FINDING SOLUTIONS TO DIGITAL INEQUALITY IN A BLENDED LEARNING ENVIRONMENT

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ABSTRACT

The move to off campus learning and teaching in Higher Education (HE) in the UK due to the Covid-19 pandemic resulted in innovative and exciting opportunities for students to study in a more flexible, bespoke way from home using a Personal Computer (PC) or equivalent device. However, for an Engineering student to benefit from these opportunities they would require regular and prolonged access to a working, up-to-date PC, which they can use to download and access software and applications, join group discussions, access learning materials etc. This access is perhaps less likely for students from lower income backgrounds or areas of higher deprivation, and there is a risk of digital inequality widening the attainment gap.

At Aston University (AU), a Virtual Desktop Interface (VDI) was implemented in order to provide students with a way to access high performance PCs remotely using their own device from home in order to use software and applications. To evaluate the VDI as a solution to digital inequality, a questionnaire (QNR) was developed and sent to AU students studying across a range of engineering programmes, and across a range of year groups.

Results from the QNR (n=53) showed that almost three quarters (73.6 %) of respondents accessed the VDI during their study, with students being able to rate the usefulness of this for different activities. Of those students that did not access the VDI, the most commonly chosen reason was that they did not need to use it (50.0 %).

The VDI system implemented at AU was well used by respondents, and comments were positive overall. Administering an online QNR presented some limitations to this study. Therefore, a paper-based QNR will be used for future research, which will be conducted at the end of this academic year. This will also allow a comparison of results between those in fully online learning environments, and the current blended delivery modes used at AU.

KEYWORDS

Digital inequality, blended delivery, online learning, digital infrastructure, Standard 7

INTRODUCTION

IMD, or Index of Multiple Deprivation, is a Government Index that measures relative deprivation for small areas in England (Gov, 2015) and is a way of understanding trends in a number of

domains including income, employment, health and education. Within English Higher Education (HE) there are demonstrated patterns for students from higher levels of deprivation including higher dropout rates, lower achievement of higher-class degrees and less progression to higher levels of study or highly skilled employment (Lewis, Bolton, & Hubble, 2021). At Aston University (AU) the attainment of higher-class degrees for students from IMD quintiles 1 and 2 was 3.3 % lower than students from quintiles 3-5 in 2020 (AstonUniversity, 2021) for example. However, in 2020, AU was named University of the Year by the Guardian for its work in reducing the attainment gap between Black, Asian and minority Ethnic (BAME) students, and White students (AstonUniversity, 2020). And in 2021, AU was ranked 2nd overall in an English Social Mobility Index (SMI), in a paper commissioned by the Higher Education Policy Institute (hepi.ac.uk). This rank was attributed to AU enrolling over 55 % of students from the IMD quintiles 1 and 2, and having continuation rates for these students of 95 % (Phoenix, 2021). A report commissioned by the Institute for Fiscal Studies (Britton, Drayton, & Erve, 2021) indicates that AU is ranked second (outside of London) in terms of it's mobility rate. This mobility rate is based upon the proportion of students who received free school meals and who became one of the top 20% of earners at age 30.

The move to a mixture of on and off campus learning and teaching in Higher Education (HE) has resulted in innovative and exciting opportunities for students to study in a more flexible, bespoke way with videos, quizzes, online labs, group work etc. accessed from home using a PC or equivalent device. However, for a student to benefit from these opportunities they may require regular and prolonged access to a number of things in their home i.e. a quiet workspace, a desk, a working up-to-date PC with camera and microphone, downloadable/cloud-based software, and a good internet connection etc. This access is perhaps less likely for students from lower socio-economic backgrounds. Indeed, Ramirez (2021) reflected on this digital divide and the greater awareness of it created by the Covid-19 pandemic. And specifically, Cullinan *et al* (2021) noted that Irish students from socially disadvantaged areas were also more likely to live in areas with poor broadband coverage and suggested students deemed at risk should be provided with targeted support.

The attainment gap between students from different backgrounds in the HE sector could well widen due to digital inequality if appropriate steps are not taken to understand the key requirements and mitigate against this.

A number of studies have looked at the impact of socio-economic background on the effects of School-aged student's ability to study online during the Covid-19 pandemic. E.g. Tran et al (2020) examined the effects of learning behaviours in School pupils studying from home in Hannoi, Cuisia-Villanueva and Núñez (Cuisia-Villanueva & Núñez, 2020) looked at the effects of socio-economic background for school children learning online in the Philippines, and Flack et al (2020) reported that Australian students from disadvantaged backgrounds were worst affected by the move to home schooling. In the UK it is accepted that there is a digital divide in School children, but that studies are limited (Coleman, 2021).

