased to 8% for the last lesson.

A second teacher 'Andy' also had access to the Roland VR-3EX to show the different camera angles. In contrast to Alison, this teacher spent 6% of the first lesson time using the close-up camera angle, 65% of the time on the mid-range camera, and 28% of the lesson time using the overall camera view. What is perhaps more interesting is by Andy's final lesson his use had changed to 12% of the lesson time using the close-up camera, 3% of the time using the mid-range camera, and 85% using the overall view. Initially we thought this could be partly explained by the different instruments they taught – clarinet and guitar, respectively. However, the second lesson demonstrates that the teachers independent approach to using the cameras had come more into line with each other by the final lesson.

Our final analysis was a typical group lesson in which the VR3 is positioned at the students' location, allowing flexibility in the use of camera angles. In the first lesson 'Emma' used a camera on each different pupil (a group lesson of three students) for 67% of the lesson and three different camera angles of the sample pupil for 33% of the time. In the final lesson two further uses of the camera were observed: a camera on each pupil in a group of two with side-view camera added, and a two-camera view of one pupil with another camera on the second. In this last lesson, Emma spent 22% of the lesson time using one

camera on each pupil, 19% with one camera on each pupil and a side view of each student, 45% with two cameras on one pupil and a third viewing another learner, and 14% with all the cameras dedicated to a single pupil.

What is interesting about both the individual and group lessons is how the teachers integrated the use of the camera angles into their teaching and how this evolved during the course of the study. For the group lessons it also shows how they adapt the use for smaller groups and suggests they have become comfortable with the technology at their disposal.

Teacher interview data

In initial interviews, teachers expressed concern about teaching children to assemble instruments, but this proved to be largely unproblematic when a standard protocol was demonstrated to pupils.

There were also some problems tuning instruments, which were overcome with adult help and, in some cases, with the use of a tuning app. Few problems were reported in teaching beginner technique, though teaching bow hold was reported to be very challenging. The main challenge for all teachers was the inherent time-delay using Skype, meaning teachers were unable to count a beat alongside a pupil playing. In group lessons, some teachers overcame this problem by asking children to count for one another. Providing a musical accompaniment for pupils was reported to be challenging.

Teachers reported that pupils concentrated well, and all the children reported enjoying the lessons:

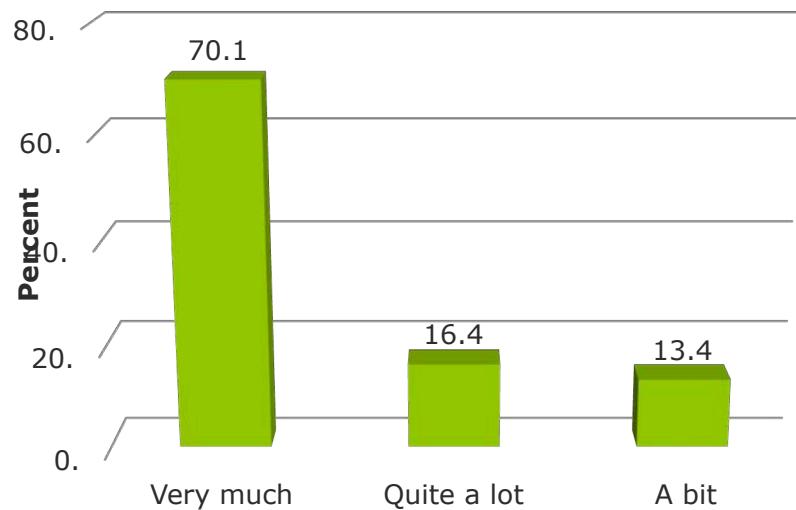


Table 9: How much did you enjoy the lessons?

We can see from Table 9 above that 70.1% of the children enjoyed the lesson ‘very much’, 16.4% ‘quite a lot’, and 13.4% only ‘a bit’. Parents’ reports of their children’s enjoyment were slightly lower (though the difference was not significant in a paired samples t-test), but still very positive: 57.1% of parents/carers said their child enjoyed the lessons ‘very much’, 24.5% stated ‘quite a lot’, 14.3% suggested ‘a bit’ and 4.1% ‘not much’. The vast majority of pupils (92.5%) reported practising between lessons. Parents were slightly less positive about the amounts of practice when this figure dropped to 83.7%. It is worth noting that lessons took place twice a week, allowing less time for practice between lessons than in standard weekly music lessons.

Parents gave positive feedback about children’s progress, with 24.5% stating it was ‘very good’, 46.9% that it was ‘good’, and 28.6% that progress was ‘satisfactory’. Most of the children (74.1%) and many parents (68.2%) wanted them to continue to learn their instruments ‘quite a lot’ or ‘very much’. This is notable considering that 79.5% of parents/carers would not have tried to find instrumental lessons for their children had this opportunity not been available.

Face-to-face delivery was seen as preferable to online remote delivery by parents:

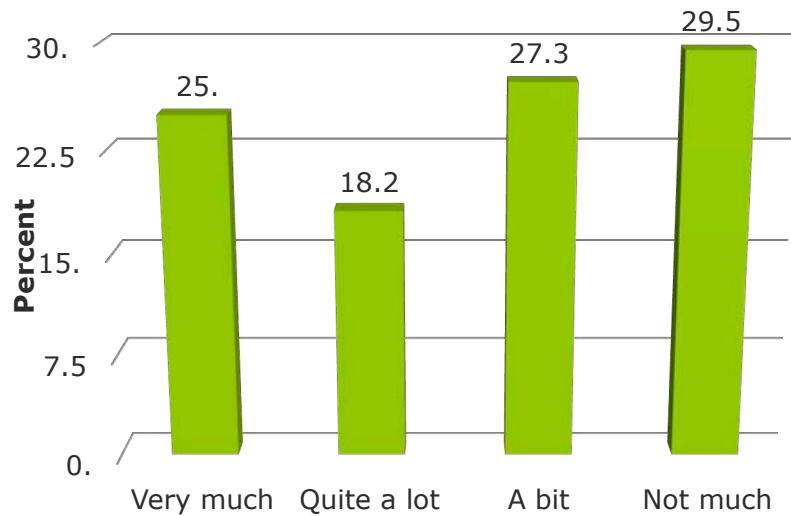


Table 10: How much would you like your child to continue with instrumental lessons?

