From face-to-face to Distance: Towards Flexibility in five Dimensions of Blended Learning: Lessons Learnt from the Covid-19 Pandemic

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Abstract: In the rapid switch from contact to distance learning in response to the 2020 Covid-19 pandemic staff at a university of technology with predominantly vulnerable students had to switch to emergency teaching and learning. This rapid switch required enormous flexibility of all staff and students in relation to five distinct dimensions – place, time, service, technology, and pedagogy. This reflective piece considers implications of each of those dimensions, as well as the extent to which lecturers worked within them in their attempts to save the academic year. Data, consisting of emails, WhatsApp messages, minutes of meetings, lecture notes, Zoom recordings and online forms, were analysed thematically and categorised into the five dimensions. These findings are then compared to the literature on knowledge management, learning theory and emergency teaching during the pandemic. The contribution of the study lies in a decision framework for the selection of technologies and pedagogies along the five dimensions of flexibility in blended learning.

Keywords: blended learning; distance education; place; time; service; technology; pedagogy

1. Introduction

It was while they were in recess at the end of the first term that university staff in South Africa learnt from a television broadcast by the President that they would not be returning to their classrooms for the next term. Everybody – executive management, administrators, teaching staff and students heard it at exactly the same moment, and nobody had been prepared for it. So began the scramble to save an academic year that had hardly started, using whatever means and techniques available. As a lecturer to first-year students, a professor and supervisor of post-graduates and a dean of a faculty with more than 3000 students I was in an interesting position experience the situation at both operational and management level. The emergency teaching and learning situation caused a significant number of conventional and regulatory restrictions to be lifted, and experimentation occurred at an unprecedented level. This article seeks to reflect on what was learnt in the process, in order to consider what new approaches could be followed when we return to the "new normal".

This reflective piece (Ellis, Adams and Bochner, 2011; Chan Kent, 2020; Livesey and Runsen, 2018) aims to explore some of the patterns that emerged as we embarked on a journey of discovery trough extremely troubled waters of emergency teaching and learning. It is told in the context of an institution where more than 70% of students are first-time entrants into higher education and many students' homes are more than 500km away from campus. Most students live in rural areas that have very low internet connectivity. The lockdown came as the students were home during recess.

Lecturing staff at the institution have always exhibited high levels of care for their students. This care was quickly translated to a distance mode. This article will provide some concrete examples of lessons learnt, in order to contribute to the unfolding pandemic stories that shape our understanding of the wide range of lecturers' use of educational technology, when "there has never been a moment in the history of humankind when professional development guidelines, resources, programs, and other training initiatives were more desperately needed" (Bonk, 2020).

The aim is to extract, from the chaos of *emergency remote teaching*, a few insights that would either support or contribute to our existing knowledge of flexible learning with educational technology. These insights will be classified in terms of five types of flexibility: Place, time, size, technology, and pedagogy, and from there a decision framework will be constructed to determine levels of flexibility for blended learning.

2. Problem statement

The problem driving this study lies in how five variables of flexibility, (place, time, service, technology, and pedagogy) may influence the design of blended learning experiences and exploring how the institution in this

case study addressed these variables with their predominantly vulnerable students. The solution was found in the high level of flexibility shown by management, administration, teaching staff and students.

The contribution of the paper is a decision-framework for blended learning, based on five categories of flexibility (Veletsianos and Houlden, 2019).

3. Literature survey and theoretical framework: Media selection and flexibility

The stated objective of the university in this case was to ensure that the pass rate of 2020 is the same as 2019, and that "No student will be left behind". In the process it moved from contact to distance and used an entirely different set of media. This article will consider the flexible design choices made by the institution and its staff in trying to achieve that aim.

In discussing the rapid transfer from contact to distance teaching and learning this article takes note of Tom Russell's *No significant difference phenomenon* (Russell, 1999), an analysis of more than 355 instances dating back to 1928, which suggests that there seems to be no significant difference in outcome between any two different media of instruction. Contact and distance education are thus equally valid.

Closely aligned with Russel is the famous debate between Richard Clark and Robert Kozma about the influence of media on learning. Clark argues that the medium has no more of an impact on the quality of learning than the delivery vehicle has on the nutritional value of the food it delivers. Kozma, on the other hand, argues that certain media may be better suited to certain types of knowledge. Insulin taken orally will be digested. It has to be injected (Clark, 1994; Kozma, 1994).

Following on Kozma's argument, one might draw on the work of Kurtz and Snowden (Kurtz and Snowden, 2003) who propose that there are four knowledge domains, Complex, Knowable, Chaotic and Known (Figure 1). Complex knowledge only becomes evident in retrospect and involves pattern management where learners probe, sense and respond. Knowable knowledge has cause and effect separated over time and space and is the domain of systems thinking where learners sense, analyse and respond.

