Lockdown Learning: the digital transformation of co-curricular interdisciplinary challenges

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Abstract

This paper explores three-key issues related to the digital transformation of co-curricular interdisciplinary challenges within a UK higher education institution during the COVID pandemic. It is widely accepted that university graduates must be work-ready with an integrated skill set in addition to discipline specific knowledge to enable them to respond to complex societal challenges. The Creative Connection at Staffordshire University developed a framework using phenomenon-based learning to bridge discipline gaps, develop interconnectivity and enhance learning through 21st century skill development leading to work-ready graduates. Phenomenology provided an epistemological grounding for constructing knowledge of the new world using an interpretive constructionist philosophy. Through responding, reframing, and rethinking, during the COVID lockdowns the Creative Connection was moved into a digital environment which enabled interconnectivity to be taken to a new level with far reaching impact for student learning and skill advancement. The study presented showcases the pedagogic transformation and learning derived.

Keywords: interconnectivity, challenges, digital transformation, lockdown learning, phenomenon-based learning

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Introduction

It is widely accepted that graduates of the future must be work-ready and fully equipped to respond to the economical, technological, and societal shifts that are happening at an ever-increasing pace. Literature provides evidence that complex societal challenges such as: food security, ageing population, disaster management, environmental sustainability, and world health reach far beyond a single discipline boundary or methodological approach (Østergaard et al, 2010; McLeish & Strang, 2014; Power, 2018; Power et. al, 2020). Innovative and sustainable solutions require interdisciplinary working and as such there is a strong argument for embedding such opportunities within the higher education experience; a view supported by policy makers, funding councils and professional bodies (QAA, 2012; RAE, 2012; DC, 2015). Forward thinking employers want an integrated skills set as well as discipline specific knowledge to enable graduates to respond to complex global challenges (D2L, 2021). Universities of the future must focus on delivering the best possible educational and cultural experience, whilst bridging the skills gap that exists between education and an increasingly competitive commercial environment. Preparing students for this complex, dynamic and uncertain climate is a challenge shared across the globe.

The fourth-industrial revolution is interdisciplinary in nature, crossing fields and transcending traditional academic disciplines. Wakil et al. (2019) identified that traditional lecturer centred learning methods are out-dated and do not meet the needs of 21st century students; who are required to be more productive, collaborative, curious and daring than ever before. He advocates for new pedagogical methods to be pursue to ensure globally competitive skills and attributes are developed within student's journeys. Various studies offer pedagogical solutions: Kolb (1984) presented experiential learning, Barrows (1985) introduced problem-based learning and Lave and Wenger (1991)

ISSN: 2044-3315

presented situated learning, all have foundations in action learning (Revans, 1982). These pedagogical approaches hold value for developing graduates skills, however, a more recent approach, phenomenon-based learning (PhBL) has become associated with studies that place academia and society as the cornerstone (Francis et al., 2013). In capitalised societies graduates contribute significantly to production, distribution and wealth exchange; therefore, higher education has a fundamental role in developing civic institutions for the creation and dissemination of knowledge; producing graduates who have a genuine commitment to society place and people (Power, 2018; Senior, et al., 2018).

Staffordshire University recognises the value of integrating interdisciplinary collaborations within the student's learning journey. The Creative Connection, funded by the Royal Academy of Engineering (RAE) Visiting Professor Scheme was established in 2019. Its fundamental purpose was three-fold: to develop and deliver innovative teaching practices to increase learning opportunities in a world of uncertainly; build sustainable networks to ensure participants are best placed for life after study; and to cultivate employability skills that will be required for graduates of the future. It used pedagogical methods designed to take students outside their comfort zones by forming cross-discipline networks to co-create, generate new knowledge, and ultimately develop 21st century skills to work within an interdisciplinary context. The Creative Connection used a mixed pedagogical framework offering co-curricular activity to support the main curriculum in engineering, art and design. It provides a unique learning environment: bringing together students, the commercial sector and educators in a three-way stakeholder partnership to work on real-world challenges. This safe environment enables students to co-create, problem solve and generate knowledge, based around a phenomenon set in the context of a complex challenge. Using a range of techniques (including narrative and storytelling) we supported our students through active participation to bring their own

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experiences and values into time-controlled co-curricular complex challenges, to development the creative confidence needed for the commercial world.

This dynamic time-challenged environment changed with the COVID lockdown (March 2020). It became impossible to conduct the challenges in a physical location. An opportunistic approach to innovate the pedagogical framework was adopted, the environment was transformed into flexible digital creative spaces, thus, providing a blueprint for "Lockdown Learning". This paper explores three-key issues related to the digital transformation: firstly, the pedagogic transformation and learning derived in the context of COVID; secondly, the connections between students, academic disciplines, and stakeholders; and finally, the development of skills and attributes for 21st-century graduates (communication, collaboration, critical thinking and creativity). The work presented provides a framework for transformative pedagogy, developing a legacy for learning to promote risk taking, co-creation and new approaches to embedding advanced technology, enabling traditional discipline boundaries to transcend within an interdisciplinary digital setting.