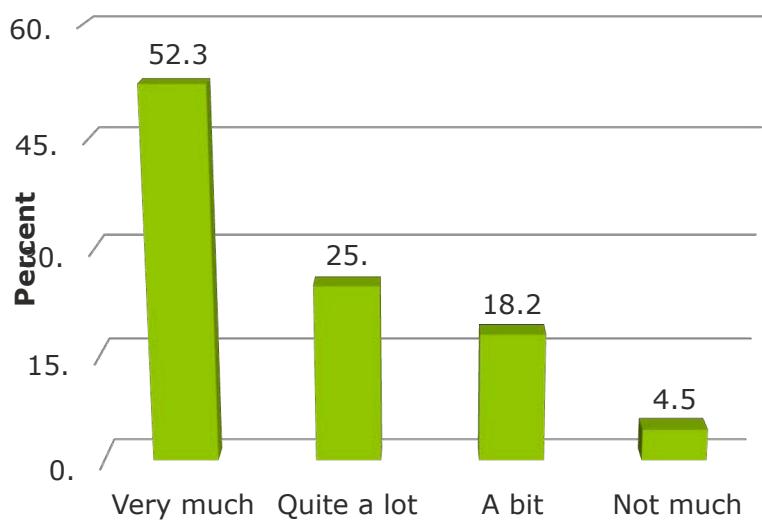


Table 11: How much would you like your child to continue with instrumental lessons in the same room as a teacher?

A similar pattern emerged with the responses from the pupils. It would appear face-to-face lessons are preferable to both students and parents/carers; however, as previously indicated, a considerable number were keen to carry on with lessons and a high percentage would not have sought lessons had it not been for this project.

Lesson behaviour

Although not relevant to the initial research questions, the research team decided to examine the lesson behaviour of the teachers involved in the project. This was achieved in two-ways: by capturing and analysing three ‘face-to-face’ lessons; and using an existing dataset from a recent article published in the journal, *Psychology of Music*.¹⁵

In the article the researchers have analysed the discourse of three adult piano teachers and the amount of time spent in their lesson within the following categories:

- Asking questions
- Demonstrating
- Giving advice/practice suggestions
- Giving feedback
- Giving information
- Listening/observing
- Modelling.

For the purposes of the Connect: Resound report we draw out from this research the main differences between online lessons and face-to-face lessons. In addition, since the teachers in this study are all piano tutors we also compare our own analysis using the Simones (et al.) dataset with the face-to-face lessons we captured, because our teachers taught clarinet, guitar, and violin.

From our analysis (see Table 1) of the online lessons, more time per teacher (mean) was spent ‘asking questions’ of pupils than in Simones’ study but not within our own face-to-face analysis, which used the same analytical approach. Although within the ‘giving advice/practice’ category there appears some difference between online (43.56%) and face-to-

¹⁵ Simones et al. (2015). ‘Categorizations of physical gesture in piano teaching: A preliminary enquiry’. *Psychology of Music*, 43(1): 103–21.

face piano lessons (35.9%), this is not significant especially when considered alongside the face-to-face lessons the team analysed (53.82%). What was perhaps more interesting is that a greater percentage of time was spent ‘modelling’,¹⁶ between the piano lessons (40.2%) and our online lessons (12.5%) but, again, this was not demonstrated in the face-to-face lessons the research team captured (8.02%).

Behaviour category	Lesson type	Percentage % (mean)
Asking questions	Face-to-face (piano)	6.1
	Face-to-face (mixed instr.)	15.25
	Online	15.51
Demonstrating	Face-to-face (piano)	13.8
	Face-to-face (mixed instr.)	19.22
	Online	10.31
Giving advice/practice suggestions/feedback/information	Face-to-face (piano)	35.9
	Face-to-face (mixed instr.)	53.82
	Online	43.56
Listening/observing	Face-to-face (piano)	3.6
	Face-to-face (mixed instr.)	11.67
	Online	13.6
Modelling	Face-to-face (piano)	40.2

¹⁶ Modelling refers to an instrumental teaching technique in which the teacher demonstrates on their instrument with the intention of the pupil joining in.

Behaviour category	Lesson type	Percentage % (mean)
	Face-to-face (mixed instr.)	8.02
	Online	12.5

Table 12: Online versus face-to-face teacher behaviour

We decided to take our analysis of the categories within the lessons to compare how much time for the pupils was actually spent playing music between online and face-to-face lessons; no such analysis was conducted by Simones et al. but we are able to use the data we collected from the face-to-face lessons. Although we had a smaller sample size of face-to-face lessons (3) compared with the online lessons (9), we observed there did not appear to be any significant difference between the amount of time the child spent making music (see Table 2 below), whether ‘playing’ or ‘singing’.

Lesson type	Instrument	Child plays %	Child sings %	Total
Face-to-face (mean)	Guitar/Clarinet/ Violin	20.52 (SD = 10.24)	2.96 (SD = 3.33)	23.48 (SD = 6.93)
Online (mean)	Guitar/Clarinet/ Violin	21.51 (SD = 9.12)	0.19 (SD = 3.28)	21.63 (9.18)

Table 13: Time spent making music between face-to-face and online lessons

Environment

There were a number of environmental issues that arose during the course of the video analysis and interviews. These can be broadly described as:

Rooms with multiple functions: Some lessons took place in rooms that needed to be accessed by others during the session. This included

using a photocopier and the room being used a thoroughfare to other places in the school.

The size of the room: Small rooms had issues with not being able to position the cameras far enough away (see Figure 9) to fully see the pupil, while larger rooms had problems with reflections that caused a lessening in audio quality.