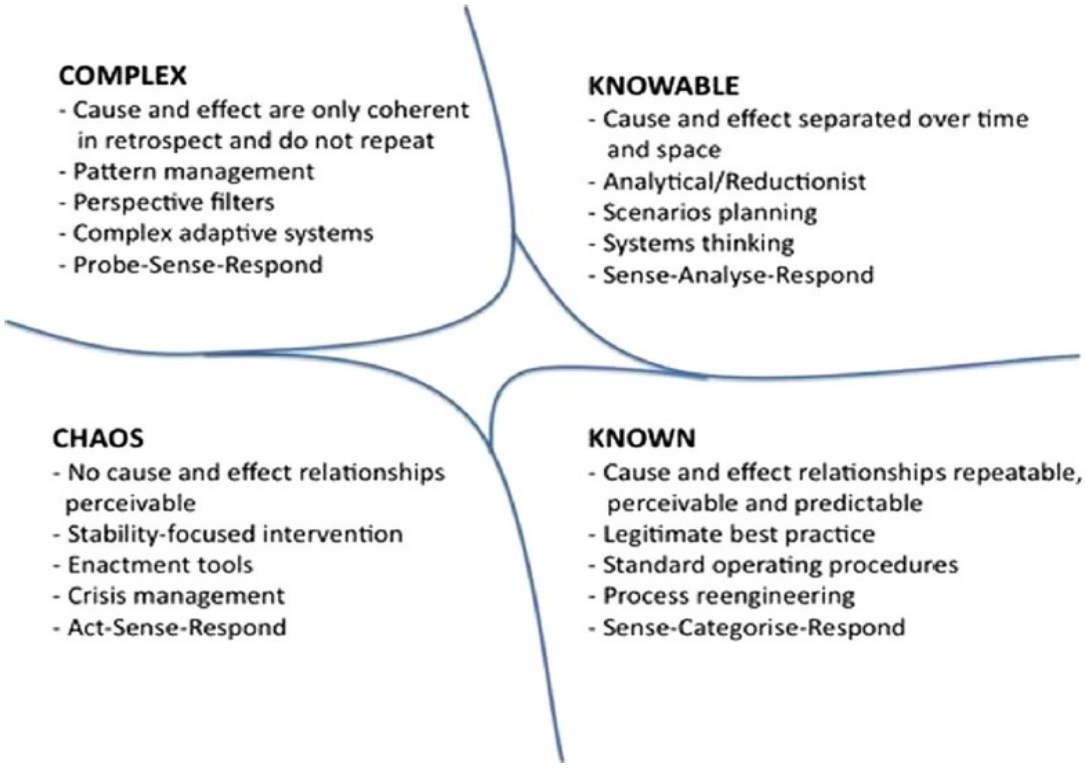

Figure 1: Four domains of knowledge (Kurtz and Snowden, 2003)

Chaotic knowledge has no perceived cause and effect relationship and is the domain where learners act, sense and respond. Known knowledge has predictable cause and effect relationships that learners must sense, categorise and respond to.

Combining this model with Kozma's (1994) argument that different types of knowledge require different media one could argue that known knowledge could be presented directly in the form of text, video or audio. Knowable knowledge may require case studies – actual or virtual – where scenarios are played out. Complex knowledge requires simulations where multiple variables must be manipulated, and the Chaotic domain is where incidental learning takes place as learners make meaning of their experiences (typically during work-integrated learning). The medium for chaotic learning would be log-books, portfolios or other ways of recording incidental learning.

Our experiences resonate with other academics "who had to rely on several learning platforms and adopt different teaching strategies in conditions never experienced before" (Martins et al., 2021, p.1). A case study from Peking University suggests five such strategies: "(a) high relevance between online instructional design and student learning, (b) effective delivery on online instructional information, (c) adequate support provided by faculty and teaching assistants to students; (d) high-quality participation to improve the breadth and depth of student's learning, and (e) contingency plan to deal with unexpected incidents of online education platforms" (Bao, 2020, p.113).

At the heart of the institutional aim to leave no student behind lay a call for flexibility in just about every aspect of the functioning of the university. To make sense of this high degree of flexibility this paper will consider five categories of flexibility: Flexibility of place, flexibility of time, service-oriented flexibility; technological flexibility and flexible pedagogy (Veletsianos and Houlden, 2019). In conceptualising this study our experience will be classified into these five distinct categories

3.1 Flexibility of place

In the design of flexible **places** earning spaces there is a move towards hybrid spaces. These spaces follow four design patterns along two dimensions: formal and informal social structures, and a blend of physical and digital tools (Eyal and Gil, 2020). In terms of deciding between formal and informal learning spaces it was found that students with application-directed learning patterns preferred innovative and flexible learning spaces, while those with a reproductive learning pattern preferred traditional learning spaces. (Yu, Vermunt and Burke, 2020). For the majority of students the home is the preferred informal learning space, and there is a strong correlation of student grades and how long they study at home (Vanichvatana, 2020).

Students have shown a preference for elearning to enhance their learning. Nevertheless, they feel that it leads to social isolation. Thus it is clear that a blend of technology and contact would be appropriate (Zuhir et al., 2021).

One of the most significant aspects of space during the pandemic, lies in its exposure of inequality. While for some working from home has been a welcome luxury, others have found the colonising of their already overcrowded home space by the intrusion of work or school most disruptive (Williamson, Eynon and Potter, 2020). In the South African context it has been argued that rural learners are excluded from education when only online learning is available (Dube, 2020).

3.2 Flexibility of time

The second dimension is time, which may be categorised as full-time, part-time and flexitime (Sheail, 2018). Further dimensions include synchronous to asynchronous, as well as time-on-task: Short and long. The immediacy of synchronous communication allows for the development of a sense of presence (Rehn, Maor and McConney, 2016). Synchronous communication also allows for easier group work which helps build productive social interaction (Walker, 2017). Asynchronous communication gives great flexibility of space and time and also provides learners with time for reflection, which may lead to deeper understanding (Pleines, 2020; Rehn, Maor and McConney, 2016). On the down-side asynchronous communication leads to feelings of isolation that could contribute to a higher attrition rate (Borup, West and Graham, 2013; Asanov et al., 2021). While many universities have had learning management systems in place for quite some time it is synchronous video conferencing that has shown the strongest increase in uptake during the pandemic (Kaqinari et al., 2021).

