The Future of the University in the Age of the Internet : An Australian Perspective

by Lev Lafayette, May 2022

A thesis in partial fulfilment of a Master's of Higher Education at the University of Otago, Aotearoa New Zealand.

Table of Contents

Abstract

One component of the the broad sweep of educational history is the qualitative changes in information and communication technologies, which each new development both building on top of its previous and extending its scope. The development of networked information and communication technologies in contemporary times, "the Internet", potentially provides a new mode of communication whose limiting factors include capacities of the physical systems and the allocation of economic resources. This macrological inquiry, focussing on Australian data, suggests that these foundational matters have been largely overlooked when considering educational technology and as a result four research themes are raised; (i) the identification of the demographic importance and trends of higher education., (ii) the economics of higher education, particularly the notion of cost-disease in service sectors and positive externalities, (iii) the engineering restrictions and licensing restrictions to software applications, and (iv) user-experiences of existing educational software. A prescriptive conclusion raises policy matters concerning the need for more extensive public funding, the adoption of open-source licensing for applications and educational content, and the use of client-server models rather than the trend toward cloud-based software architecture.

Acknowledgements

remain anonymous, this by no means lessens the degree that I am truly thankful for their time and insightful remarks.

List of Tables and Figures

List of Abbreviations

ABS : Australian Bureau of Statistics. An independent statutory authority of the Federal Australian Government responsible for statistical collection and analysis that also conducts the national Census of Population and Housing every five years.

CMC: Computer-mediated communication. The use of computing and information technologies as a medium by which human-to-human communication can occur. The capacity of CMC depends on the financial cost, the processing capability, and effective throughput (bandwidth, latency, signal-to-noise ratio) of the medium.

FOSS : Free and Open Source Software. Software released under a license that allows one to run the software, and view, modify, and distribute the source-code. Part of a continuum that ranges from FOSS to levels of proprietary software and trade secrets.

GDP : Gross Domestic Product. The added market value of all final goods and services produced and recorded within an economy in a given period of time. Can be measured by income, expenditure, or production. It can be differentiated as nominal and real, per capita and purchasing power per capita.

GPGPU : General-Purpose computing on Graphics Processing Units. Graphics Processing Units (GPUs) are a computational devices that perform a range of pleasingly data parallel tasks where a single instruction is applied across many instances of data (SIMD in Flynn's taxonomy). Whilst GPUs were originally designed for the acceleration of graphical processing, the workflow pipeline is also suitable for many general computing tasks.

ICMP : Internet Control Message Protocol. A support protocol used by network devices and diagnostic tools (ping, traceroute) to send error messages and operational information from a host device to one or more requested services.

LMS : Learning management system. Software applications for administration, content management, delivery, and reporting of educational material.

MOOC : Massive Open Online Course. An online course designed for an extremely large number of participants with asynchronous delivery and web-based content delivery. A further distinction is between cMOOCs, that use a connectivist educational methods, and xMOOCs that use a more traditional approach.

NSFNet : National Science Foundation Network. A seires of projects sponsored by the United States National Science Foundation (NSF) from 1985 to 1995 to promote research and education that was responsible for several major computer network backbones and supercomputer centres.

OECD : The Organisation for Economic Co-operation and Development an intergovernmental economic organisation with 38 member countries, founded in 1961. The countries involved profess a commitment to a democratic political structure and a market economy. Most countries have a high GDP per capita and a high Human Development Index. These similarities make OECD countries useful for comparative studies.

R&D : Research and Development or, in Europe, Research and Technological Development (RTD). The development of innovative products and systems based of future-orientated and long-term trajectories. Notable for significant positive externalities.

SARS-CoV-2 : Severe Acute Respiratory Syndrome - Coronavirus2 : A strain of coronavirus that causes COVID-19 (coronavirus disease 2019) and the ongoing COVID-19 pandemic which, at the time of writing (April 28, 2022) there has been 511,379,751 reported cases of COVID-19 and 6,252,953 deaths. The pandemic has been responsible for a rapid and disruptive transition to online learning in the University sector. This thesis was intiated prior to pandemic.

TCP/IP : Transmission Control Protocol/Internet Protocol. Network-layer communications standards that provides error-checking and ordered delivery of packets (TCP) from a source host to a destination based on addresses in packet headers with routing functions (Internet Protocol). The two protocols are widely considered to be the defining technical protocols of the contemporary Internet

XR: eXtended Reality, a combination of real-and-virtual environments with extensive human-machine interactions including immersive computer technology.

1.0 Introduction

1.1 Personal and Academic Interest

This inquiry is exploratory, multidisciplinary, with prescriptive recommendations. It raises multiple research questions, both quantitative and qualitative, related to the future of the university in terms of the he context of economics and user experiences associated with the integration of contemporary information and communications technologies. A significant portion is a "desktop study", evaluating and synthesising existing research from multiple disciplines. It is sociological, looking for future enrolments trends in the tertiary sector. In part it is economical, reviewing the debates over financing, both of the sector, but also the issues of the provision of information as a public good. In part it is legal, assessing the categories of intellectual property. Qualitative interviews from system administrators, online course designers, learners and teachers, seeks to acquire insight to identify problems with existing technologies and administration. Finally, it also combines the competing requirements of andragogy with engineering requirements in the provision of content. In short, the study seeks to answer, through these multiple perspectives, whether the contemporary university could be replaced, at least in part (e.g., through hybrid learning), by the online provision of content via the Internet. The following research questions are examined:

1. What are the projected trends for participation in university education, globalisation, and lifelong learning?
2. What are the cost-diseases and positive externalities associated with higher education?
3. What are the throughput technologies to provide Internet-enabled higher education on an engineering and licensing level?
4. What are the user experiences of application attempts to provide Internet-enabled higher education?