Noise spillage: Lessons that took place during break time near playgrounds had problems with noise spillage onto the audio feed, and noise from adjacent rooms also caused concerns on occasion.



Figure 9: Example of small room causing problems with fitting pupil into overall view

These rural schools are often challenged in terms of the size and space that can be given over to this type of activity. However, by making schools aware of the issues surrounding this type of delivery it is anticipated that this can be kept to a minimum. It is important to note that rooms used for online lessons would be the typical rooms used for face-to-face lessons.

Impact

Overall, the project received a positive response from the teachers, pupils, and head teachers involved. In addition, other spontaneous feedback was received from school governors:

'The children were engrossed in what they were doing...we are all very impressed with the concept... As a governor I feel there are huge opportunities offered through the internet for geographically remote schools, small schools with very limited budgets (like ours) and also for specialised teaching, not just of music but of foreign languages... In short – brilliant project well executed.'

Kevin Tasker, School Governor, Hawes CP
School

It would also appear the pupils made good progress when we asked the teachers:

'Really good, actually [...] especially the individuals got further than they would in a normal lesson. I think it was because of the kids, I think they really liked doing it over the internet'.

Andy, guitar teacher

There were other positives drawn from the interviews concerning travelling between different schools to teach:

'Well, the organisation of it, if the schools on board, it's so much easier [...] North Yorkshire being massive and travelling and not getting there, so actually having lessons [...] rather than running from school to school [...] that was great, in the office, I couldn't get stuck in traffic.'

Daniel, woodwind teacher

But there was also feedback from teachers to suggest some felt they could be more effective in a face-to-face environment:

'Because I'm able to hear and see subtle differences, sometimes the visual or the sound is more information I can react [to] or provide feedback [to], or inform my instruction for students, and therefore it's easier to get what I want quickly.'

Daniel, woodwind teacher

Head teachers were also interviewed as part of the study, who touched on the issue of accessibility to instrumental music lessons a number of times:

Because we're so very small and rural and I think it's important to give every child that opportunity to have instrumental lessons and that's what's so very difficult in a small school – [you need a] group of three that want to start. If you have just one child who wanted to play the guitar it's not economically viable to send a teacher'.

Claire, music coordinator, Goathland School

Views concerning the project were also expressed by one of the stakeholders, who suggested a blended approach (both online and face-to-face) could be the way forward:

'And I think that has real potential there [for online], in an ideal world [...] a combination of both, [an] initial [face-to-face] meeting with the teacher [...] then maybe four or five lessons over the internet, and then you have another [face-to-face] meeting, [...] I think it's got real potential for [...] providing opportunity for those kids that can't, or are not sure about whether they want to do an instrument, to actually make a start.'

Ian Bangay, head, North Yorkshire County

Council Music Service



Figure 10: North Yorkshire school pupil

Source: Sam Atkins

Discussion

Although there were some technical issues during the project, many of the more minor problems were eradicated during the short trial period. The time lag for the audio stream presents a challenge but the project team understands that applications are under development to minimise this. What has been discovered from a pedagogical perspective will inform future work and has assisted the development of support materials for teachers as a legacy arising from the project, available at www.nymaz.org.uk/connectresound. The environmental challenges could be problematic for small rural schools since space can often be at a premium during the school day. However, by making teachers and schools aware of the potential challenges it is anticipated that the impact can at least be managed.

The project has clearly been successful given that the lessons were delivered, pupils concentrated well and reported enjoying the tuition, and pupils were observed by parents and teachers to be making good progress in their musical learning.

Feedback from stakeholders suggests this has been a valuable addition to music learning for the schools involved in the project. Although there are some differences in how teachers deliver lessons online, what has been demonstrated is that they are able to adapt their approach to teaching to suit this particular medium.

Four approaches were trialled during the project and the research team would initially recommend that schools and Music Hubs adopt two of these:

- Skype (school) to Roland VR-3EX (Music Hub)
- Roland VR-3EX (school) to Roland VR-3EX (Music Hub).

What is also evident from the research is that a simple two-camera setup (as opposed to the three cameras used in the pilot – one overall view of the teacher, and the other enabling close-ups) would be an effective way to deliver the lesson. The camera views could then be switched between an overall and a close-up view, with the latter used primarily for teaching aspects of instrument technique.

Although the cost of setting up the Roland VR-3EX technology at the school location is relatively low, it may prove prohibitively expensive to schools on small budgets. We would therefore suggest that Skype with an external webcam and microphone could deliver an effective lesson for learners. However, where it is possible for schools to invest in the technology, the flexibility of having multiple camera angles (especially for group lessons) is clearly beneficial.

Music Hubs could be delivering a greater number of online lessons from their geographical base, making their investment in the VR-3EX technology more cost-effective.

Information provided by North Yorkshire County Council Music Service indicated that:

- £77,000 is spent annually on mileage allowance for teachers
- In a typical teaching week, 980 hours were spent on face-to-face delivery of instrumental lessons
- A further 139 hours per week were spent on teachers travelling from school to school. This equates to 4.2 full-time members of staff.

There are therefore potential savings, both in terms of economic costs and time spent for teachers travelling between schools. Currently, lessons take place at a school only when a certain group size has been achieved, because of economies of scale. The approach used in Connect: Resound means that even if a single child wants to study a particular instrument, it would be no less cost-effective than a face-to-face instrumental lesson in a school with multiple pupils. Hence, access to music can be increased in these remote areas.

We would also recommend that consideration is given to the environment that the lessons are delivered from to ensure a reasonable

acoustic and a fibre-optic broadband connection. If it were possible to setup a number of Music Hubs across the country in this way with specialist online music tuition facilities, the Hubs would have the potential to reach a greater number of pupils and widen access to music education.



Figure 11: North Yorkshire school pupil

Source: Sam Atkins

Insights

Technical insights

There are three main areas of insight in relation to technical issues: selection of equipment, use of equipment, and issues associated with learning from the project and making recommendations for others.