Gous & Roberts (2015) warn of the impact of technology on instructor time and the potential for academics to be progressively drawn into working longer and longer hours without realising it. This confirms Mike Spector's finding many years ago that while students spent a little more time on online instruction, online instructors spent significantly more time teaching than their face-to-face colleagues (Spector, 2005). Again this resonates with an Ecuadorian study that showed during the pandemic students spent roughly the same amount of time with online learning than they would have in a contact situation (Asanov et al., 2021).

3.3 Service-oriented flexibility

Service-oriented flexibility is associated with inclusivity, accessibility and equity (Veletsianos and Houlden, 2019). The role of the pandemic in exposing social inequity and injustice is well reported (Nicola et al., 2020; El-Mohandes et al., 2020). People with disabilities, as well as those who support them, are particularly vulnerable at this time (Scott and Aquino, 2020). Access to broadband and hardware is one of the most significant concerns in ensuring an equitable service for all (Cesco et al., 2021).

Community engagement has been proposed as a way of addressing inequalities (Aminur Rahman, 2020). group size, was identified as a key variable in creating social presence (Lowenthal and Dunlap, 2020). While group size does not seem to influence individual responses, it has a meaningful impact on interaction. In class-wide groups students receive unequal attention. Some become stars and some are neglected, while smaller groups lead to a sense of community (Wang et al., 2020).

3.4 Technological flexibility

Digital higher education has been seen as both a bridge builder and a divider during the pandemic, with access, learning and collaboration being the strengths, and inequalities at individual, institutional and systemic levels forming the weaknesses (Laufer et al., 2021).

The immediate nature of the pandemic has meant that institutions scrambled to find the first available technology, and thus a plethora of technologies (such as Moodle, Blackboard, Microsoft teams, TV, Zoom, and Google Meet) have emerged without clear guidelines for policy and practice (Basilaia and Kvavadze, 2020). Mobile learning, and WhatsApp in particular, have been suggested as necessities (Naciri et al., 2020; Tarisayi and Munyaradzi, 2021). The diverse range of technologies available makes it necessary train lecturers how to choose and use them (Nguyen and Chung, 2020). The digital maturity of an institution must dictate the educational technology strategy (Kaqinari et al., 2021).

3.5 Flexibility of pedagogy

Despite the debates around the differences that technology can, does, or does not make in delivering learning (Russell, 1999; Clark, 1994; Kozma, 1994), technology has put learners at the centre of their own learning. They can access just about any learning resources at just about any time. The role of the teacher has also changed since the teacher is no longer the main source of information.

Pedagogical flexibility ranges from direct instruction to generative, project-based learning. There is a traditional divide between direct and indirect approaches to learning with some authors claiming them to be mutually exclusive, sometimes in quite explicit terms: "Constructivism is completely incompatible with objectivism" (Duffy and Jonassen, 2013, p.91). Nevertheless The pandemic has resulted in a convergence between traditional direct-instruction based online teaching and problem-based learning (Bumblauskas, 2017). This convergence resonates with Cronjé (2006) who has argued and with Elander, who has demonstrated, that the two can be plotted at right angles to form four quadrants of learning (Elander and Cronjé, 2016). The four quadrants (Figure 2) range from a chaotic quadrant with no overt planning either of constructivist or behaviourist nature, through a quadrant that is highly behaviourist and one that is highly constructivist to a quadrant of integration where an instructor would use both behaviourist and constructivist elements in the same learning event, depending on the learning context. The immersion quadrant is the domain of experiential learning where there is no clear evidence of structured behaviourist learning, nor of scaffolded constructivism. The injection quadrant is for direct instruction of known concepts, and the construction quadrant for project-based learning. The integration quadrant speaks to a design that would use both direct instruction and project-based learning almost simultaneously.

The pandemic resulted in a great deal of "emergency experimentation" (Williamson, Eynon and Potter, 2020), where lecturers experimented with methods that are located in each of the quadrants.