Doubtless there will be some who will give a wry smile and perhaps raise an eyebrow at a master's level thesis that has the temerity to call itself "The Future of the University in the Age of the Internet", a study includes both the migration of university learning online and the use of the Internet in such learning. Surely, it could be argued, that this is a scope too large and with a technology too dynamic to achieve a satisfactory result in just over a score thousand words. One wonders if the same response would be proffered for a historical study of the transformative role of printing press in European universities at the dawn of the modern age, or even the importance of written records in the scholarship of axial age, for these are equivalent inquiries. Narrowly-focussed studies certainly have their place of course, and are extremely useful in the immediacy. It is hoped, however, that there is still space in academia for those who prefer to paint with broad brush-strokes on a large canvas and have the intellectual courage if their pre-existing knowledges are commensurate.

This is particularly relevant when other bodies are engaging in a similar survey. In particular, EY (formally Ernest & Young) have recently released a report, *The Peak of Higher Education* [1], that argues that independent higher education is a thing of the past, and that the sector should be replaced by training and research services that are orientated towards satisfying the needs of private corporations with on-the-job learning and micro-credentials. This is framed in a technological argument that the traditional means of content and delivery in university sector will be largely replaced by online learning, resulting in a widespread of institutions to fund their programmes unless they adopt "commercialised research" to fund university operations. The fact that the

scenario report was written with interviews from 32 university Vice-Chancellors from Australia and New Zealand is indication enough of the seriousness of the issue, even if the report engages in no substantive analysis. The political and positional weight of merely raising the speculations is sufficient.

At least partially due to serendipitous choices, I find myself with what seems to be some appropriate prior background in the chosen subject. An honours degree at Murdoch University in Western Australia emphasised a wide multi-disciplinary and interdisciplinary approach, as part of the University's original Educational Objectives [2]. Majoring in politics, philosophy, and sociology, courses were also taken in education, computer science, and economics, all of which are critical to this inquiry. It was also during this time I became involved in student politics, and in particular education policy both in terms of national policy, and policies within the university itself. I found myself elected ast the Education Vice-President of the Student Guild three times in succession, and was subsequently employed as a staff member as the Education Research Officer, advising the Guild on education policy matters.

After moving to Melbourne, I was employed for a number of years as an Electoral Officer for various members of Victorian parliament. Whilst initially this was in the usual political roles of constituent assistance and advocacy, I was transferred to an state-wide role for managing the electoral roll database for various MPs and their staff and. It was from this position that I experienced a career change, volunteering to take up a role as the ICT advisor for the Ministry of Foreign Affairs and Cooperation for Timor-Leste, which again included a significant portion of staff training, along with the publication of the manual, "Neon-komputador" by the United Nations Development Programme.

Returning to Australia, I took up a systems administration position with the high performance computing team at the Victorian Partnership for Advanced Computing (VPAC) for eight years and then the University of Melbourne for seven years and continuing. These roles included training and workshops for over six thousand graduates and researchers from some twenty universities, government research agencies, and national centres, along with four years as a member of the steering committee for the international HPC Certification Forum. In During this time I also completed an MBA (Technology Management), an MSc (Information Systems), and graduate certificates in both project management and adult and tertiary education, all before taking up this thesis. It perhaps should be noted at this point that this trend towards engineering and systems reasoning in part contributes to some strong opinions concerning the recommended use of the American Psychological Association (APA) referencing system and a personal preference for the Institute of Electrical and Electronics Engineers (IEEE) referencing system. With a considered opinion, the APA is extremely inefficient, encourages bias and discrimination, and incoherently mixes authors and publication dates, and as a result it is not used here.

There is a strong personal interest in the aforementioned topics, motivated by trying to determine the more optimal public policy choices for higher education that incorporates contemporary information and communication technologies and their trends. Yet this interest is not academic fancy, or sublimated epistemophilia [3], but rather it is deeply embedded in personal experience, the most visceral source of evidence. This personal introduction also exists to make motivations and biases explicit, and to indicate prior experience in the subject. It is hoped that this combination of experiences provides sufficient background for exploring the research questions of this inquiry.

1.2 Social Theory, Education, and Technology

The relationship between education and technology in the sense of its relationship to social formations suggests a model derived from critical social theory that combines both the differentiation between social systems and cultural life worlds and their unity as the equilibrium state in structural-functionalism. It is also possible to contextualise these in socio-historical structures and in terms of individual development. In the former, broad social formations (primitive, traditional and modern) correlated with the medium of communication (speech, writing, print), means of production (gathering, agriculture, industry), institutional form (kinship, the state, the corporation), systematic differentiation (kinship, political rank, economic class), mode of consciousness (mythic, religious, secular), and crisis (nature, political, economic). The following table provides a summary of these components that are dominant, and often novel, for each social formation.