Selecting equipment

At a technical level, the project built on work done by UCan Play with the Roland Systems Group, notably exploring the educational potential of the VR3 (now VR3-EX) in an educational setting for teaching, the quick and easy preparation of curriculum resources and the live streaming of school events such as school concerts and graduation events. At the time (and this is still the case), the VR3-EX is currently the only ‘all in one’ audio and video mixer on the market at its price point. The selection of the VR3-EX was relatively straightforward given previous knowledge of the product, its reliability and price.

One challenge was to try to find a suitable video camera for use with the Roland VR-3EX video mixer and streamer for use within instrumental music teaching lessons in remote locations across North Yorkshire.

Budgetary constraints meant that the camera proposed by the manufacturer (a Go Pro camera) was beyond the financial means of the project. However, on further investigation the Go Pro and other cameras included many features unnecessary for the proposed use, i.e. to live record footage onto physical storage within the camera wasn’t needed.

Our solution was to source a camera from a very different market sector, the security and surveillance market, and, in particular, a camera that would normally be found within CCTV networks. This camera was significantly cheaper (around a quarter of the price) and less likely to confuse participants with unneeded functions, making it easier to use. We were subsequently able to procure all the cameras that were required within the proposed budget.

This decision came about due to some lateral thinking by the consultant employed within the technical lead organisation. His eye for detail and ability to think outside and beyond product categories led him to source

an alternative camera that is highly suited for the intended purpose and is, to our knowledge, the first application of this type of camera within an explicitly educational setting such as that being considered within the project.

Other technical elements of the solution were relatively straightforward, although the quality of microphones is an essential component in a successful online music teaching environment. The Rode microphones used within the project were high quality at an intermediate price point. We would counsel against cutting corners and using cheaper, inferior products.

As discussed above, the focus of Connect: Resound was to investigate accessible, cost effective methods of delivering musical education experiences remotely, using digital technology. The agreed model for delivering instrumental learning to schools via the internet proposed Skype (in addition to specifically designed hardware to enhance the audio visual quality) as a free to access, universally available software.

This was not without its problems. Project teachers were employed by the music service and based at their offices on local authority premises. All schools had been supported by the project technical team to setup Skype accounts with no issues. However, when we came to install the hardware in the Music Service base, with under two weeks to go before project launch, we discovered that the local authority protocols and firewalls did not enable Skype to be installed. We discovered that a number of local authorities have such protocols in place, and were asked to consider alternative video conferencing solutions. However, these lacked the free and universal availability of Skype thus compromising would have compromised the underpinning vision of the project. This was ruled out. We explored alternative venues but they did not have the flexibility we required and the expense of daily room hire over several weeks would have been prohibitive.

After a lot of negotiation and very hard work on the part of the local authority IT team, as well as the music service and the research and technology partners, technical solutions were found to enable us to use Skype securely onsite. Perseverance and tenacity have proved key behaviours required to solve technical challenges.

Use of equipment

The VR-3EX has proved robust and reliable throughout the project, being used over 196 teaching hours without fault. Participants also reported that it was straightforward to use. CCTV cameras were also used effectively with only one technical fault (due to fragile wiring within the camera). There were no reported issues with microphones.

The weakest part of the solution was Skype. This caused a number of issues throughout the project. Despite the relatively low up-stream requirements of the VR3-EX (less than 1Mbps), the large demands made on wireless networks within schools has caused problems in the broadcast's transmission and reception. At key moments within the project, see below, this has caused us to consider alternative hosted solutions. However, we have persevered with the proposed solution and seen improvements over time.

As part of our commitment to the project, we streamed three live events from various locations across North Yorkshire. One of these featured a band streaming from an unusual location - a rehearsal studio in a crypt beneath a church in West Yorkshire - without a wired broadband facility. Until this event the VR3-EX had only been used with a wired connection (Ethernet) to a broadband router.

To overcome this challenge, we researched 4G mobile-phone solutions for streaming live video. This provided us with a Wifi hotspot and this proved to be a workable solution. The broadcast went ahead in late March using the 4G connection and the up-load, down-load stream provided by the 4G connection was significantly above minimum requirements of the technology and also better than many wired connections that we had been using in the project to that point.

This was an exciting development from our point of view. Although 4G coverage in the UK is still patchy, where available it provides a significant if not better way to broadcast with technologies such as the VR3-EX. The opportunity to broadcast using the VR3-EX with an external battery pack and 4G connectivity means that in areas without broadband there is a viable alternative and also outside and location broadcast is possible for live, multi-camera video streaming.

During the project we also noted that YouTube had made significant advances on the streaming of live video, including the support of 360 video. Whilst technological developments continue to move on apace, it is important to remember that this project explored the VR3-EX and its potential as a multi-camera mixer and streamer. This is still something that is difficult to achieve unless you have a very powerful PC, multiple capture cards and sophisticated software. The setup and training required to deliver this solution would still be well in advance of the skills of most teachers. The simplicity and ease of use of hardware solutions like the VR3-EX are significant and beneficial for this sector. We have been impressed with the way that teachers have engaged with the solution we have created with minimal training and little additional support.

In terms of the use of equipment, we have been genuinely impressed with teachers, and others, desire to explore how these technologies can be used efficiently and effectively within the teaching episodes and the live performance broadcasts. Relatively straightforward elements such as handling a video camera and ‘capturing’ live video for streaming has been embraced enthusiastically by staff. For example, the Hope and Social broadcast utilised a fixed camera and a roving camera, manned by a NYMAZ worker.

During the broadcast, the band and the camera operator were moving around the already-confined rehearsal area quite a lot. The camcorder’s wires became a trip hazard, not least when they became tangled in all the other wires and equipment that come with a busy studio. Having more experience with aspects such as how long to focus on particular elements of the performance, moving around the space and checking the light levels and so on would have helped us to improve the audience experience even more.