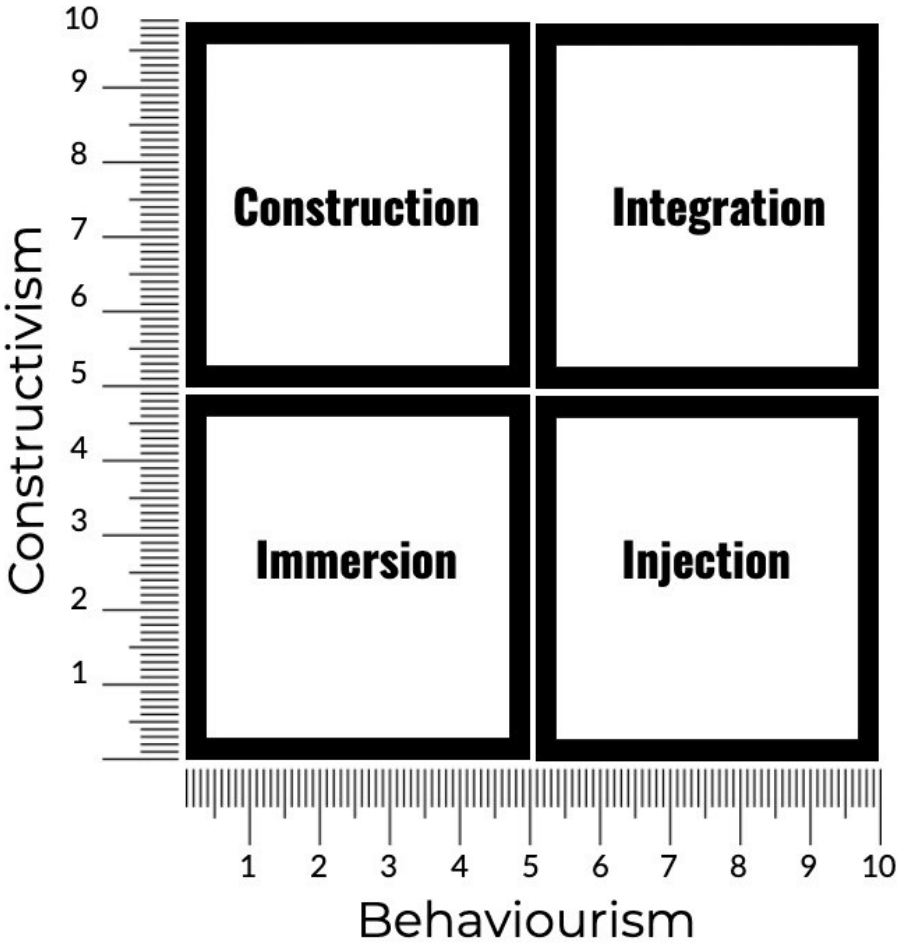

Figure 2: Four Quadrants of Learning

4. Method

The rationale for this reflective case study is to uncover contextual conditions (Yin, 2013) of flexibility (Veletsianos and Houlden, 2019) that may resonate with other stories of higher education institutions (Bonk, 2020) with predominantly vulnerable populations coping with the pandemic (El-Mohandes et al., 2020).

Methodologically, as an educator, I draw on Kolb's experiential learning cycle (Kolb and Kolb, 2017) as I work through my own phases of concrete experience, reflective observation, abstract conceptualization and active experimentation. I also cycle through both reflection in action and reflection on action (Schön, 2017), as I consider our immediate responses to the challenges of the pandemic, as well as the lessons learnt on thinking back on them. I reflecting on communication with students and fellow academics I follow a model of collegial sharing that includes an analysis of the aesthetic, personal, ethical, empirical and reflexive elements experienced (Johns, 1995). The critical reflection is prompted by three questions (Rolfe and Freshwater, 2020), What, so what, and now what?

4.1 Data sources and analysis

The principal source of data is my lived experience, my own recollection of events as they unfolded, backed up by emails, WhatsApp messages, minutes of meetings with my seniors and my staff, lecture notes, Zoom recordings, and online forms that were created to poll staff regarding their progress through the syllabus, and for student feedback on teaching and learning. In this personal reflection, for ethical reasons, I draw only on my reflection on these experiences and do not quote directly from any data source.

In analysing the data I followed a grounded approach where I worked systematically through each of the themes of place, time, service, technology, and pedagogy. For each of the themes I would consider the literature, as well as the reflections that were triggered. I would then look for the most salient resonating factor, be it an email, a discussion, a memory of a discussion at a meeting, etc. From this the reflective piece emerged that forms the discussion part of this article. To ensure trustworthiness, by way of member checking (Birt et al., 2016) the article was circulated to a number of academic and administrative staff and their comments were worked into the final submission.

The next sections will describe the institutional context of the research site, clarify my own position in the research.

4.2 Institutional context

With more than 30 000 students, the institution under discussion is the largest higher education institution in the Western Cape province of South Africa. It is the second largest university of technology in the country. Demographics amount to approximately 68% Black, 25% Coloured, 7% White, and 1% Indian students, of whom 56% are male, and 44% female. The majority of students are the first members of their families to enter higher education (Cape Peninsula University of Technology, 2020). The university had been particularly hard hit during the 2015-2017 #FeesMustFall protests, with serious damage to property and to staff and student morale (Cape Peninsula University of Technology, 2019), but had learnt valuable lessons about business continuity during times of interruption. The university's core values centre around Ubuntu, mutual respect, equity, innovation, accountability and excellence (Cape Peninsula University of Technology, n.d.). University residences can accommodate 38% of the students (Fredericks, 2020), but a week before the national lockdown the University had closed for recess and all students had returned home, many to the neighbouring Eastern Cape province approximately 500 km away.

4.3 My position in the research

This paper draws from my own lived experience as I navigated the pandemic in my roles of a dean, a first-year lecturer and a supervisor of masters' and doctoral students. As a dean it was my duty to lead and to train my staff, during the two weeks of recess, in the basics of technology-based distance education, and then to lead them through the rest of the year. I also had to report to management on a weekly basis on the state of the faculty and participate in strategic planning to save the academic year. As a first-year lecturer I had to look for my students as they were scattered all over the country, allay their fears and introduce them to a new way of learning. As a supervisor, over and above taking care of my own students, I was asked by the Institution to present an online course in proposal writing to about 200 masters' and doctoral students.