However, in HE, there is often an assumption that all students will have access to a good quality computer or laptop, that they will have internet at home which is of sufficient quality, and that their home environment provides a suitable place for them to study. This is not always the case and it is important to understand student's digital resources in order to best support them. Staff at AU have noted multiple occasions of speaking with students who only have access to a shared computer at home, students who have a shared bedroom with no 'quiet space' to work, their PC is old, cannot load software, does not have a suitable camera or microphone etc., and their internet connection is low and often not sufficient to remain in

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meetings, watching videos, performing group work etc. In addition to the above, students at AU have also reported that their only form of connecting remotely is via their mobile phones. Utilising AU as an example of a richly diverse HE provider, the aim of this study is to evaluate any proposed solutions to digital inequality from a student perspective.

METHODOLOGY

Prior to the Covid-19 pandemic, AU had invested in an online platform for students known as the Virtual Desktop Interface (VDI). The VDI can be accessed from any on campus or personal device such as a computer, mobile phone or tablet. It allows the user to connect to a virtual University PC over the internet, with full access to the Apps and Software (specialist and standard), which a student would usually need to be logged onto a campus PC for. It consists of two independent server clusters located in secure data centres, is available for Windows, macOS, Linux, iOS Android and ChromeOS and is based on a HTML5 web based access (AstonUniversity, 2022). The VDI is managed by the Digital Services team at AU.

This VDI has the potential to meet the challenge of students who do not have access to an individual and/or high specification PC at home, providing opportunities for accessing and using software without having to visit the campus PC rooms.

In order to evaluate the effectiveness of this solution, a digital questionnaire (QNR) was developed and sent to students from three engineering disciplines; Mechanical Engineering, Biomedical Engineering and Design Engineering, from foundation year through to final year studying. The QNR was anonymous, and contained a mixture of multiple choice, multiple selection, and open comment questions.

Ethical approval was granted by the local Research Ethics Committee.

RESULTS AND DISCUSSION

The QNR participants were asked to identify themselves by their year and programme of study, their student status and disability status. The breakdown of these responses is shown in Table 1.

Table 1. Breakdown of QNR participants (Fd = Foundation, Yr = Year, F = Final) where n (%age) is displayed and where total n=53

Year of Study	Fd Yr 2 (3.8 %)	Yr 1 6 (11.3 %)	Yr 2 19 (35.8 %)	Yr F 24 (45.3 %)
Prog of Study	Mech Eng 32 (60.4 %)	Des Eng 6 (11.3 %)	Biomed Eng 10 (18.9 %)	
Student Status	Home 50 (94.3 %)	EU 2 (3.8 %)	International 1 (1.9 %)	
Disability Status	Yes 3 (5.7 %)	No 47 (88.7 %)	Prefer not to say 2 (3.8%)	

One of the key questions in the QNR asked participants if in the last academic year they had used the VDI. The results from this question (Figure 1) show how almost three quarters of participants had used the VDI.
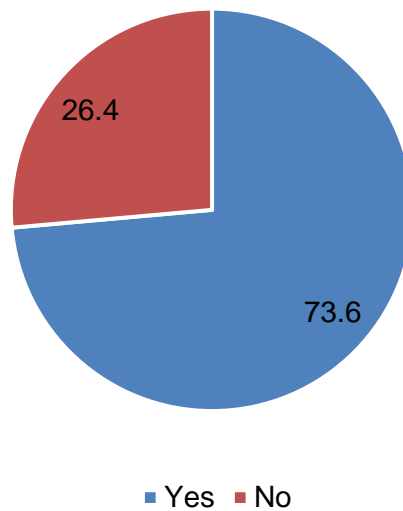
Figure 1. A pie chart displaying the percentage of participants who accessed the VDI for University work in the last academic year

An open comments question then asked those participants who had used the VDI (n=44) to share the reason why they had chosen to use it. The two key themes that emerged from these open comments were that 1) Access could be gained to software which could not be downloaded to own device, and 2) To be able to work from home without going into University. Comments included "*Because my pc is very slow compared to the VDI*", "*It was the only way to do my coursework while the university was closed*" and "*VDI allows you use a Aston university computer from home. Without the need to physically be on a university desktop. Specially engineering softwares which are easier to use on the VDI then install on your own computer due to the shear size these programs take up.*"

Knowing that AU has around 55 % of students from IMD quintiles 1 and 2, it is the hope that this high usage of the VDI is enabling students to access digital resources which otherwise would be unavailable to them during a period of online learning.