In a multi-sector partnership, the more the non-technical members of the team are closely involved with actually creating the broadcasts, the more the team as a whole can learn about what does and does not work and can have more useful and in depth conversations about how to prepare for such events and what we can do to make sure we have the skills and practice under our belts. Time must be put aside for rehearsing and testing with the equipment. There will always be a demand for

professional support to facilitate live broadcasts, and it is important that the particular needs of this form, and the requirements of audiences and performances, are honoured and central to the process. However, as the technology becomes more affordable, and new and existing generations with digital native level skills in recording moving image join the workforce, the possibilities for organisations to be more informed clients of their broadcast partners, and/or broadcast work themselves, directly to their audiences, are growing, and it has been exciting to explore what can be done at a very different end of the market. As mentioned earlier the appetite for by others to learn how to use the equipment gives the opportunity to develop skills 'in-house'.

Moving forwards and recommendations for others

During the project, the technical partner has reflected on the technical solution that was offered to the project. We wanted to ensure that we could give good advice to the project team and other interested parties moving forwards as the project comes to an end and the outputs are disseminated.

As we have discussed already, technology always moves on apace. During the project we have become aware of other technologies and technical solutions that might impact on the best advice that we can give. As the research described above has shown, we have also gained a detailed understanding from the end users of the technical solution that we have implemented. These twin prompts have caused us to reflect on how live streaming within an educational context can be promoted and developed through a cost effective technological solution.

We reviewed and evaluated the tools that were used within the existing project's technical solution. The choices we made were with a consideration of the end user in mind. Instrumental teachers have precious little time to set up technology in advance of teaching, they often have minimal technical skills in areas outside of basic music technologies, and the equipment itself needed to be robust and easy to manage.

From our perspective, the project has proved that these tools are fit for purpose. There has only been one technical issue associated with the power lead of one CCTV camera. A relatively sophisticated technology

such as the VR3-EX has proved easy for project participants to use with little reported difficulties. Audio quality from the Rode microphones has been excellent. The video quality from the cameras has been generally good, and certainly good enough for the intended purpose, but there have been comments about the quality of the image on occasions that have led us to consider other options.

The availability of HD cameras providing a live or recorded stream at 1080p are coming down in price. However, they are still going to cost significantly more than the £95 cameras used for this project (typically starting at around £250 each). The VR-3EX itself cannot cope with true HD quality either. The next level 'up', the VR-50HD, is significantly more expensive (around £6000 compared to £1350). Our view is that these significantly higher quality pieces of equipment (in terms of their image at least) are not justified in the near future for live streaming in an educational environment.

During the lifespan of the project, we have also developed our knowledge of other live streaming solutions typically involving a computer, multiple HD webcams, sophisticated capture and streaming software (such as Open Broadcaster) and hardware interfaces. These are an emerging technology and it is certainly possible to imagine a solution built around these components. However, the technical knowledge need to build such a system, maintain it, and train non-specialists in its use (and support them in an ongoing capacity) would be extensive. We do not consider that these solutions offer a productive end user experience at the current time. The VR-3EX, even with a few limitations, does provide a bespoke and specialised technology that is easily accessible and robust, minimising down time and distractions for busy teachers.

Finally, we should comment on the fragility of Skype as a medium for live streaming. This has been the cause of several problems throughout the year. Skype, as we know, is a free service but, as such, has its limitations. We would recommend that schools, music services and teachers consider a hosted service in order to provide a more stable and reliable upstream and downstream speed for these educational activities. Skype has not proved as reliable as we would have hoped in

these respects and time outs have been relatively frequent and frustrating for project participants.

Project management insights

We noted a range of insights within the project related to our partners and the specific contexts within which they work, our own internal communications strategy, and our emerging ideas about how to disseminate the project's findings.

Working with busy schools

The challenge of balancing a fixed term research project with the reality of the delivery partners' contexts is a perennial issue for arts projects in educational settings. When is the right time to involve the end delivery partner? Too early and you are asking busy people to engage with an unformed project idea that they may not ultimately be involved in. This has the potential to take up their valuable time and energy in a conversation that can feel too unformed, and at that stage, irrelevant, to be worth their time and expertise. Too late, and the project design or timetable is not appropriate for its context, and too many sacrifices are made that render the project unworkable and not useful, relevant or enjoyable for the participants. In our project, the first seven schools were approached in the summer term of 2014, with intensive follow up communication from September following the summer vacation.

Schools were asked to find space within crowded busy buildings, and crowded busy timetables, to accommodate a project which required four hours of their time each week, including a dedicated space and member of staff. They are asked to identify ten pupils to take on an additional, or begin from scratch, forty minutes of instrumental tuition a week. At that point, we were not able to tell them which instrument their students would be learning be learning, or exactly how they would be taught, but we did know the teacher would be many miles away, communicating via a video screen in a context which demands the building up of trust, and a complex physical, emotional and psychological interplay between student and teacher. The demands of the curriculum, significant time factor involved, competing subject priorities within the school strategy and fear of the unknown all had the potential to impact negatively on take up.

However, we are pleased to note that the teachers we have worked with have been unfailingly flexible, collaborative, enthusiastic and excited about participating in something that they feel could make a real difference to the issues they face in providing music education opportunities to their young people.



Figure 12: Technology in use

Source: Sam Atkins

Timetabling and scheduling restrictions

Throughout the project there has been a need to maintain responsive to the changes in the workforce, particularly in relation to the music teachers who often have to balance their professional playing careers alongside their teaching commitments.

For example, in the first week of the project, one teacher found that she would be unable to deliver one of the planned weekly sessions, from the following week, leaving the project with a potential gap in the teaching timetable. There was no-one else on the music hub team who could cover this session. Therefore, as a matter of urgency we set about recruiting a replacement teacher, targeting other neighbouring music hubs and other teacher contacts. The teacher needed a high level of

experience and ability, to be available at no notice, and to participate in training to ensure that they knew how to use the technology and deliver teaching effectively online. Happily, an experienced and enthusiastic teacher was able to take over the classes, and was enthusiastic about the overall project and its vision.