Table I: Social Structures

Social formation	Medium of Communication	Means of Production	Dominant Institution	Social Differentiation	Mode of Consciousness	Crisis Trajectories
Primitive	Natural	Gatherer-Hunter	Kinship	Sex/Age	Mythic	Natural
Traditional	Writing	Agricultural	State	Rank	Religious	Political
Modern	Print	Industrial	Business	Class	Secular	Economic

This representation is very similar to that provided by Habermas [4]. A novel contribution to such a table is the addition of the "means of communication" of which Innis [5] is an important precursor, describing a means of communication in terms of its physical characteristics and phenomenological experiences and how this acts as telic inclination to the information hermeneutics of cultural lifeworld which is, of course, represented in the content and delivery of the education system. In many ways this is an elaboration and softening of the perceived technological determinism once expressed by Marx ("The hand-mill gives you society with the feudal lord; the steam-mill society with the industrial capitalist") [6] but applied to information and communication technologies. Instead of a conflict being a locus expressed between the physical means and social relations of production, it is instead expressed through the medium of communication and the mode of consciousness in a dialogical manner; it is the speech of the tribal elder with a mythic worldview that is part of the primitive social formation, it is the writings of the monks with their religious worldview that is part of the traditional social formation, and so forth.

One issue that has generated debate in social theory for a number of decades, even centuries, is identifying the causal relationship between changes in the components and the development from one social formation to the next. In classic sociology this can be identified by the perspectives of Marx, Weber, and Durkheim. Whereas Marx argued that the class struggle, the social relations, were in conflict within a social formation the revolutionary change would occur as the means of production offered the possibility of new relations. Weber and Durkheim, in contrast, whereas more influenced by the role of the mode of consciousness and the development of increasing rationalisation of society and organic relations, the moral development of collective consciousness, and disenchantment in cultural world-views, with particular religious world-orientations being more prone to social transformation [7][8].

Regrettably, it is not possible to elaborate the question of whether the Internet represents a new medium of communication for a new social formation, although an attempt has been made elsewhere [9]. Certainly however, it can be noted here that new social formations seem to begin with the development of new medium of technologies in an environment where reflexive learning can take place, and with increasing differentiation between world relations and validity claims. Education, on one hand, can be provided in a manner where system integration occurs with compliance with established constative, normative, or aesthetic values. However, to integrate the informational experience of the cultural lifeworld (which has epistemological priority), reflexive learning is also required across those same dimensions to ensure a dynamic and critical approach to social knowledge which is, on the one hand, requisite for growth and adaptability, but on the other hand, disruptive to established customs and institutions.

Some well-known historical examples can serve to illustrate some points on the relationship between the medium of communication, the mode of consciousness, and social dynamism, and how this relates to education. The first is the matter of the Druids, and their prohibition on writing on their religious matters [10], with élite status apparently determined by recollection of secretive oral content. The result of this prohibition is that what written records we do have is are from Roman and Greek sources and reconstructions from archaeology. As another missed opportunity, Korea's Hunminjeongeum alphabetic script, invented in the mid-15th CE, suffered opposition from the literary élite and as such was not adopted in official documents until the final years of the 19th CE, although it was used in popular works beforehand [11]. In contrast, the development of movable type print with an alphabetic script in Europe witnessed a rapid expansion in number and content to the medieval university system. In the following one hundred years after Gutenberg's famous invention and synthesis of existing technologies, there were more books published in Europe than in all prior history, the Protestant reformation was successfully initiated (in stark contrast to prior protestant heresies), in what would become a succession of bloody "Religious Wars" [12]; the Modern Age was born.

1.3 Aims, Limitations, and Justifications

Whilst it would be fascinating to engage in a grand and sweeping review of the history of the medium of communication in history and all the great changes and conflicts that have resulted from such inventions and discoveries, this particular inquiry is somewhat more focussed on contemporary issues; the past is what we learn from, the future what we prepare for, and the present is where we live. This in itself provides the opportunity for an immediate justification for the inquiry; that the changes currently experienced in information and communication technologies are qualitatively different to those of previous generations in modernity and have increased at a quantitatively greater rate. Whilst various technological tools have been developed for the application of higher education in this new environment, placing these in the context of the economics of higher education is not something that has been subject to detailed exploration. The question of whether the contemporary university can be replaced or changed, with the provision of online content and learning, raises questions relating to the political-economy of knowledge and information goods, as well as those relating to educational theory for advanced learners.

The narrower selection of the higher education sector rather than education as a whole is quite deliberate, based on a central intuition that technologically-mediated andragogical-heutagogical education has its own particular challenges and advantages that are sufficiently different to warrant specific attention to address the particular characteristics [13] of advanced adult learners (e.g., voluntary attendance, social equality, immediate application of knowledge), as well as general

techniques (e.g., structured content). Similar studies for those learners more on the pedagogical end of the continuum may be carried out by those more familiar with the specific techniques better orientated towards such an audience, whilst drawing upon the more general principles examined here. A further restriction is the examination to university education, rather than higher education in general. Whilst the boundaries between university education and polytechnical colleges has largely being been broken down, partially because of the necessity of combining theoretical knowledges with applied skills [14], the focus on this inquiry is more towards information goods and thus the theoretical knowledges. Further studies could apply similar principles to applied skills. Finally, this study refers to a particular technological mediation of online content, that of the Internet, specifically any computer network that uses the TCP/IP suite and is connected to other systems that use the same suite within the global domain name service. Whilst much of the content that follows could apply to more restricted networks (e.g., content stored on a university local area network with a non-Internet protocol suite) the Internet represents the most advanced and most global communications online network.