The participants who had used the VDI (n=44) were also asked to evaluate the usefulness of the VDI for three key activities, and the results from this are shown in Figure 2. Over 70 % of participants found the VDI useful for learning activities, 53 % for tutorial exercises, and 65 % for assignments and project work, with 20.5 %, 11.6 %, and 18.6 % finding it not useful for these activities, respectively.

An additional open question asked participants if they had used the VDI for any other activities not listed. Participants mentioned activities such as accessing general University work and files, practicing software outside of the course requirements, and using software for a collaborative volunteering project. By understanding why students are using the VDI, and what they find it useful for, the solution can be further developed and customized for key activities.

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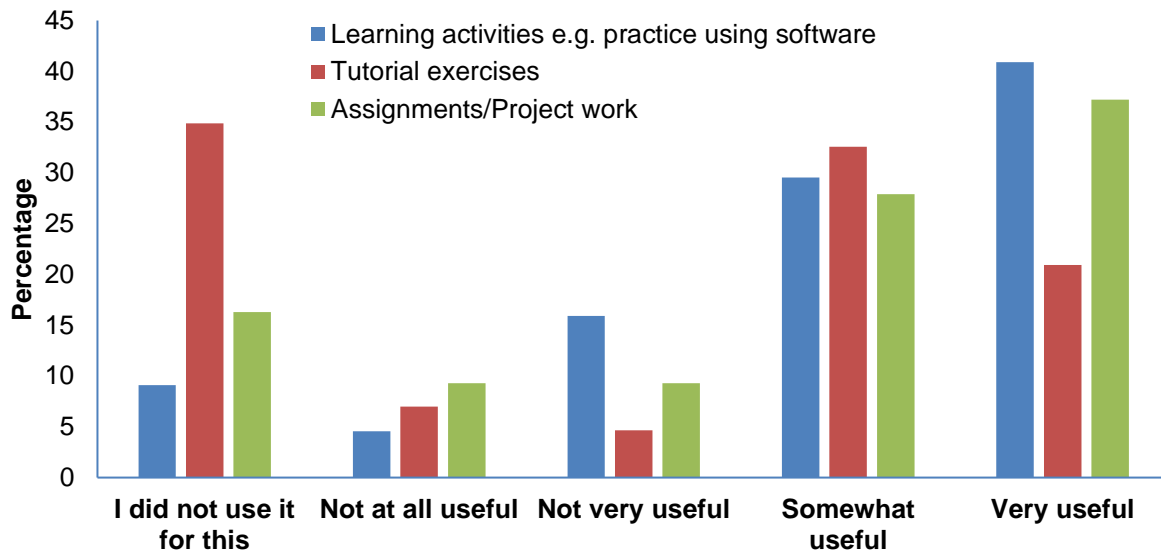
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Figure 2. An evaluation of the usefulness of the VDI for assisting with various activities (n=44)

The participants who had used the VDI were asked to comment on the positive experiences of using the VDI, and also make any suggestions for improvement. A selection of comments were received and quotes from these which are representative of those comments are shown in Table 2. A key theme from the comments for the positive experiences included being able to access software and files from anywhere without any downloads. A key theme for improvement was that there was often a 'lag' when using the software across the VDI.

Table 2. Samples of quotes from both the 'Positive Experience' and the 'Suggestions for Improvements' open comment questions

Positive Experience Quotes	Improvement Suggestion Quotes
• *Can complete work started in uni, use the software without complications of storage or ram* • *It meant I didn't have to pay for the software* • *It didn't slow my pc at all and could keep it on the side, while doing other stuff on the actual pc* • *Can access it from multiple devices like a tablet or even on a phone if needed and all the software and things are already on there* • *It doesn't require storage space and lets you access any of the university softwares from home* • *Allowed me to be flexible with working around my home situation, for university work that included technical software programmes.*	• *More computing power assigned* • *It was lagging too much* • *Solidworks can sometimes be laggy, I think this may be down to internet connection and the VDI rather than the performance provided by the PCs on campus powering Solidworks* • *If it wasn't as glitchy and laggy*

In Figure 3, the results from a question asked solely to those participants who had not used the VDI (n=14) are shown. The question asked participants why they had not used the VDI. The most selected reason from participants was that they did not need to use the VDI (50.0 %). However, there were 42.9 % of participants who responded to say they did not know what the VDI was.