In this case, the member of staff was embarking on a change of career and needed this time to attend interviews and auditions in London. The nature of employing professional musicians with a mixed portfolio of work and a varied practice, at different stages in their careers, means that these changes in availability do arise for music hubs. However, as this project is an intensive one, with specific logistical challenges around availability of the technology, and school timetabling issues, solutions such as a short gap in teaching, changing the lesson time etc, did prove difficult.

As a tightly scheduled research project with two cohorts, there was no option to delay lessons, and losing the lessons altogether was not an option either. Apart from breaking trust with the school, it would also have meant the data for the research project was incomplete.

The digital technology also created scheduling issues that made it difficult to change the time of lessons, thus further reducing the available teacher pool. Tuition is delivered using a hardware package that ensures the audio-visual experience is comparable to face to face tuition, including the Roland VR-3EX video mixer and streamer. Whilst this was sourced as cost effectively as possible, the music service only has one onsite, so only one digital lesson took place at any one time. Equally, the school needed to set aside physical space to set up and use the equipment, and lessons needed to take place at an appropriate time and when a teaching assistant was available to supervise the pupils. Bearing these circumstances in mind, replacing the teacher in the above example was more difficult than it would have been for a music hub in more regular teaching circumstances.

Blended communications

The opportunity to meet together physically, together with other forms of online communication, has helped the project team work together constructively throughout the year. The learning events that we have

attended during the year have been very helpful in bringing us together, challenging our thinking and promoting new avenues for further exploration within the project.

We held a final project sharing event, a useful way to ensure that everyone involved in the project had the chance to collectively reflect on, and make plans to build on, the successes and learning points of the project. It may be useful to consider holding similar events at the start of future projects like this, where teams and working practices are so diverse.

Looking ahead

As the Connect: Resound project has come towards the end of its first year, our attention has turned to dissemination. Central to this has been a discussion with partners about how the Connect: Resound model of online instrumental tuition would continue to be implemented as part of the North Yorkshire Music Hub's business model now that a legacy of skills and equipment has been left by the Digital R&D Fund for the Arts grant.

A variety of applications were discussed, and it has become apparent through discussions that some Music Hubs across England may find taking up this new model of remote instrumental tuition challenging without more intensive support, such as that received by the North Yorkshire Music Hub. Many Music Hubs are still negotiating new governance models and ways of partnership working, as well as dealing with severe Local Authority cuts and the need to raise additional income, leaving them little time to explore innovative delivery methods for core roles.

Therefore, we agreed as a partnership that additional funds should be sought to enable us to pilot the Connect: Resound model in a small number of Music Hubs operating in rural areas in the first instance. By subsidising equipment, providing specialist training, piloting online tuition and supporting Hubs to integrate the approach into their individual business plans, we would aim to thoroughly embed Connect: Resound in participating Hubs and build up a 'head of steam', which will in turn help to promote online tuition as an effective solution for others.

Future

This project has demonstrated that online peripatetic music lessons can offer a cost effective way to increase access to music for learners. There could also be wider implications for schools by increasing quality access to specialists remotely. Support for other areas such as modern languages could also be explored. It would also be useful to share practice and collaborate more closely with others undertaking similar work, notably Dumfries and Galloway Council, which has been delivering online music tuition since 2004.

Connect: Resound took place in North Yorkshire which is England's biggest county and an area with a high number of rural communities. However, there are a number of other locations in England (and the UK) in which Music Hubs are presented with a similar set of challenges in providing music education for learners. In heavily populated urban areas this form of delivery may have benefits for schools and teachers by providing another service for pupils to access music.

Access to adequate internet connections remains the key challenge for the further dissemination of the Connect: Resound approach. The Government's Superfast Broadband programme (part of the wider Broadband Delivery UK programme) aims to provide superfast broadband (speeds of 24Mbps or more) for at least 95% of UK premises by 2017 and universal access to basic broadband (speeds of at least 2Mbps) by 2016 with a total public investment to date of around £1.7bn.¹⁷

There has recently been significant press coverage about the frustrations of those living and working in rural areas about the reality of their limited access to high-speed broadband compared to the ambitions and projected delivery dates of the Superfast Broadband programme.¹⁸

A new inquiry by the House of Commons Select Committee for the Department of Culture, Media and Sport (DCMS) 'Establishing world-class connectivity throughout the UK' – has been launched to look at the coverage, delivery and performance of superfast broadband in the UK,

¹⁷ <https://www.gov.uk/broadband-delivery-uk>

¹⁸ For example: <http://www.ft.com/cms/s/0/ce80cd56-4029-11e5-9abe-5b335da3a90e.html#axzz3ial7EhGt>

and what needs to be done in order to connect the most remote areas - the final 5% of premises.¹⁹

The screen casting software used by the research team could provide an opportunity to expand the approach used by teachers when using online delivery. The ability to capture a live lesson so that both teacher and pupil had a video record could serve as a practice aid for students and a reflective tool for teachers.

When Music Hubs consider music lesson delivery one of the challenges identified in Connect: Resound was access to specialist teachers and the problems with commuting between schools. If Music Hubs could share information concerning music specialists there is an opportunity to share teaching experience at a national level and beyond. If lessons were to take place online then the geographical location of the teacher need not be an issue. The regional hubs could manage the process and scheduling of lessons and would have the advantage of drawing upon a national database of approved expertise.

The project partners are currently looking at recruiting more Music Hubs so that this method could be rolled out over a wider geographical area. Now that the technological challenges are understood more fully a more focused investigation of the pedagogical challenges could be carried out. These could include the following:

- Working with children with special educational needs and disabilities;
- Moving beyond music and using online technology to deliver specialisms to schools in different subject areas;
- A longitudinal case-study over a longer timescale (i.e. a year) to see how pupils progress using online learning;
- The creation of specialist facilities at regional centres for teachers to deliver online lessons; and
- Setting up a national database of teachers trained in online instrument lessons.