There are specific limitations in the datasets and historical resources used in this study as well. In a broad sense, these will be limited to OECD countries, and for Australia in particular. The limitation to OECD countries is a function of the general availability of the Internet connectivity to the population, but also with more specific engineering calculations based on the availability of bandwidth. The limitation to Australian data is primarily a function of the ready availability of data and time allocated to the inquiry. Whilst specific relevant policies relating to university funding and delivery and information goods vary significantly [15] among different jurisdictions, it is expected that the principles elaborated here will be relevant for general application and with comparison to those variations. This in itself provides a strong justification for the inquiry; to determine whether there are aggregate social welfare gains through the application of prescriptive policies in particular information goods and technologies for the university sector. To ensure proper empirical grounding in the claims the inquiry will make use of core statistical tools including forecasting.

As mentioned, this inquiry does not review or make recommendations for primary and secondary educational levels, applied skills, or for non-OECD countries, although it is expected that elaborations to such areas could readily be made. The potential scope from the inquiry could also be applied outside of education for information goods in general, including entertainment goods or transparency in institutionally-restricted knowledge. Whilst this is well beyond the scope of this inquiry, both in terms of scale and disciplinary boundaries, the possibility of further research to determine what welfare gains could be derived from such an "open society". This involves a return to a philosophical inquiry [16] on the coherence of whether the linguistic mediation of decentered consciousness and the formation of shared symbolic values under the conditions of discourse ethics provides the foundation for knowledge across constative, normative, and expressive validity claims.

1.4 Dissertation Outline

This inquiry consists of five short chapters, of which this Introduction is the first. The Introduction initially states the research question and outlines personal interests to provide the reader the relevant experience and motivations of the author, as well as to highlight any potential biases, explicitly stated or otherwise. This is followed by a broad statement of social theory and in particular the relationship between social formations, mediums of communication, and the role of consciousness, all of which provide for consideration of the application of information and communication technologies to education in a general sense. The third section returns to the focus of the inquiry and, whilst reiterating the research questions, specifically notes the limitations of the study and

whether or not the inquiry could be elaborated in future studies to cover a wider scope of educational settings, but also the general social application outside the context of education itself.

The second chapter provides a review of relevant existing theoretical literature, which can be considered across three broad subjects. The first is the literature related to the use of information and communication technologies in a university setting, with a particular focus on the development and application of the Internet in such a context, noting especially the diversity of networks prior to the dominance of those networks running on the TCP/IP suite. The second section concentrates on the economic theories related to information goods, both from a micoeconomic perspective and a macroeconomic perspective, but also informed by institutional economics to account for the political realities as an explanation of variance from optimal policy to actual policy. A third section reviews the literature of existing studies in online university teaching, especially with phenomenological and hermeneutic perspectives, but also actively seeking those economic considerations that would form an intersection between the previous two sections.

Having provided an introduction to the research questions and existing theoretical literature related to the broad thematic considerations, the third chapter begins the investigative side of the inquiry in earnest with consideration of methodology and methods. As the two are frequently conflated, an initial section provides for a differentiation between the two and especially the practical effects of making such a distinction. From establishing a methodological foundation, in this case formal pragmatics, selective methods can be drawn to evaluate validity claims that are raised in the course of the investigation. Validity claims are evaluated either from the facticity of propositions or their normative value, with aesthetic claims screened out. The scope of claims for assessment is as established under section 1.3, primarily orientated with Australia but with selections with the broader OECD. Whilst quantitative selections are drawn from relevant public sources and journals, qualitative evaluation of various online learning and teaching environments will be derived from a small selection of deeply-engaged participants.

The fourth chapter reviews quantitative findings and qualitative discussion. The quantitative findings will evaluate and are orientated around the contemporary political and economic challenges and technological requirements. These are structured initially in terms of breadth of scope, starting from those aspects that are a result of late modernity itself, i.e., globalisation, the need for lifelong learning, then to those that arise from economic frameworks in general (cost-disease of the service sector, externalities from trades), and finally particular political economies (intellectual property), before engaging in a necessary excursus on the computer and network engineering requirements for various implementations of online learning. In contrast qualitative discussions are orientated toward the actual application of higher education distance learning as case studies. Whilst desk-based research can provide a wealth of empirical and factual data, it cannot provide experiential assessment of the actual learning experience, of qualia. Rather than seeking a large scale survey, this inquiry is oriented towards a small survey of individuals with significant experience and consideration of online learning through different settings, primarily distal, but also with the special (and previously unexpected) temporal setting of online learning and teaching during the SARS-CoV-2 pandemic.

The final chapter provides a qualified answer to the research question, bringing together the theory of the literary review, with the research evidence, and the qualitative experiences. As with the outline of the quantitative and qualitative research, this evaluation occurs first across the matters of contemporary trajectories and political economy, before resolving the question in terms of engineering requirements and content delivery. The recommendations provided are necessarily prescriptive and some require some fairly fundamental changes to existing property rights, let alone

those changes needed in the university, both in an institutional sense and in culture. As a result, the very last section of the inquiry looks at the question of leadership both within the university, and for the university sector, assigning probabilities and results in particular actions are taken or not undertaken.