Methodology

The research strategy was grounded in the philosophy of constructional interpretivism. In adopting this stance it was recognised that views expressed and their interpretation were inevitably influenced by the individual participants (their experiences, situation and cultural background) in addition to the researchers. PhBL was selected as the underlining pedagogic method due to its alliance with specific skill development such as: creativity and critical thinking; within collaborative societal learning (Wakil, et al., 2019). This pedagogic method doesn't prescribe a specific set of learning rules; it enables students to take an active role in the comprehension of the phenomenon and subsequent actions. This makes it particularly suitable for commercial challenges, where student

ISSN: 2044-3315

participate in collaborative activities with the intension of providing solutions to a complex phenomenon (Blogger, 2018; Silander, 2015; Zhukov, 2016). Phenomenology provided an epistemological grounding for constructing knowledge about the world using an interpretive constructionist philosophy.

At the start of the first UK lockdown, The Creative Connection was approaching the end of its first year. Prior to this the framework for the interdisciplinary challenge-led activity was based on a well-established model (Figure 1). During March 2020 the COVID pandemic had reached new heights and the UK government imposed tight lockdown restrictions that forced all educational establishments to transition to virtual learning (using digital platforms to deliver synchronous or asynchronous learning). Within a matter of weeks a difficult decision was upon us: to rethink the essential components and the pedagogical framework for the challenges; or to postpone them until physical campus re-opened.

This paper presents the pedagogical transformation of the challenges into virtual delivery. The analysis is split into three sections: 1. responding – the pilot virtual challenge is presented; 2. reframing – four virtual-commercial challenges are contextualised from the students' perspective; and 3. rethinking – interconnectivity is discussed in the context of PhBL offering a new collaborative approach within digital learning.

Student learning was captured though a qualitative questionnaire distributed after the event (response rate 34%). The questionnaire was split into five-categories: student's likes, skills/knowledge, takeaways, networking, and understanding the innovation process. Table 1 presents the sampling framework for the five challenges.

ISSN: 2044-3315

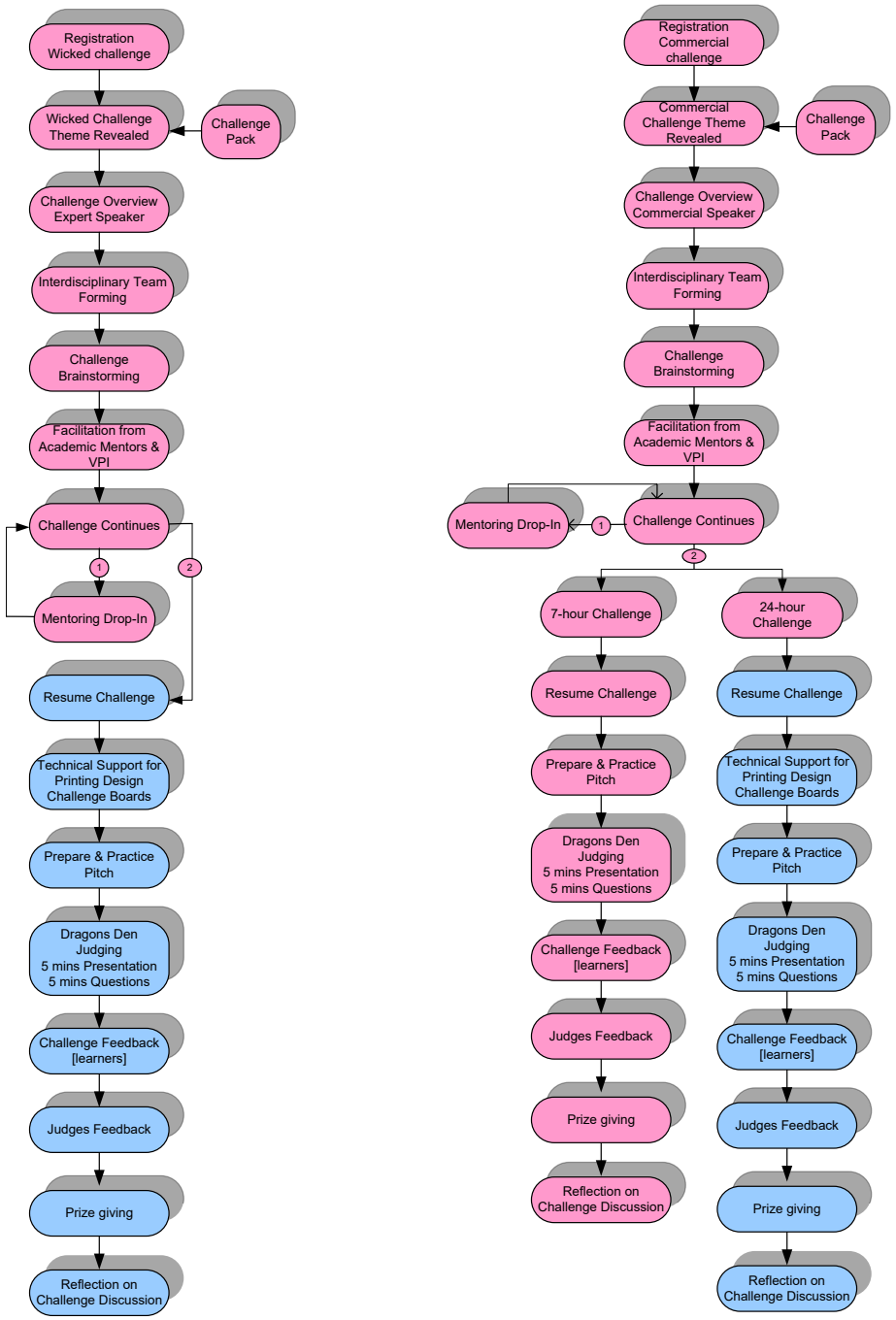

Figure 1 - Model for challenge-led learning (Power, 2018)