¹⁹ <http://www.ispreview.co.uk/index.php/2015/07/select-committee-starts-inquiry-into-uk-superfast-broadband-strategy.html>

- Practice sharing with other authorities undertaking online distance learning of musical instruments, notably Dumfries and Galloway

In terms of dissemination of the existing research findings, two international conference papers have been accepted: Research in Music Education (April, 2015) and the European Society for the Cognitive Sciences of Music (August, 2015). Further submissions will be made to Music Expo (March, 2016) and The International Society for Music Education (July, 2016). Draft journal articles are being prepared for submission to publications of international standing and will be submitted in September 2015.

Further Resources

Further project information

Connect: Resound: <http://www.nymaz.org.uk/connectresound>

Roland UK: www.roland.co.uk

Rode Microphones: www.rodemic.com

UCan Play: www.ucanplay.org.uk

Superfast Broadband availability in rural areas

Superfast Broadband Coverage in North Yorkshire:

http://www.northyorks.gov.uk/media/28476/Superfast-broadband-in-North-Yorkshire---revised-coverage/pdf/Superfast_broadband_in_North_Yorkshire_-_revised_coverage.pdf

Select Committee announces new inquiry:

<http://www.ispreview.co.uk/index.php/2015/07/select-committee-starts-inquiry-into-uk-superfast-broadband-strategy.html>

Tools and guidance

Video-streaming technology

We used the VR-3EX throughout this project. Further general information about this product can be found here:

<http://proav.roland.com/products/vr-3ex/>.

The VR-3EX Owner's Manual can be found here:

<http://roland.com/support/article/?q=manuals&p=VR%2D3EX&id=63077772>

The VR-50HD is Roland's higher end HD multi-format audio video mixer with web streaming and recording capabilities. It offers a broader range of functionality than the VR-3EX and also true HD streaming. Further information about this product can be found here:

<http://proav.roland.com/products/vr-50hd/>.

Throughout this guide we have mentioned the opportunities to build a custom computer to help stream live video from multiple cameras. This is not for the faint hearted! However, there are a number of products available that will allow you to do this. One of the most popular companies is Blackmagic Design and their product DeckLink allows for video capture and playback:

<https://www.blackmagicdesign.com/products/decklink>. We are not promoting this brand. Other similar products are available from other manufacturers.

Since we began the project, YouTube have increased their functionality to include the opportunity to broadcast live events. Like any technology, there are pros and cons here. But further information is available here:

https://www.youtube.com/my_live_events. A full user guide for live streaming events on You Tube is available here:

https://support.google.com/youtube/topic/2853712?hl=en-GB&ref_topic=4355169. Please note that in order to set this you will need a significant hardware infrastructure and a considerable amount of technical knowledge, including knowledge of ingestion settings, encoders, bit rates, resolutions and more besides.

Whatever hardware solution you choose, you will need to also think about a software environment for the handling of video and audio streams. This is something that the VR-3EX manages through its own software and the USB interface with your PC. If you are wanting to build your own system (without the VR-3EX), software such as Open Broadcaster could be used (its a freeware product):

<https://obsproject.com>. Other commercial solutions are also available but they tend to be very expensive.

Microphones

Throughout our project, we used Rode's NT5 and Smart Lav + microphones. Here are the links to the key product pages on the Rode website:

NT5: <http://www.rode.com/microphones/nt5>

Smart Lav +: <http://www.rode.com/microphones/smartlav-plus>

Rode have a very good web interface that allows you to experience the 'sound' of different microphones in different contexts. Their Soundbooth Studio allows you to hear how different microphones sound for different instruments or voices. Further information from here:
[http://www.rode.com/soundbooth.](http://www.rode.com/soundbooth)

The placement of microphones is simultaneously straightforward and highly complicated! At one level, you put microphones wherever they sound good to you! At another level, the subtleties of each microphone, the room, the musician and instrument all impact on how they could be used effectively. There are numerous guides on the Internet. This video shows you how to set up a pair of stereo microphones in a range of formations that are applicable to the use of the NT5 microphones that we have used throughout the project:

[https://www.youtube.com/watch?v=roTG_uM17JE.](https://www.youtube.com/watch?v=roTG_uM17JE)

References and Further Reading

Academic articles

Kruse, N and Veblen, K (2012). 'Music teaching and learning online: Considering YouTube instructional videos'. *Journal of Music, Technology & Education* 5:1, 77-87.

Kruse, N, Harlos, S, Callahan, R and Herring M (2013). 'Skype music lessons in the academy: Intersections of music education, applied music and technology'. *Journal of Music, Technology & Education* 6:1, 43-60.

Pike, P and Shoemaker, K (2013). 'The effect of distance learning on acquisition of piano sight-reading skills'. *Journal of Music, Technology & Education* 6:2, 147-162.

Waldron, J (2012). 'Conceptual frameworks, theoretical models and the role of YouTube: Investigating informal music learning and teaching in online music community'. *Journal of Music, Technology & Education* 4:2/3, 189-200.