1.5 References

[1] Richard Cawood, The peak of higher education - a new world for the university of the future, EY, 2021

[2] Geoffrey Bolton. It had better be a good one : the first ten years of Murdoch University, Murdoch University, 1985

[3] Zoe Sofoulis (Zoe Sofia), Whose second self?: Gender and (ir) rationality in computer culture. Deakin University, 1993.

[4] Jurgen Habermas, Legitimation Crisis, Beacon 1975 FP 1973

[5] Harold Innis, The Bias of Communication, University of Toronto Press, 1964 [FP 1951]

[6] Karl Marx, The Poverty of Philosophy, Progress Publishers, 1955 [FP 1847]

[7] Max Weber, The Protestant Ethic and the Spirit of Capitalism, Unwin Hyman, 1930 [FP 1905]

[8] Émile Durkheim, The Division of Labour in Society, Free Press 1997 [FP 1893]

[9] Lev Lafayette, A Social Theory of the Internet, Doctoral Dissertation, University of Melbourne (inc., unpub), 2002

[10] Nora Chadwick, The Druids, Cardiff University, 1966

[11] Young-Key Kim-Renaud. The Korean Alphabet: Its History and Structure. University of Hawaii Press, 1997

[12] Elizabeth L. Eisenstein, The Printing Press as an Agent of Change, Cambridge University Press, 1980

[13] Malcolm S. Knowles, Elwood F. Holton III, Richard A. Swanson, Petra A. Robinson, The adult learner: The definitive classic in adult education and human resource development (9th Edition), Gulf Publishing Company, 2020

[14] John Pratt, The Polytechnic Experiment 1965-1992, Society for Research into Higher Education and Open University Press, 1997

[15] Enquiries Into Intellectual Property's Economic Impact, OECD, 2015

[16] Karl-Otto Apel (trans. Glyn Adey, David Frisby), Towards a Transformation of Philosophy, Routledge and Kegal Paul, 1980 [FP 1972, 1973]

2. Literature Review

2.1 An Overview

A literature review provides the most significant and relevant theoretical inquiries into a chosen topic, along with important contributions of prior evidence. The selection of material is specifically chosen to address the research questions of the inquiry. As this inquiry is derived from multiple disciplines, specifically advanced education, public economics, computer engineering, and intellectual property law, it is probable that the choices may seem incongruous. However, as divergent as they may seem at first glance, they are necessary to provide a fully grounded approach to the research question. This literature review thus initially covers the history of information and communications technology in the university setting, starting from the early modern period to contemporary experiences, especially in the light of the SARS-CoV-2 pandemic of 2020 and continuing. This is followed by a review of some of the core theoretical texts in economics relevant to this study, particularly the role of externalities in resource allocation and the prospects and limitations of public economics. A third subsection discusses the theoretical and existing findings of "the online university", that is, a focus on Internet-enabled distance education for the higher education sector.

The first section initially reviews the four- volume book-series, "A History of the University in Europe" [1], that covers the late medieval universities (c1200 to 1500), early modernity (1500 to 1800), the nineteenth and early twentieth centuries (1800-1945), and the latter half of the twentieth century (1945 to c2010). Whilst it is possible to initially raise concerns of a potential Eurocentric focus, the series editor makes a strong starting case that the University is not just a European institution, but "the European institution *par excellence*" [2], due to its degree of institutional and research autonomy that has served for a global modal. Concerns that the volumes do not address the critical issues in information and communication technology, require reviewing journal articles that do [3]. In addition to focussing on the technological innovations included in these volumes, a most contemporary addition to the literature review of the first section is "What Teacher Educators Should Have Learned From 2020" [4], along with systematic literature reviews of the experience [5, 6].

For the second section, studies in externalties are initially drawn from Henry Sidgwick for articulation in the 19th century and Arthur C. Pigou for formalisation in the first decades of the 20th century [7]. Another very important contribution and summary of these insights can be found in "Externality and Institutions" [8], a somewhat overlooked text that also draws upon institutional economics, that is, economics as if institutions actually mattered, which also includes theoretical developments in this field since Pigou's forulation. This is supplemented with a perspective on regional economics and the knowledge economy, "Knowledge Externalities, Innovation Clusters and Regional Development" [9], but also the theory of public goods as first elaborated by Samuelson [10], and especially as it relates to rent-seeking activity.

Finally, the third section discusses the cultural perspectives in online learning, initially reviewing the theory of the pedagogy-andragogy continuum [11] to provide a theoretical foundation on the cognitive level for online university learning. The next component includes selected essays in "Culture and Online Learning: Global Perspectives and Research" [12] providing for excellent scope and anthropological insight. The combination of these two approaches notes cultural biases in online delivery content and instructional tools and delivery and narrows the scope of the inquiry to the stated objectives. The chapter concludes with an critical evaluation of the three collections of

reviewed texts with a view of bringing together a synthesis that combines technology, economics, and culture for the possibility of the online university.

2.2 Technology and the University

It is implausible to engage in a thorough review the massive expanse of the comprehensive four-volume "A History of the University in Europe", and nor is it appropriate to do so. It would be too fascinating to examine in detail the development of disciplinary boundaries, the competing relations between church, state, and scholars, the teaching profession, the administrative norms, & etc., all of which are included in the collection. Instead, the narrower scope of this inquiry demands a focus on the technological changes in the university, in an attempt to derive some insight to the probable opportunities and threats from the contemporary technological changes. Despite this, it will be unsurprising to discover that the series is also referenced in other places in this study, especially in reference to governance and funding.