Table 1 – Sampling framework

Date	External Stakeholder	Duration (days)	No of students	Disciplines
18-05-20	Pilot internal	5	10	Aeronautical engineering Automotive engineering Computer security Electrical engineering Event management General engineering Graphics Mechanical engineering 3D designer maker
08-06-20	VX Fiber	5	16	Automotive and Electrical engineering Industrial Design Mechanical engineering Product Design Transport design
16-11-21	VX Fiber	2	33	AI and Robotics Business Management Computer Science Education studies Electrical engineering Games studies General engineering Graphics QTS UG primary
18-01-21	Potteries Museum and Art Gallery	2	25	Aeronautical engineering Animation Automotive engineering Computer science Engineering design Film TV and radio Fine Art Games design Graphics Mechanical engineering Product Design Transport design
17-05-21	University Hospital North Midlands	5	9	Aeronautical Engineering AI/Robotics Animation Fine Art Graphic Design Electrical engineering Engineering design Mechanical Engineering

Responding – the pilot challenge

Due to the speed of transformation into on-line learning and uncertainty of coordinating a virtual co-curricular challenge, the pilot used an internally designed brief. Synchronous learning was conducted over five-days using Microsoft Teams to facilitate information sharing, problem solving and team building. The pilot challenge was about **"***Optimism",* students worked in teams formed from different academic disciplines to imagine the world beyond COVID.

ISSN: 2044-3315

The challenge was to think of a design, brand, product or piece of innovation that wasn't there before but is now a source of inspiration in the world post-COVID. Student teams from nine academic disciplines (Table 1) formed ideas over five-days using the digital platform to connect with their peers and mentors. A virtual Dragons Den was conducted on the final day which enabled the participants to undertake a time-controlled pitch to a panel of judges. Forming virtually co-curricular collaborative opportunities was a new concept at the start of the pandemic, the student teams took advantage of the competition format to develop essential digital skills including virtual communication within the new pedagogic framework. The winning idea in itself was novel, but the analysis formulated was based on the principles of PhBL which promotes skills training as equal to cognitive development. Østergaard et al. (2010) emphasised the close relationship between learning process and human development as a key element of PhBL.

Pilot impact

The students who participated (Table 1) had not previously worked together; teams were formed at the challenge start and students immersed themselves in the challenge theme. Feedback was analysed under three initial categories (Table 2: likes, skills and takeaways); followed by a more descriptive analyses in relation to interconnectivity and innovation.

It was found that the participants placed significant value on three key themes: 1. the opportunity to work as part of an interdisciplinary *team,* 2. the *operational* aspects (including guidance, well-developed briefs and support) and 3. the *innovation* opportunities (freedom to create, exploration of new techniques within the co-curriculum environment). The more personalised comments related to meeting *new people*, the challenge *theme* and the *structure* (with positive references to the virtual synchronous environment).

ISSN: 2044-3315

Unsurprisingly *team working* was the most recognized skill developed during the challenge; there was value placed on using one's own skill set, but also on recognizing other team member's skills to gain a competitive edge. *Software, research, creativity* and *presentation* skills were also highlighted as being developed. The feedback in respect to takeaways was more varied, and ranging from improved *pitching,* to developing skills of *research*. It was particularly interesting that *risk analysis* also appeared, as this was one of the recent additions to the QAA subject benchmarks.

The final category explored in the feedback was the interconnectivity. Interconnectivity is defined by Advance HE (2019) as making connections between people, disciplines and activity locally, regionally, nationally and internationally. This was very prominently reflected in the general comments: *"I met people who I didn't know and was able to collaborate them"* and "*it is important to look at different people's skills in a team and use these to your advantage*". It was interesting that the students made positive references to the digital element: *"[learned] how to make groups on Teams and develop the skill of participatory technical* competitions" and "[I liked] *the theme of post-Covid, and the way it was done completely online*."