Other reading

'Classical Live Offers Orchestras Another Internet Stage':

http://www.nytimes.com/2015/06/16/arts/music/classical-live-offers-orchestras-another-internet-stage.html?_r=1

Gone In The Air: <http://www.nymaz.org.uk/news-and-views/post/gone-in-the-air-summary-of-findings/>

Music Education in England: a review by Darren Henley for the Department for Education and the Department for Culture, Media and Sport: <https://www.gov.uk/government/publications/music-education-in-england-a-review-by-darren-henley-for-the-department-for-education-and-the-department-for-culture-media-and-sport>

The Importance of Music - A National Plan for Music

Education: <https://www.gov.uk/government/publications/the-importance-of-music-a-national-plan-for-music-education>

National Foundation for Youth Music: <http://www.youthmusic.org.uk>

Other examples

ArtForms: <http://artsdigitalrnd.org.uk/projects/artforms/>

Cambridge Junction: <http://artsdigitalrnd.org.uk/projects/cambridge-junction/>

Clapping Music: <http://artsdigitalrnd.org.uk/projects/london-sinfonietta/>

Edinburgh Napier University and the Royal College of Music (RCM) demonstrate the power of the Janet network in supporting collaborative performances across remote locations:

<https://www.jisc.ac.uk/news/musical-demonstration-transcends-geographical-barriers-thanks-to-advanced-network-27-nov-2013>

Eric Whitacre's Virtual Choir: <http://ericwhitacre.com/the-virtual-choir>

Ministry of Stories: <http://artsdigitalrnd.org.uk/projects/ministry-of-stories/>

Miracle Theatre Company: <http://artsdigitalrnd.org.uk/projects/miracle-theatre-company/>

Online Orchestra: <http://onlineorchestra.com>

The National Piping Centre's Online Lessons:

<http://www.thepipingcentre.co.uk/bagpipe-education/online-lessons/>

Video Nation's case study from Dumfries & Galloway:

<http://www.videonationsltd.co.uk/about/customers/dumfries-galloway/>

WithWholeWorldBand: <https://www.wholeworldband.com>

Soundtrap - online music collaborations <https://www.soundtrap.com>

Appendix 1

Equipment list

Full Kit (Roland VR-3EX, 3 cameras, 3 mics)

- 3 x Cameras
- 3 x Camera power lead
- 3 x Camera video lead
- 1 x Full size tripod
- 2 x Desk tripods
- 1 x Smart Lav kit (microphone, TRRS to TRS adapter, extension lead, mini-jack to XLR converter)
- 1x Pair of Rode microphones in hard case
- 2 x microphone stands
- 2 x XLR microphone leads
- 1 x 6-socket plug board
- 1 x Roland VR-3EX in box (including power lead and USB cable)

Skype-only Kit (PC and webcam)

- 1 x Pre Sonus headphone amp in box (including power lead and audio lead)
- 4 x Senheiser headphones
- 1x Webcam

Appendix 2

Detailed data tables relating to bar charts in report:

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	2	2.9	3.0	3.0
	OK	19	27.1	28.4	31.3
	Good	39	55.7	58.2	89.6
	Very good	7	10.0	10.4	100.0
	Total	67	95.7	100.0	
Missing	System	3	4.3		
Total		70	100.0		

Table 1: How good was the sound quality?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	2	2.9	3.0	3.0
	OK	45	64.3	67.2	70.1
	Good	14	20.0	20.9	91.0
	Very good	6	8.6	9.0	100.0
	Total	67	95.7	100.0	
Missing	System	3	4.3		

	Frequency	Percent	Valid Percent	Cumulative Percent
Total	70	100.0		

Table 2: How good was the video quality?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Bad	9	12.9	13.4
	OK	35	50.0	52.2
	Good	19	27.1	28.4
	Very good	4	5.7	6.0
	Total	67	95.7	100.0
Missing	System	3	4.3	
Total		70	100.0	

Table 3: How good was the internet connection?

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rarely	2	2.9	3.0
	Sometimes	15	21.4	22.4
	Most of the time	41	58.6	61.2
	All the time	9	12.9	13.4
	Total	67	95.7	100.0

		Frequency	Percent	Valid Percent	Cumulative Percent
Missing	System	3	4.3		
Total		70	100.0		

Table 4: Were you able to hear what the teacher was saying?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Rarely	2	2.9	3.0	3.0
	Sometimes	7	10.0	10.4	13.4
	Most of the time	34	48.6	50.7	64.2
	All the time	24	34.3	35.8	100.0
	Total	67	95.7	100.0	
Missing	System	3	4.3		
Total		70	100.0		

Table 5: Were you able to see what the teacher wanted you to do?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A bit	9	12.9	13.4	13.4
	Quite a lot	11	15.7	16.4	29.9
	Very much	47	67.1	70.1	100.0
	Total	67	95.7	100.0	
Missing	System	3	4.3		
Total		70	100.0		

Table 6: How much did you enjoy the lessons?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not much	13	18.6	29.5	29.5
	A bit	12	17.1	27.3	56.8
	Quite a lot	8	11.4	18.2	75.0
	Very much	11	15.7	25.0	100.0
	Total	44	62.9	100.0	
Missing	System	26	37.1		
Total		70	100.0		

Table 7: How much would you like your child to continue with instrumental lessons over the Internet?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not much	2	2.9	4.5	4.5
	A bit	8	11.4	18.2	22.7
	Quite a lot	11	15.7	25.0	47.7
	Very much	23	32.9	52.3	100.0
	Total	44	62.9	100.0	
Missing	System	26	37.1		
Total		70	100.0		

Table 8: How much would you like your child to continue with instrumental lessons in the same room as a teacher?

Glossary & Abbreviations

App	A self-contained piece of software designed to fulfil a particular purpose
CCTV	Closed circuit television camera
Downstream speed emails, watching	The time it takes to receive incoming data from the internet on a computer (eg receiving downloading files, visiting websites, audio/video footage)
Embouchure	Position and use of the mouth and facial muscles when playing wind and brass instruments
Firewall	A security system preventing unauthorised access to or from a computer or network of computers
Latency	Audio latency refers to the delay between the sound being created and heard
Live streaming	The delivery of content, such as audio and video footage, live over the internet
NYCC	North Yorkshire County Council
Skype enabling tablets and devices	Internet based communication software video chat and calls from computers, mobile phones to other similar
TED are live view	A non profit organisation which organises short talks on a range of topics, many of which streamed and subsequently available to online
Upstream speed files,	The time it takes to send outgoing data from a computer (eg sending emails, uploading audio or video footage)

Video/audio mixer and streamer Hardware enabling video and audio footage to be captured, mixed and delivered live from a computer to the internet

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