Correlating with the structural proposal in Table I of this study, it is extraordinary that a publication with such scope has very little to say in relation to technological change. As a contribution to a literature review however, this serves as an illustration of the need to provide a social theory approach to the influence of information and communications technology to the university system. There are broad references to the introduction of the printing press with movable type and an alphabetic script, describing it as a "historical turning points", with massive, revolutionary, changes in cosmology, in geography (e.g. the New World), in law, in humanism, in theology (e.g., the Protestant Reformation), and with an explosion in the number of books and the number of universities. "More recently, it has been argued that a key role was played in the Scientific Revolution by the coming of the Gutenberg era." [13] This has been explored more thoroughly by Moodie [14], providing the empirical evidence and coherent connections to how the Gutenberg press caused the displacement of Latin with vernacular languages, the expansion of libraries, an stronger emphasis on the written word in teaching and examinations, but also noting that the printed word did not change the role of educators as had been previously proposed: "Printing made learning resources more accessible, but did not thereby change its method."

Moodie also ties the development of the Gutenberg press with comparison to popular education pieces to the rise of online systems in the University sector. This is a very logical elaboration, and especially helpful as a contribution in the context of this inquiry. Whilst this is framed as both introductory comments and as concluding remarks for the further inquiries, Moodie does note that, at the time of publication, the new technologies were providing greater accessibility and overcoming many of the delays of various forms of distance education, appropriate andragogical changes had not been implemented. Even this contribution, however, is far in advance in what is provided by "A History of the University in Europe". For all its importance, the Internet is accorded approximately a page of text, despite being described as having "an impact on the entire fabric of university life of unprecedented magnitude" [15]. It is certainly curious when one considers that the researchers would have used, at the very least, electronic library record systems in the production of the study and email to ensure correspondence between contributing authors. Quite clearly, "A History of the University" is missing sufficient input from "A History of the Internet".

Perhaps this is unsurprising; science and other rational disciplines is typically given intellectual priority over the more visceral and empirical concerns such as technology, reflected even in the separation in tertiary education between the theoretical orientation of universities and the practical orientation of polytechnic institutes, in pithy definitions such as "technology is applied science".

13

But, as a phenomenological investigation of technology illustrates [16], it is technology that uncovers what is hidden, it extends our senses, our reach, our ability to record thoughts, to transmit them to others, to engage in discussion and debate over space and time. As epistemology depends on ontology, rationality depends on the empirical. There is no deductive logic that is not based on either an abstraction of inductive evidence or following inductive conditional branching. In reality, science is elaborated from, depends on, and is mediated technology. The lack of understanding of how technology shapes experience is very prevalent as literature surveys on technology-enhanced learning in higher education point out [17]; technological enhanced learning tends to replicates existing teaching practise, fewer supplement existing teaching practise, and fewer still utilise the technology in a transformative manner.

The final text reviewed here is selected essays from "What Teacher Educators Should Have Learned From 2020", along with other literature reviews. As the title indicates many of the contributions are specifically for pre-university education, which is out-of-scope for this inquiry. Nevertheless, there are several special insights that are particular for any study of Internet learning and teaching. The first several essays, for example, are dedicated to social and emotional learning for teacher education, making the important insight that in the process of online learning quite often it is the teachers more than the learners that require additional support as the producers of content using a medium, often in real-time, that with which they are not familiar with. Another third of the book provides for online education and learning for teacher education, raising the issue of teacher presence in an asynchronous environment and transactional limitations. The third section, however, discusses eXtended Reality (XR) for teacher education, bringing in new tools such as mixed reality simulations, new online tools, and digital field trips. Unfortunately, and surprisingly, given the publishers, the essays do not develop the experiences beyond advocacy and cultural anthropology. Whilst the requirement for professional training for educators, new support approaches for teachers, and new means for engagement for learners are all requisite, they do not position these questions in manner that is systemic and integrated to the wider technological trajectories. The critical issue that needs to be explored is to what degree is the SARS-CoV-2 pandemic of 2020, "the new normal" for education.

The two literature reviews of the impact of the SARS-CoV-19 pandemic on higher education ("Analytical study on the impact of technology in higher education during the age of COVID-19", and European Commission's "The Impact of COVID-19 on Higher Education: A Review of Emerging Evidence"). It is, of course, very interesting to this inquiry that the pandemic occured after the study was initiated. The pandemic, of course, forced universities to rapidly move to online provision which in many cases was already taking place in a more incremental manner. University operations experiences campus closures with emergency management decisions and challenges to operations. In general, the widespread studies both note how ill-prepared the university sector was for such changes and quite notably the a socio-economic differences in academic and research performance, with the potential of a widening and persistent social gap. Mitigation of this system shock requires substantial motivational and morale support for students, the provision of better quality e-learning tools, investment in teacher training, a great emphasis on real-world problems (which, of course, have a fairly visceral association given the circumstances), and infrastructure development to assist equity issues.