I recognise the anecdotal nature of these findings but present them here in the hope that they may resonate with others in the development of flexible technology-supported education.

5. Discussion of findings

The findings will be discussed as they emerged in the dimensions of place, time, service, technology, and pedagogy.

5.1 Place

The institutional experience resonates with the call for hybrid spaces (Eyal and Gil, 2020). During the initial hard lockdown, it was decided that no teaching and learning activities would take place. Instead about two weeks were devoted to staff training in emergency remote teaching, as well as training in using *Linked-In Learning* which had been purchased at the end of the previous academic year. In my faculty we started a series of cascading WhatsApp groups to reach all staff, and to coordinate the training. Teaching staff were instructed to trace all the students they taught using email and WhatsApp and to make a needs analysis in terms of students' ownership of technology and access to bandwidth. The fact that all students were not in one place made it difficult to track and monitor their progress and attendance. Staff found that their homes were not necessarily suited as home office spaces. Some had to get special permission to take their office computers and even office chairs home, as they did not own such items personally.

After the initial hard lockdown was suspended an Institutional directive stated that lecturers who preferred to work from their offices, could do so, but no contact teaching was allowed. Minutes of various meetings show

that, for reasons of social distancing, it was decided that, even when students could return to campus, there would still not be any contact teaching. Students who did not have access to computers for remote learning could come to campus where they had access to socially distanced computer laboratories.

Some staff and students found their homes much more comfortable than their work environment, while others, particularly students from under-resourced communities, found it difficult to study in their sometimes-overcrowded shacks. Many students and staff had trouble incorporating work and home responsibilities – particularly with young children not going to school.

What was also problematic, was the physical distance in kilometres between vulnerable students in deep rural areas and places with good Internet access. From their WhatsApp messages to me I learnt that it could take them hours of walking to get to the closest cell phone reception, or public library or mall with free Wi-Fi.

At the affluent end of the spectrum some students and staff were able to continue uninterrupted and some of my own first-year students used the lockdown to finish all the work for my course so that they could spend that time on other lecturers' work once lockdown was relaxed. These findings underscore the inequalities exposed by the pandemic (Williamson, Eynon and Potter, 2020; Dube, 2020).

Initially inter-provincial travel was banned, so some students had to work from hundreds of kilometres away, while a ban on international travel meant that students who were visiting abroad could be thousands of kilometres away. Emails showed that we had some of our own students marooned in foreign countries, while some foreign students were stuck in South Africa. Ironically the financial situation of both those categories of students had to be carried by my Institution. We had to pay for the extended stay of our student abroad, and we had to forfeit the accommodation costs of the foreign students who could not leave. During the pandemic, therefore, distance could vary from the room next door, to around the world.

A comparison of student grades from 2019 and 2020 showed that the physical distance between students and lecturing staff, or even between students themselves did not have so much of an impact on their performance, supporting the findings of Russel (1999).

5.2 Time

Feedback during meetings with heads of departments indicated that lecturers' first reaction to teaching during the pandemic was to adhere to the current timetable, and teach through Zoom, Collaborate or Microsoft Teams. This resonates with the literature about synchronous video conferencing having the strongest increase in uptake during the pandemic (Kaqinari et al., 2021).

The social imbalance exposed by the pandemic (Nicola et al., 2020; El-Mohandes et al., 2020; Scott and Aquino, 2020; Cesco et al., 2021) became evident quite soon when we found that very few student had good access to technology. Some had to go to friends, public libraries, or shopping malls where free Wi-Fi was provided. Others used their night-time data bundles that were substantially cheaper. Initially lecturing staff would record their synchronous lectures and make them available to students asynchronously immediately thereafter. However, some lecturing staff, who were familiar with the "flipped classroom" took to pre-recording their lectures and then making themselves available for synchronous discussions, usually on WhatsApp, whenever students needed to consult with them.

My own personal experience as a middle manager, as well as a lecturer, resonated with comments from staff during de-briefings meetings that a synchronous Zoom session of 90 minutes was much more taxing than a 90-minute face-to-face class would have been. Lecturers also realized that when they pre-recorded their lectures there was much less repetition and they could edit out errors or irrelevant discussions, and so the actual contact time was reduced.

At a certain stage I presented a five-day writing workshop, which had initially been planned as a contact session. The contact format was an introductory interactive session where each person would present their expectations, then there would be a brief lecture about a certain aspect of academic writing, followed by uninterrupted writing until the close of the day, when participants would first exchange work, read and comment, and then report back on their progress to the larger group. To move it online we formed a WhatsApp group where the initial instruction was given for participants to prepare a short goal statement. We then met on Zoom for participants

to present their statements and discuss. Thereafter, instead of a lecture, they were given a link to a YouTube video of the lecture. Then the uninterrupted time started, with the WhatsApp group being used to share information of common interest throughout the day. Participants also used WhatsApp to share their work in pairs for the discussion, and the closing of the day took part, once again, via Zoom. In this example one sees a blend of synchronous and asynchronous participation. Participants had to attend the Zoom sessions at the times when they were presented but could attend to the WhatsApp or YouTube whenever it suited them. The asynchronous time allowed them to work at their own pace and convenience. The synchronous time allowed for the development of social presence, but also created a sense of urgency and a deadline to prevent procrastination.