Students also reflected on expectations: "*It was different to what I expected, but I feel like I'd have a better chance at this sort of thing if I tried again; it was a better experience than expected and helped make me a little less nervous about future collaborative work*" *and "I've had a really good time on this project and am proud of what we've accomplished."*

ISSN: 2044-3315

Table 2 – Student comments: virtual pilot

What you liked…	Skills Developed	Takeaways (Impact)
Team working • good-team work • the cooperation • teamwork experience with strangers • working in a team • as a team in conversations • good team	Team working • it's helped me to develop my team-working skills • I will be able to work as a team more fluidly and collaborate more easily • collaboration • it is important to look at different people's skills in a team and use these to your advantage • participatory technical competitions	Pitching • it allowed me to get practice pitching • gave a clearer indication of the level of detail that is expected in presenting a concept
Operational • brief was well prepared. • daily feedback to keep us on track, • good event leaders, • good levels of guidance and support from leaders	Research • researching • it has shown me research is necessary through everything	Work Ready • understanding of industry jargon • it prepared me for work as I got to work with people I usually wouldn't have worked with
Innovation • freedom to create • exploring new ideas, • used the technique to participate in a competition • this is something new and safe from work	Creativity • creative skills • creativity	Wider development • when I explained my idea, it increased my goals for the future • enabled one to think about the wider impact of the product
Structure • the format: of it being completely on-line • smooth running considering it was on-line • the handling and the way it was done completely online	Software • use of illustrator • how to make groups on teams technology and develop the skill of participatory technical competitions	Risk analysis • it's important to ensure feasibility of every idea to reduce risk
New People • meeting new people • I got to know new people	Presentation • presenting an idea	Research • it has made me more enthusiastic about research
Theme • the theme of post-COVID		Technology • social (media) things

It was clear from the student's reflections (Table 2) that the virtual challenge was beneficial: firstly through increasing learning opportunities within a world of uncertainly; students commented about how it made them more "*enthusiastic about research*" and that it raised expectations "*increased my goals for the future*." Secondly, it facilitated the building of sustainable networks to ensure participants were best placed for life after study; "*…it helped me to develop my team working skills", "I will be able to work as a team more fluidly and*

ISSN: 2044-3315

collaborate more easily" and "*this is something new and safe from work*." Finally, it cultivated creative confidence through introducing the concept of play: it gave participants the "*…freedom to create*" and allowed the "*exploring [of] new ideas*". One student commented that they developed "*confidence and communication, something [they've] struggled with a lot; but if you do it more it comes easier to you. Especially with COVID it felt unlikely to practise this again, so it was actually quite fun and reassuring*".

Reframing

Using the knowledge gained from the preliminary evaluation, four-further co-curricular virtual interdisciplinary creative challenges were conducted (which attracted a further 83 students - Table 1). The subsequent challenges re-aligned with the RAE initial project and brought commercial partners as stakeholders into each challenges (Figure 2). This brought new opportunities to push the technology boundaries through incorporating virtual reality and 3D image generation to enable the students to virtually visit the environments or engage with simulated artefacts (using both synchronous/asynchronous learning).

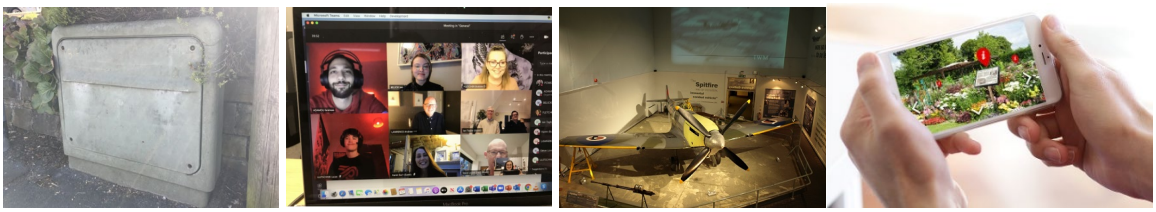

Figure 2: Commercial challenges

(VX Fiber, Games-hub, Spitfire, and UHNM challenges)

In the Street Cabinet Hackathon (a five-day design challenge set by Swedish technology company VX Fiber), students were tasked with designing street furniture to house fibre-optic cables which would complement or even improve their surroundings. Councillor Jellyman (Cabinet Member for Infrastructure,

ISSN: 2044-3315

Regeneration and Heritage) commented: *"This is the sort of collaborative project that can inspire young people to achieve even greater things and hopefully be Stoke-on-Trent's world-class Engineers of the future. It also helps to show the fantastic things that are happening with digital technology in this great city."*

The second commercial challenge (The Gaming Hub), raised the bar in term of PhBL due to the number of external stakeholders, there were two partners: VX Fiber and Stoke-on-Trent City Council. Thus, cementing the social, civic and global nature of PhBL. This was a live brief and the intention was to use the ideas to inform an actual development. The Intellectual Property for the challenge belonged to the commercial company and therefore limited information can be placed in the public domain. But to ensure the students fully understood the scope, a team of academic staff from Staffordshire University were able to get access to the identified site and using technology were able to capture data to create a virtual grey image of the location. This enabled students to virtually access the site and use real dimensions to create virtual prototypes of their solution to what a gaming hub for the region might look like. The place and the regional significance of this development enabled the students to bring their own knowledge and socially construct ideas based on their living memories to bring a lived connection into the final ideas. The teams created inspiring visions, incorporating community, learning and gaming. Mikael Sandberg, Chairman VX Fiber commented: *"it was inspiring to see how the students came together from multi-disciplines over the short space of time they had, to produce such a diverse yet compelling set of ideas around what could be done to provide a creative, educational and engaging location to attract young people in Stoke-on-Trent interested in the Games industry to pursue and develop their interests."*