For those students who did not need to use the VDI, further study is planned to explore the reasons why. It could be because they have the digital resources at home, or it could be those students were not taking modules which required the use of specific softwares, or a combination of factors.

The results also suggest that more work should be done on introducing students to the VDI and engaging them with the uses of it.
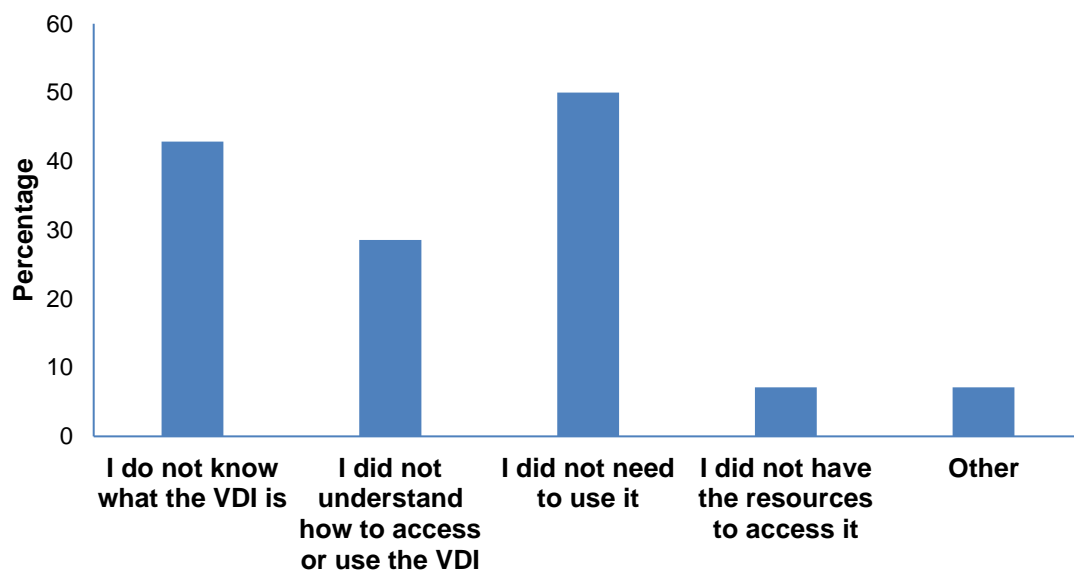

Figure 3. A question asked to those participants who did not access the VDI was to explore the reasons for this and the results of this question are shown here (n=14)

CONCLUSIONS AND FUTURE WORK

The aim of this study was to evaluate the VDI supplied by AU as a solution to digital inequality in an online learning environment. This evaluation was performed using a QNR, which was completed by 53 participants from across three engineering disciplines. Almost three quarters of participants had used the VDI, and the key reasons stated were that students could access software that they either could not or did not want to download to their own device, and that that they could access the software and files at University from their home environment.

Positive aspects of using the VDI again had themes around not needing to download software to own devices. Suggestions for improvement had the theme of removing 'lag' from software use.

From these preliminary results, the VDI appears to be well received by students, and useful for exactly the reasons it was implemented, to provide a digital resource to a diverse population of students, levelling the playing field and providing access to all. This can be useful for any taught programme where access to software which requires a high powered PC is required. At AU this included, for example, students studying computer-aided-design where access to Solidworks (Solid Solutions, Warwickshire, UK) is a necessity for all students. Though they have the option to download the software to their personal device, or use on campus PCs with access to the software, the VDI provides an option for those to work off campus without downloading the software.

However, a high specification PC is only one element of the resources required for students to learn in an online environment. Resources such as home internet quality, time and space will should also be explored. The VDI does not, for example, alleviate issues for students with poor Broadband connection in their place of residence, which is a limitation of this type of off-campus support and should be further explored.

The sample size, though small, was great enough to give a representation of students. However, one of the key limitations of this QNR was the electronic delivery mode. It is a natural assumption that students with a good digital infrastructure are more likely to respond than those without. To further this study, a paper QNR will be delivered at the end of this academic year (2021/22). This will not only capture a wider audience but will also enable an evaluation of the VDI in a year in which a mixture of online and on campus learning has taken place.

The next step in this research is to evaluate other solutions to digital inequality at AU and other HE Institutions and to enable the sharing of best practice between HE Institutions.

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