In their feedback forms undergraduate students showed a preference for asynchronous attendance and tended to work in the afternoons and late evenings. Mature students and lecturers also preferred asynchronous communication and noted that their time was impacted by family responsibilities. Once again though, in both groups it was found that deadlines had to be set to prevent procrastination.

From discussions with lecturing staff, it became clear that, as was shown in the literature, students did not need or spend more time with online learning (Asanov et al., 2021). In fact, many lecturers, including myself, found that we were able to get through the syllabus much more quickly. However, there was an almost universal consensus with lecturing staff that never had they been obliged to put in so many hours of hard work into re-designing the curriculum and then re-developing all their contact material to online materials, resonating with Spector (2005) and with Gous and Roberts (2015). Although staff recognised the fact that they had produced quite a bit of re-usable digital material, they still felt that the need to provide much more support to students would still impact on their time.

5.3 Service

When asked what support they needed staff put *communication* as a priority, second only to data and internet access (Figure 3). Increased communication was provided by creating cascading WhatsApp groups and regular University and Faculty news bulletins.

Staff were given additional data allowances and both government and the institution provided zero rated Internet access to students.

Figure 3: Staff support needs

With the rapid move online of traditional contact institutions the contact class was simply moved online and thus the class size remained the same. Similarly one-on-one supervision of masters' and doctoral students moved from the office to the screen. However, discussions with lecturing staff showed that, to compensate for the inequalities of access (Cesco et al., 2021), lecturers moved to a "big group – small group" format where they would pre-record or present work to larger groups of students, and then move towards small group or even one-on-one interactions to provide a better service to students who required individualised attention. Most lecturers formed WhatsApp support groups for their whole class, while the students themselves spontaneously formed smaller work groups of three to six, also on WhatsApp. Thus flexibility in group size enabled community

engagement, which harnessed social presence to address inequalities and in that way augment the service that the university was struggling to provide (See Aminur Rahman, 2020; Lowenthal and Dunlap, 2020; Wang et al., 2020).

5.4 Flexible technology

To accommodate both technologically enabled as well as technologically challenged students a wide range of technological solutions were employed simultaneously, resonating with the suggestion that media does not influence learning (Clark, 1994). Early in the lockdown staff were asked what new technologies they had learnt to use. The results are shown in Figure 4. Not surprisingly, the three most used technologies include video conferencing software such as Zoom, Blackboard Collaborate and Microsoft teams, resonating with Kaqinari *et al* (2021).

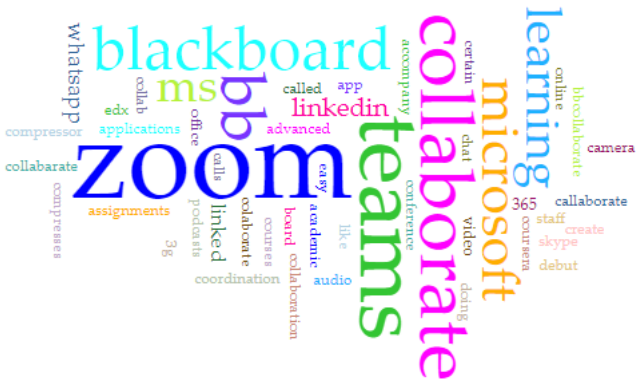

Figure 4: New technologies used by staff

In remote locations with limited internet connectivity printed study packs were couriered to students. Students who had access to technology but not connectivity were send USB drives with pre-loaded materials. Minutes of the emergency command centre meetings showed that, ironically, the distribution of printed packs and USB drives to remote areas was so slow that many students had already returned to campus before the items reached their rural homes.

The university went as far as allowing some students to purchase government subsidized laptop computers on their student accounts. In the spirit of community involvement (Wang et al., 2020) we noticed that some disadvantaged students would WhatsApp their assignments to more privileged students, who would upload it to the LMS on their behalf.

My own experience with my first-year students showed that WhatsApp allowed us to send large amounts of information in video, audio or pdf format to students quite efficiently and they could either download it during cheap hours or go to public areas that had free Wi-Fi to download. For smaller groups, low technology, low bandwidth solutions worked well, but as group sized increased the automation of a learning management system became necessary.

Teaching and learning committee meetings revealed that lecturers realised quite quickly that while many students had limited access to computers and some did not know how to use them, smartphones were almost ubiquitous, and it was easy to supply them to those students without. Lecturers therefore modified their assignments requiring voice notes, photographs, and even video clips instead of written assignments. A mind-set change occurred whereby a smartphone, rather than a tablet or a computer, was seen as the primary technological affordance for teaching and learning, thus supporting the notion that some technologies may be better in certain contexts than others (Kozma, 1994).

A cursory comparison between student results of this year compared to the previous years, moreover, shows very little difference, thus providing at least tentative, support for the *No significant difference phenomenon* (Russell, 1999).

5.5 Flexible pedagogy

When asked what their training needs were, staff requested training in the use of Blackboard, Zoom and Teams, as well as training in online teaching and learning (Figure 5).

Figure 5: Staff training needs

The response of teaching staff to teaching and learning during the pandemic was spread across all four quadrants of Cronjé's (2006) model.

Most instructors simply went the *injection* route, presenting online lectures using various synchronous video platforms, and recording those for use by students who could not attend. We had also purchased a LinkedIn Learning license and trained staff to incorporate it in the Learning Management System. The initial uptake is shown in Figure 6.