Potteries Museum and Art Gallery (challenge three) is opening a new gallery to celebrate the iconic Spitfire. This is intended to be an education hub for design,

ISSN: 2044-3315

engineering and technology re-interpreting the story of the Spitfire and its place in history. Students were challenged to explore ways to engage the next generation of designers and engineers by using the iconic aircraft as inspiration. Using principles from PhBL synthesizing community, learning, heritage and technology they provided creative solutions to engage visitors with activities and artefacts. The winning team came up with the "Spitfire Gallery Pilot's Logbook" based on a WW2 logbook from the Battle of Britain. The logbook raised awareness of some of the 21st century engineering challenges: such as how to encourage more females into engineering careers; as well as narrative of cultural and historical importance "the life of Reginald Mitchell". The disciplines participating in this challenge were extended to include those studying education (as well as design, games, engineering and technology – Table 1). This extra knowledge benefited the teams to create inclusive educational material aligned to the national curriculum.

The final challenge with University Hospital of North Midlands NHS Trust (UHNM) challenged students to come up with creative ways to preserve the landmark site's legacy. During lockdown site visits were not possible, so high-tech footage captured by the Forensic Archaeology Team was made available during the challenge. Sophisticated data capture was used, flying drones with cameras through the derelict building to capture still and moving imagery.

Students from 7-different disciplines worked against the clock to develop creative concepts before pitching their ideas to a panel of judges which included civic leaders. The winning team designed a 'Path of Recovery' which took visitors down memory lane and showcases a chronological history of the infirmary, incorporating architectural features salvaged from the demolition such as tiles, stained glass, benches and chimney pot planters. It also features interactive

ISSN: 2044-3315

information plaques with QR codes to reveal stories about place and people. Lorraine Whitehead, Director of Estates, commented *"If there is one thing we aim to do as a hospital is to make patients better and the 'Path of Recovery' symbolises that. It also recognises the fact that our staff have been through a really tough time and this garden trail is as much about staff restoration and recovery as it is for patients."* This statement reinforces the interconnectivity of the virtual environment bringing together key stakeholder with a narrative of hope for the future whilst capturing milestones of the past and contributes directly to the region.

Rethinking

The commercial interdisciplinary challenges were contextualised; drawing out the impact from the students' perspective in terms of what they liked. Three new themes (*community, real brief, skill development*) were added to the six-themes *(team working, operational, innovation, structure, new people* and challenge *topic*) drawn out within the pilot. These are unsurprising additions considering that all four-challenges had commercial partners and briefs linked to improving the local region. This reiterates the value of the underpinning pedagogical approach, students wanted to give back to the local community; and develop skills in context to the stakeholders. What is surprising is the change in frequency of the themes. The commercial challenges revealed *Innovation* as the most dominate theme and within this freedom was a word used repeatedly to express the concept of opportunities for exploration and play. This was followed by the theme of meeting *new people* and *team-working*, "*I enjoyed meeting and working with new people",* "*…the ability to connect with other areas outside my own field of study"* and *"working in a team from different disciplines and how friendly and accommodating everyone was".* There was also sufficient value placed networking with peers from other disciplines: "The *community* aspect was evident. The feedback made reference to *"being able to give something back",*

ISSN: 2044-3315

"…benefits to the community" and made reference to the *"history and heritage"*. The commercial aspect and appreciate on the live brief was also important *"…I enjoyed the real-world application"*, *"introducing external partners to the challenge"* and *"working with a live client"*. The remaining themes related to the *structure* and *operation* of the event: students appreciated the COVID safe environment, the support and opportunity to work with others.

Table 3 – Student "likes"

What you liked…
Innovation The freedom to come up with concept designs as well as more realistic ones, the freedom to express ideas, the freedom, the freedom of ideas, easy to handle, the short time frame to develop an idea, challenging but achievable task to be completed in the timeframe, the challenge, challenge, the focus on gaming, idea generation, innovation, opportunity to be creative, working on inspiring the next generation of STEAM students, a chance to apply myself in an area I otherwise may not experience in my career, the technology aspect.
New People Networking, meeting new people, making new connections, working with different people from other courses, working with new people from different degrees, very good at involving people from different backgrounds, opportunity to be creative and meeting new people, the ability to meet new people, the chance to work with other courses, mixing with other course students, working with students from different subjects, I enjoyed meeting and working with new people, the ability to connect with other areas outside my own field of study, working in a team from different disciplines and how friendly and accommodating everyone was.
Team working Research and collaborating with the team, the team based system, experience group work, team work, team working, the challenge, teamwork, working as a team, cooperation, group work.
Community Directly contributing to the gallery and allows me to pay respect to someone close to me who worked on the spitfires, the fact that this will go on to benefit both the VX Fiber and also the wider community, I liked the fact that this challenge had a lot of history and heritage behind it, having the opportunity to work with the university and the museum, an opportunity to learn about Stoke as my knowledge is limited seeing as I am not local to the area, being able to give something back, the creative side of making memorial ideas for the infirmary to be displayed in the new housing estate, supporting the UHNM charity in exchange for a prize.
Real brief I enjoyed the real-world application, being able redesign something that I have physically seen and been around, the fact it was for a real company, learning more about the gaming industry and link this to my course in education, learning about the gaming industry in Stoke, working with a live client, introducing external partners to the challenge, the interaction with the hospital estates team.
Structure Coming up with ideas quickly, the short time frame giving us a challenge, great organisation and structure given the situation, the organisation, COVID safe, that results were announced on the day
Skills Get help for my anxiety problems, learning new skills, gaining experience of presenting ideas, the podium
Operational Learning from the staff members, working closely with the judges and hosts getting good feedback, the level of support given, having a clear brief and outline of expectations.
Theme The topic (I love the spitfire and WW2 aircraft), the history involved.