2.3 Public Economics and the University Sector

Throughout most of the world, university education is substantially funded through public authorities. Given this, it is important to provide a critical and theoretical review of public fundsing,

especially in terms of economic efficiency, distribution, and policy. This involves the main issues of public economics, especially matters of externalities, globalisation, and public goods. Public economics itself is a challenging discipline due to its monopoly position (except in cases in civil war, there is only one government in a geographical region). Despite this, economies have a clear long-run upward path in public spending as a proportion of GDP, even if this has stabilised in recent decades, with expenditure on core (physical) and complementary (social) infrastructure, and equity concerns (transfer payments). Given all this it must be demonstrated that the public sector has the ability to improve on what a minimally-regulated economy can achieve. Typically, this means looking at matters of market inefficiencies and failure, and their solution through public goods, and accounting for externalities. It is opportune to explore each of these in turn in reference to the university, and in particular keeping in mind the how the application of Internet-enabled university education effects provision of a public good, the generation of beneficial externalities, and spatio-temporal reach. The outputs of university research could be applied as a public good (e.g., accessible research results, online journal articles) in an open environment and the inputs (e.g., free online course content) as a cost-reduction as a non-damaged good.

In economics, an externality is as cost ("negative externality") or benefit ("positive externality") that third parties receive that are not involved in a discrete transaction. A classic example of a negative externality is pollution that occurs through industrial processes. A positive externality is education, as there are additional social benefits from an educated population that are over and above the direct benefit to the recipient. The concept of externalities in economics was first formally developed by economist Pigou in the 1920s [18]. Pigou's approach suggested taxed for "incidental uncharged disservices" (i.e., negative externalities) and subsidies for "incidental uncharged services" (i.e., positive externalities), although the problem of such a calculation was recognised. Since Pigou, critical contributions have been made by Coase and Arrow, criticising the ability to of government to make rational decisions with regard to externalities.

These historical and theoretical contributions are reviewed by Papandreou, especially the calculation problem, the ubiquity of externalities, the complexity (can be positive and negative at the same time), and that they can be pecuniary or technological depending on the response of the third-party. Papandreou argues that economic consideration should be drawn to the matters of interdependence of institutions, who ultimately will be the major and most powerful bodies that will be argue relative benefit or cost from real or perceived externalities. Papandreou is quite critical of suggestions that institutions with property rights will produce optimal or efficient outcomes, let aloneg satisfy normative claims to distributive justice. There is a special criticism levelled at arguments for "wealth maximization" presented with such institutional relations, precisely on the grounds of civil liberty and distributive justice. Despite the expansive understanding of externalities and their novel application to institutional behaviour, Papandreou does not sufficiently apply econometric models that, by regression analysis, do provide for a better understanding of internal and external costs and benefits of transactions, and thus determine to what degree public funding should be applied. Whilst these empirical findings are explored in chapter four, they are flagged here as the core requirement from this initial exploration.

Further, it is not just institutions and transactions costs that should be considered when considering the economic benefits of positive externalities, but also their geographical effects that comes with theoretical and empirical considerations edited by Suriñach, Moreno and Vayá [19]. Specifically, the series of essays considers the concept of regional innovation systems and agglomeration economies from knowledge "spillover" effects both from a theoretical and empirical point of view, along with how technological innovation and education act as determinants for regional economic growth. The concept of knowledge "spillovers" is used to explain a number of major economic phenomena,

15

including the geographical clustering of inventions and patents; the social returns to R&D that significantly exceed private returns; and the sizeable disproportions that exist between firms in terms of their R&D inputs and outputs, with small firms being responsible for far more product innovations than large firms relative to their measurable knowledge resources. This specifically geographic approach competes against rather naive and idealistic approaches to economic globalisation from the university sector, which Altbach's research [20] with a world-systems perspective highlights the major issues, namely high levels of inequality on a global scale (finances, technology, resources etc), representing a new neo-colonialism of knowledge production, a flow of talent from the "South" to the "North", the development of multinational institutions, and Anglophone dominance.

In part, these neo-colonial effects come from the use of rent-seeking in the university and the knowledge economy. By this, what is meant is activities that seek to derive an income without adding to wealth. The classic model, of land-rents, was recognised by Adam Smith but most fully elaborated by David Ricardo. In the knowledge economy, rent-seeking is achieved by various impositions of intellectual property claims that produce damaged goods, although the matter is complexified by Schumpeterian rents, that recognise that some economic rents, such as innovations, do occur from actions that do create new wealth [21]. A particular challenge in the knowledge economy for the concept of Schumpeterian rents is the presence of institutional power that seeks to enforce and extend their monopoly profits. An alternative is to turn such products into "public goods", as elaborated by Samuelson drawing upon prior literature. Given that a public good, such as university-level knowledge, has significant positive externalities (in the way that individual consumable knowledge does not) an economic argument can be put to provide such knowledge in an open manner (like public libraries etc). Such an argument is made by Verschraegen and Schiltz [22], who argue for open access to knowledge for economic advantages and especially for global equity reasons. The authors note that collaboration between non-state actors has been very successful in providing knowledge as a public good, although political, technological, and skill barriers remain. It is perhaps notable that the authors, despite their own university qualifications, their extensive use of university references, and their university publication, have neglected consideration of the role that the university could play in the provision of open access public goods.