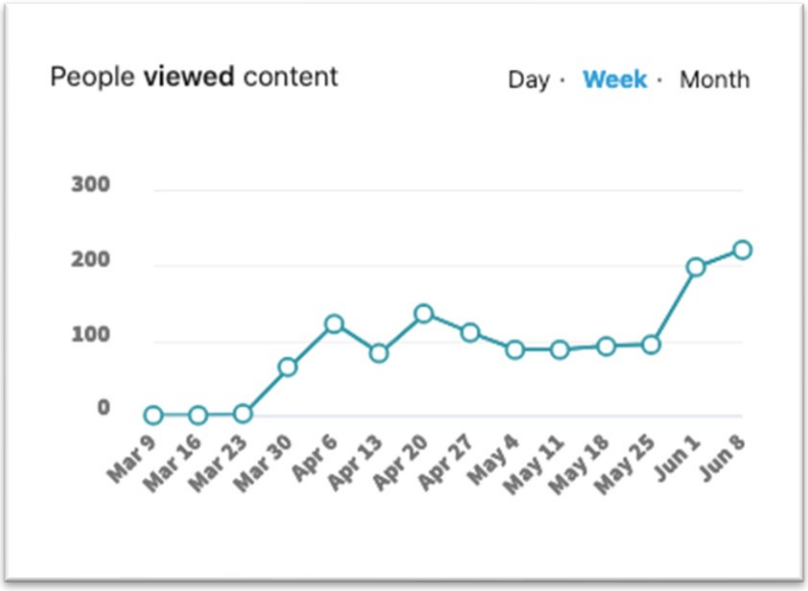

Figure 6: Initial uptake of LinkedIn Learning

In the creative disciplines, however, students were given projects and assignments that align with the *construction* quadrant. The University already supported its work-integrated learning projects via the Learning Management System, which means that there was no change from our side, and students were working in the *immersion* quadrant. Figure 7 shows the LMS uptake in the first semester. The sudden drop in April accounts for recess, and a moratorium placed on online learning until it could be shown that all students had reasonable access, indicating the University's response to addressing social inequalities (See Aminur Rahman, 2020; Lowenthal and Dunlap, 2020; Wang et al., 2020) .

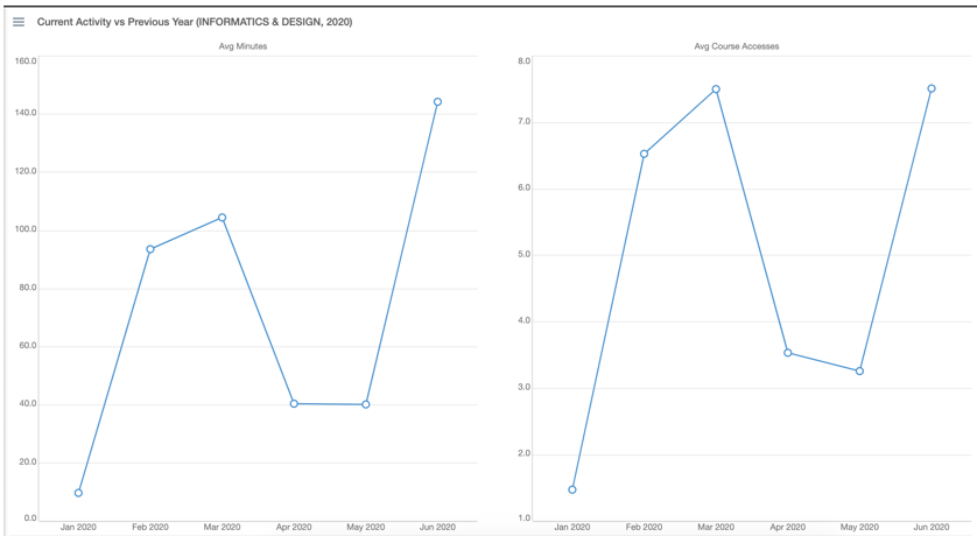

Figure 7: Blackboard Access: First Semester

Work-integrated learning was difficult, during hard lockdown. Employers could not support students working from home. In such cases we developed a "simulated working environment" with lecturing staff pretending to be the employers and assigning simulated work projects to the students. In this way they were combining instruction and construction, effectively working in the *integration* quadrant.

There were, however, teaching staff who took a long-term view and cycled students through the entire four quadrant model. A typical learning event might start in the *injection* quadrant, high in behaviourism, low in constructivism – students may be asked to watch a content-rich video clip, or read a paper, and then to do an online quiz on its content. On that may follow an *immersion* session where students are given a problem to solve based on the information that they had learnt, but with no overt scaffolding or feedback. Once that has been done, they might be asked to discuss their solutions with their peers in smaller groups and, working in the *construction* quadrant, construct a set of heuristics based upon what they had learnt. Finally, there might be a capstone project in which students are given an instruction manual (either printed or on video) as well as an assignment to complete – either individually or in teams, in which all the knowledge and skills are *integrated* and both direct instruction and construction of a final project are required.

A decision framework was developed and presented to the Faculty Board meeting, for lecturing staff to decide on the mode of teaching and learning based on the kind of knowledge outcomes required (See Kurtz and Snowden, 2003).