ISSN: 2044-3315

Concurring with the most popular skill development from the pilot, the most dominate theme was *team working* (Table 4). There were some similarities with the prior themes (*presenting, creativity, software/technology* and *research)*, with a few notable additions: *time management, reflection, virtual skill* and *communication*. There were lots of comments relating to the virtual nature of the challenge *"…online team work and presentation has built my confidence in using communication tools", "the main takeaway was being able to work in Teams over the internet and not face to face"* and *"This I feel will be a vital skill needed in the future in this current world climate."* In general, there were lots of references to *employability skills* and *confidence building*; indicating that the students were embracing the networking and mentoring opportunities.

The commercial nature of the four-challenges appeared to change the order of the takeaway themes established from the pilot study (Table 5). Those themes that featured in the pilot (work ready, wider development, pitching and research) were still evident. However, many new themes were established including: enjoy, commercial awareness, innovation, networking, structure and confidence. There were 37 individual comments in relation to the positive networking opportunities. Some related to the virtual nature of the event: "*I think that given the fact that we could not talk face to face and that networking had to be virtual, networking was organised very well*", "*I think given the current climate this was organised really well and there was very little that could have been improved*" and "*The digital setting hindered some of the networking, particularly with the external partners, not in a major way but from a point of small talk and casual conversation.*" Some comments were reflective "*I enjoyed meeting new people, at first I was really nervous, but as we worked together we became more confident working with each other. I liked hearing from the staff as well as they had some useful insights"* and *"I feel that this event has shown what I have to offer as a person. I am now acquainted with people from different disciplines and*

ISSN: 2044-3315

Table 4 – Student "skills"

Skills Developed
Team working Good team building skills and collaborative skills, practice at online team work and presentation has built my confidence in using communication tools, being comfortable meeting and working with a group of new people, I will try to work with more people whom I don't usually work with, it has helped me develop more group work skills, team working, experience building confidence in team leadership skills.
Time management Along with being able to structure my resources and timings in a more practical way to achieve goals, in the future this will help me within the working environment to carefully plan out tasks before committing to them, tight schedule working, planning and organising skills, will improve employability, time management - allowed us to cut out 2.5 mins of our time, fast pace.
Pitching and Presenting It has helped me develop presentation skills, public speaking, presentation of ideas and time management, presentation skills, furthered my presentation and teamwork skills which will be used in the wider working environment, benefits of scripting presentations, I also have become better at presenting and storytelling visually.
Reflection The skills I have been able to develop are ones which enable me to draw from useful areas from my surroundings and areas to do with the brief, also techniques of persuasion and influencing people, I felt like this would have improved the outcome for my team if I could have better conveyed my vision and valuable experience from previous challenges, it has helped me to be able to discuss problems and find solutions as a group, I have learnt to work under pressure, a short deadline meant having to be assertive with decisions made to keep moving forwards, working under time constraints, gaining feedback on how improvements could be made, open-minded.
Creativity Being able to aesthetically and fundamentally pair certain things together to enhance the overall design, is something I have been able to work and train during this event. quickly developing ideas, communicating the ideas, it has definitely helped me to improve both my visualisation and design skills and usage and creation of displacement maps, my creativity, I already knew about the merlin engine and my ability to research.
Virtual Remote working, working online, the main one being working in teams over the internet and not face to face, this I feel will be a vital skill needed in the future in this current world climate.
Communication It has highlighted a definite need to work on communication skills, effective communication and articulation in presentation.
Software/Technology Insight into technologies, software improvement rendering, it increased my knowledge of technology currently on the market.
Research More research skills and improved interpersonal skills, I have definitely learnt a lot about spitfires and lots surrounding that topic, more about the hospital and the history of Staffordshire.
Confidence From being a shy and quiet person, I think this challenge helped me with confidence with talking to new people, developing confidence.

with different areas of expertise", and *"it has definitely helped me to be more confident when putting forward ideas and to see that I do have the ability to work within smaller timeframes and still achieve outstanding results."* Others referred to the need to do more of this type of activity "*More of those opportunities to do little projects for companies"* and *"have more of these mini*

ISSN: 2044-3315

events, they are a lot of fun and a good way to earn some money but also improve and learn how to apply your skills."

Table 5 – Student "takeaways"

Takeaways (Impact)
Work Ready I will use (the skills developed) these to support my future career and working skills in my courses and at work, it helped me through setting me a deadline which I then had to make sure I adhered to in order to be complete the event, it gave me a view into how companies like VX Fiber operate and interact with the local community when planning out their work, and so has shown me how I can use these methods in the future when in the working world, being able to demonstrate ability to work quickly, it has allowed me to add a new talking point to my CV, aware of the inter-personal skills necessary when working with colleagues for the first time, makes you more aware and prepared to making ideas, working with others and expect the unexpected, the internship at the hospital will be lucrative, not much but there was and informative factor of what kind of businesses are interested in gaming industry, I've worked with a client outside of my degree, it helped me to gain knowledge on the current commercial market, this will help become more versatile once I leave education at Staffs, I think that this project has given me an insight into the future of what working with future clients and colleagues will be like.
Enjoy Overall, I really enjoyed it and got a lot from it, I appreciate all the time people have put into organising the event, thank you, thank you for the opportunity, really appreciate it, thanks for the opportunity, enjoyable and engaging, thank you for everything - I've really enjoyed the challenge and hope to do something like this again, thank you for the amazing opportunity, I enjoyed every moment, it was fun.
Wider development In terms of developing employability skills the challenge has definitely shown me what I can achieve in a very small timeframe with proper planning and execution, very worthwhile doing, aware of linkages between gaming and education which will help me in my teaching career, thank You for the opportunity to work on this and I will be happy to help further in Gaming HUB or other gaming industry related projects or work, taking part was useful, it highlighted some areas I urgently need to develop, as an engineer we learn more from failure than from success.
Commercial awareness This then enabled me to be able to work on my key time keeping and planning skills, which I can take forward with me within industry, I learned about the importance of brand identity, I think it made me think more about visitor/ customer experience and as a graphic design student I think it's important to always consider that, commercial awareness is a difficult aspect for me and I have an understanding but not been able to see how to apply this, I found on this challenge and especially seeing the winning presentation I felt that I got a bit more insight into how to develop better skills in that respect, showed me what employers are looking for and how professional executives think.
Innovation It has shown me that while sometimes innovation requires creative flare, it is also necessary to assess the practicalities of a design and make sure that while it is creative it is also functional and meets the project requirements, innovative, showed me how to use creativity in a work environment.
Networking I really loved this challenge and hopefully there can be more opportunities with working with the museum and more specifically SPITFIRES!!!!!!, by having external people to the university and interacting effectively with them, it allowed for networking and an opportunity to show work ethic.
Structure Everyone was friendly and very accommodating especially with it taking place while exams are going on, the support throughout the challenge was great and it was very engaging, hopefully the next one will be physically on campus (fingers crossed).
Confidence I have in the past shied away from conference video calling and it has caused me anxiety, together with the limitations of the pandemic this has helped build my confidence, more confidence in myself to reach out to potential employers. shows employers my flexibility and ability to work as a team and on unusual briefs.
Research It I was able to generate ideas and gain feedback from the staff, it allowed me to think of something on a grander scale
Pitching Good practice with presentation skills, gave me experience with working online, developed my business skills in putting forward a pitch as I want to go self-employed someday.

ISSN: 2044-3315

The analysis of the final category (understanding of innovation process) showed similarities to the comments from the pilot:

- the themes related to the value of research "*The complete freedom let us come up with any ideas. Although the brief was focussed on education, the fact that STEAM was talked about, which includes art meant we could be more creative"* and *"it showed how much research is needed just for one part and how essential a team with a variety of skills can be"* and *"It has shown me more ways to explore the rich culture of a project. By seeing the winning teams' presentation I can now take inspiration to further improve my presentation skills."*
- the value of realisation was prominent "*I think this made me think more about how to design for a physical environment in a way that is suitable for everyone. I haven't done anything like this before so I enjoyed the experience"* and *"this enabled me to explore a lot of different areas in the initial design phase to then enable me to make the best design choices in the later stages of the design process"* and *"the requirements allowed me to both think realistically while at the same time allowing me to broaden my horizons and come up with innovative solutions."*

Summary

This paper presented: the digital transformation of interdisciplinary challenges, their value to learning, and the impact in terms of promoting interconnectivity during the COVID pandemic. The data collated showcased the successful pedagogic transformation of the co-curricular activity into a synchronous virtual environment which enabled advanced technology in the form of 3D simulations to be developed which created new opportunities for learning. Through responding, reframing and rethinking, new insights were developed to support PhBL within virtual co-curricular activity. Student's fed back that they enjoyed the

ISSN: 2044-3315

freedom of the challenge environments and found them to be innovative dynamic and exciting. They did not see the transition to virtual as a barrier for meeting new people, making connections or developing community. In fact most believed that being able to work in a virtual environment was a vital skill for the future and helped prepare them for the global commercial environment. Students commented that the support throughout the challenges was very engaging. In addition: interactions within a time-controlled was highlighted as a positive, the short time-frames, external stakeholders and team formations were all considered important to the learners. The elements of community was a strong feature throughout: key benefits were giving back to the region (which strongly supports the universities civic responsibilities) and also developing a strong sense of social responsibility (as discussed by Senior et al., 2018). The findings of this study have far reaching benefits for educators that are considering adopting co-curricular interdisciplinary virtual challenges. Through adopting the principles of PhBL networking opportunities were embedded that bridged gaps between industry, academia and society; enabling students that participated to develop integrated skill sets for the 21st century.