Knowledge	Methods	Technologies	Platform
Known	Tutorial Drill	Lecture Book/PDF Video PowerPoint	Linked-in Learning Blackboard Collaborate Youtube
Complex	Construction Exploration	Construction kits and tools Spreadsheets	Computer Lab Workshop Studio
Knowable	Puzzle Discussion Debate	Games Discussion tools	WhatsApp Collaborate Kahoot
Chaos	Field trip Work-integrated learning	Blogs Logbooks Assessment tools	Blackboard Linked-in Learning Respondus

Figure 8: Faculty decision framework for multimodal teaching and learning

Figure 8 shows how known knowledge can be presented via tutorials and drill methods through lectures or texts, and that these could be presented in contact, various delivery platforms. Complex knowledge is acquired

through construction and exploration using construction kits (physical, such as jewellery tools, or virtual, such as graphic design software, or programming languages) and delivered via laboratories, workshops, and studios. Knowable information is processed through puzzles, discussion, and debate, facilitated by WhatsApp, Collaborate (or other video conferencing software) and by games such as Kahoot. Chaotic knowledge cannot be taught, since it is the domain of experience, and must instead be recorded and assessed through whatever assessment and record keeping systems are available.

6. Conclusions and recommendations – Five dimensions of blended learning

Where the term "Blended learning" was commonly used to describe systems that "combine face-to-face instruction with computer mediated instruction" (Graham, 2006, p.41), it now becomes clear that there are at least five elements to blend – place, time, size, technology and pedagogy. These elements all need to be considered in making design choices in distance education. The next paragraph shows how each of the elements resonates with the literature.

In terms of *place* the inequalities exposed by the pandemic (Williamson, Eynon and Potter, 2020; Dube, 2020) was addressed by the use of hybrid spaces (Eyal and Gil, 2020). Distance did not impact performance (Russell, 1999). *Time* wise the initial reaction to move the conventional timetable to synchronous video supports the literature about the steep increase in the uptake of video conferencing during the pandemic (Kaqinari et al., 2021). However the social imbalance (Nicola et al., 2020; El-Mohandes et al., 2020; Scott and Aquino, 2020; Cesco et al., 2021) was addressed by moving asynchronous, which in turn led to procrastination becoming a problem. Online learning did not take more student time (Asanov et al., 2021), but did impose much time pressure on lecturing staff (Spector, 2005). *Service* levels had to be increased to compensate for the inequalities of access (Cesco et al., 2021). Using a "big group – small group" approach enabled community engagement through social presence to further address inequalities (Aminur Rahman, 2020; Lowenthal and Dunlap, 2020; Wang et al., 2020). The wide range of *technology* that was used, shows that media does not influence learning (Clark, 1994). WhatsApp groups facilitated community involvement (Wang et al., 2020) which helped address social imbalance. Depending on the context synchronous or asynchronous technologies were preferable, and sometimes high-bandwidth technology such as audio and video was required, while at other times text sufficed, showing that some technologies work better under certain circumstances (Kozma, 1994). The technology used did not affect students' results (Russell, 1999). *Pedagogy* ranged from direct instruction of known knowledge, through construction and exploration of complex knowledge, discussion and debating of knowable information and the acknowledgement of the acquisition of chaotic knowledge through assessment of logs and portfolios, showing that all four paradigms of Cronjé's (2006) model were used in acquiring different sets of knowledge as described by Kurtz and Snowden (2003).

From the conclusions above the following table is recommended as a decision framework to consider when deciding upon elements of a blended learning solution. The table is by no means exhaustive but gives an indication of how such a table could be populated for a given context.

Further research should be conducted to determine the variables to consider within each of the elements in making such decisions.

Table 1: A decision framework for blended learning

Category	Inflexible	Flexible	Implications for blended learning
Place	Formal learning spaces, on campus	Informal, anywhere, hybrid	Moving towards a flexible environment needs closer monitoring of "attendance" Blurring boundary between home and university leads to high complexity
Time	As timetabled	When convenient or possible	Flexibility aligned with social justice Pre-recorded work allows a flexi-time approach, but specific real-time contact allows for greater interaction and reduces procrastination
Service	Fixed: Dictated by student-staff ratio policy	Student:Staff ratio Determined by student's level of competence and type of learning material	Pre-recorded materials and automated delivery and assessment for large groups free up time for individual and small group sessions

Category	Inflexible	Flexible	Implications for blended learning
Technology	Computer laboratory	Mobile devices	Adaptive design is required so that materials can be delivered to any device Some platforms work better for some contexts Media do not influence results
Pedagogy	Direct instruction OR Project-based learning	Serendipitous immersed, integrated	Scaffolded blend of Direct instruction AND project-based learning Selection of pedagogy dependent on context and type of knowledge to be attained

This research has shown that distance learning can occur if the student is in the room next door, or around the globe. Asynchronous learning allows learners to work at their own pace – but is prone to procrastination. Synchronous learning creates urgency to meet deadlines but is hard to schedule. Technology-based online learning need not take longer than contact learning, but allowance might have to be made for increased instructor time. Learning material and learner proficiency can help determine if work can be covered in large groups, or whether individual attention is required. Learning tasks and teaching methods must be adapted to take into consideration the level of technology available to a student and it may be necessary to use more than one platform and more than one design to achieve the same learning outcome for different students. Direct instruction and generative learning tasks can both be facilitated online, and their use need not be mutually exclusive.

Finally, our experience of lecturers' response to the pandemic supports a definition of blended learning that goes beyond a blend of content and technology to include considerations of place, time, size, technology, and pedagogy.

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