Interconnectivity was evident in all of the challenges and did not appear to be effected by the virtual environment during lockdown. Students commented that these learning experiences helped prepare them in terms of global competitiveness and in skill development such as: time-management, planning, team working. During the challenges students developed narratives to pitch to create brand identity. Whilst it is important that universities forge environments to bring key stakeholders together in a safe secure framework, it is also essential that students are provided with opportunities to think outside the box in a high pressured complex climate, cumulating knowledge, experiences and relationships. In these types of collaborations everyone benefits so there is a material acknowledgment of satisfactions from all stakeholders as demonstrated

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in the earlier analysis. Students commented that this new pedagogical method supported the development of creative confidence and in some cases was deemed to reduce learning anxiety through developing successful communities for learning. Thus, it can be concluded that the framework for transition to digital co-curricular interdisciplinary challenges presented a legacy of learning which promoted risk taking, co-creation and interconnectivity with people, place and society. This enabled traditional discipline boundaries to be transcended within a digital setting and will be of interest to all educators who are interesting in extending networks within the digital landscape of what has become the new norm.

References

Barrows, H.S. (1985). *How to design a problem-based curriculum for the preclinical years*. USA: Springer.

Blogger, G. (2018). Phenomenon-based learning in Finland inspires student inquiry. [Accessed June 2021]. Available from: https://blogs.edweek.org/edweek/global_learning/2018/10/phenomenonbased_learnin g_in_finland_inspires_inquiry.html

D2L (2021) What's driving the vision for the University of the future. Navigating the skills gap, digital transformation and a global pandemic. [Accessed July 2021]. Available from: https://www.d2l.com/en-eu/resources/assets/whats-driving-the-vision-for-the-university-of-the-future/?asset=7015W00000096poQAA

ISSN: 2044-3315

DC (2015). Design Council Celebrating 70 years. *Design Council*. [Accessed June 2016]. Available from: http://www.designcouncil.org.uk/about-us/celebrating-70-years

Francis, C., Breland, T.A., Østergaard, E., Lieblein, G. & Morse, S. (2013). Phenomenon-based learning in agroecology: A prerequisite for transdisciplinarity and Responsible Action. *Agroecology and Sustainable Food Systems*, 37(1), 60-75.

Kolb, D. (1984). *Experiential Learning. Experience as the source for learning and development.* USA: Prentice Hall.

Lave, J. & Wenger, E. (1991). *Situated Learning: Legitimate Peripheral Participation.* UK: Cambridge University Press.

McLeish, T. & Strang, V. (2014). Leading interdisciplinary research: transforming the academic landscape. *Leadership Foundation for Higher Education*.

Østergaard, E., Lieblein, G., Breland, T.A. & Francis, C. (2010). Students learning agroecology: phenomenon-based education for responsible action education for responsible action. *The Journal of Agricultural Education and Extension*, 16(1), 23-37.

Power, E.J. (2018). Chapter 6: Embedding interdisciplinary and challenge led learning into the student experience. In Hyams-Sekasi, D and Caldwell, E. (ed.) *Experiential learning for entrepreneurship Theoretical and practical perspectives on enterprise education*. UK: Palgrave. pp. 105-124.

ISSN: 2044-3315

Power, J., Belloc, C. & Lawrence, A. (2020). Stand up and Shout out…. Paper presented at *QAA Scotland Annual Conference: Building resilient learning communities: using evidence to support student success*, 3rd - 5th Nov, Online. [Accessed August 2021]. Available from: https://www.enhancementthemes.ac.uk/docs/ethemes/conference/stand-up-and-stand-out-brand-yourself!.pdf

QAA (2012). *Enterprise and entrepreneurship education: Guidance for UK higher education providers*. UK: Quality Assurance Agency.

RAE (2012). Educating engineers to drive the innovation economy, *The Royal Academy of Engineering*. [Accessed August 2021]. Available from http://www.raeng.org.uk/publications/reports/innovation-economy-2012.

Revans, R. (1982). *The ABC of action learning*. UK: Chartwell-Bratt.

Senior, C., Fung, D., Howard C. and Senior R. ed (Oct 2018). What is the role for effective pedagogy in contemporary higher education?. [Assessed Feb 2020]. Available from: https://www.frontiersin.org/research-topics/4621/what-is-the-role-for-effective-pedagogy-in-contemporary-higher-education#overview.

Silander, P. (2015). Phenomenon based learning. [Accessed June 2021]. Available from: http://www.phenomenaleducation.info/phenomenon-based-learning.html

Wakil, K., Rahman, R., Hasan, D., Mahmood, P., & Jalal, T. (2019). Phenomenon-based learning for teaching ICT subject through other subjects in primary schools. *Journal of Computer and Education Research*, 7(13), 205-212.

ISSN: 2044-3315

Zhukov, T. (2016). Phenomenon-Based Learning: What is PBL? [Accessed June 2021]. Available from: https://www.noodle.com/articles/phenomenon-based-learning-what-is-pbl.

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