2.4 Education Theories for the Online University

A consideration of the theory of andragogy is necessary for any study of teaching at a university level. With significant development and popularisation by Knowles [23], the fundamental principle is that adult education should be distinguished from child education and that this differentiation can be considered as a continuum, although consideration of development psychology both in cognitive (Piaget) and moral development (Kohlberg) should also consider this a staged development. Over the decades, as the theory developed, several core characteristics at the adult-learner of the continuum became evident [23]. Firstly, participation in education by adults is increasingly voluntaristic and based on a need to know rather than a statutory requirement. This also means that the adult learner is seeking an education for content that has immediate relevance, whether it is for work or employment reasons (which also has implications for lifelong learning), whereas the child-learner is often subjected to content provided didactically and with a fixed curriculum that they do not have an immediate use for. With child-education, the teacher evaluates the degree of learning that has been achieved whilst in adult-education, formative and substantive assessment aside, it is more likely to be the learner that evaluates what they have learned from the experience. As a contribution to design, the focus of the adult-learner is only particular problems that they have consideration for, rather than the content that is assigned to them.

Further, the adult-learner has a wealth of prior experience, both successes and failures, to draw upon, which the child-learner does not. There is greater social equality in adult education as well; the adult learner usually has the same rights in accord to the age of majority compared to the child learner, which also implies adult responsibilities for their participation and engagement in the subject. This links with the source of their motivation for participation, with the adult-learner more prone to intrinsic motivators, such as self-actualisation and self-efficacy, rather than extrinsic. All these features do vary individually and contextually, and certainly there are challenges in the context of different cultural and legal norms. However, the principles are largely applicable in advanced liberal and democratic adult education systems. Importantly, for the concern of online education, the theory of andragogy implies that instructional design should also vary on the level of education being offered and should also imply a difference of engagement by the learner in the provision of online and Internet education and again, this can be represented a continuum where content and delivery can be partially provided via an online medium and partially by traditional delivery, such as "blended learning". Of course, any reference to "traditional delivery" must account for the range of distance education and the range mediating technologies over the decades centuries, of which Internet technologies are the latest medium.

Moore's theory of transactional distance [24], first developed in the 1970s and as an ongoing research project, is perhaps the most important contribution in comparing traditional classroom-based education to that of distance learning. With recognition that distance learning is a highly technologically-mediated form of education, the theory building on prior approaches that sought distinguishing characteristics for this mode of learning, such as the physical distance with non-contiguous communication, the one-to-one experience of teaching delivery, and the physical learning environment; these characteristics also suggest a typically higher degree of autonomy and independence upon the learners. Moore argues that the theory of transactional distance exists in all educational relationships, determined by the dialogue and interaction between learner and educator, and the structure of course content, and learner autonomy and control [25]. Greater distance occurs, not through geography, but when then a course of education has more structure and less teacher-learner dialogue. More than just a heuristic theory, several attempts have been made to actually calculate the level of transactional distance, with the highly developed Coll-TD/F Scale system using 46 elements [26]. A clear advantage of the theory of transactional distance is that because it implies measurable categories, that have been implemented, then this suggests elements that can be managed. This, of course, has clear implications for instructional design with an emphasis for creating a learning environment ecology that reduces transactional distance when learning through the Internet.

With a theory of andragogy as a continuum that varies individually and culturally, and with a theory of transactional distance for online learning in general and the Internet in particular that also includes such variations on behalf of the learner, it is almost unsurprising to turn to wider cultural perspectives and the relationship with online learning. In particular, select chapters from "Culture and Online Learning" [27] provide a very useful contribution to the influence of mutually-understood shared symbolic values in the online learning process. In particular, adopting from Hall, a continuum is drawn between high-context cultures (China, Japan, India, the Arab world) where context is a significant contribution to meaning, compared to low-context cultures (the Anglophone world, most European countries) where meaning is explicit and direct.

These differences, in communication and thought-patterns, have obvious implications to the delivery and design of online content, with a specific case study analysing the indirect communication styles in Morocco and Sri Lanka [28], which are in many other respects fairly

divergent cultures, albeit with patriarchal structures where the anonymity of Internet identity (when used) provides a challenge to this tradition. Implications for online learning communities suggest that facilitating the expression of self-identity along with protocols of engagement that are cultural and gender sensitive. A further relevant case study [29] reviews the Wisdom Communities instructional design model (WisCom) model in online classes in Sri Lanka, Venezuela, and the United States, arguing for consciousness of cultural expressions in online educational content, noting that it is particularly well suited for cross-cultural and intercultural learning with self-determined cohorts, integrating ideas, learner-focussed, and accommodating diverse learner needs. The results of the class surveys indicated that the application of the WisCom model that a sense of community was created in reflective dialogue with the construction of new knowledge.

One final, and very important, educational model for the online university is that of the "community of inquiry" [30, 31] by Garrison, Anderson, and Archer, which draws extensively from similar studies as well the pragmatic philosophy of C.S. Peirce and John Dewey. This framework, specifically designed with computer-mediated communication (CMC) in mind, describes a process of an collaborative-constructivist educational experience is generated through the interaction of social, cognitive, and teaching "presence". The cognitive presence is modified by the medium (e.g., distal text-based asynchronous versus immediate face-to-face seminars), that social presence is modified by "familiarity, skills, motivation, organizational commitment, activities, and length of time in using the media", and that "cognitive and social presence, and ultimately, the establishment of a critical community of inquiry, is dependent upon the presence of a teacher", which has unique challenges due to the medium. The framework, whilst valuable, seems to be overstate the uniqueness. Asynchronous text-based material has been available for a long-term for learner in the form of books and articles; the major change is the ease of availability (potential and real) and the capacity for collaboration, error-checking, and, most recently, the capacity for real-time video conferencing. As the tutorial room and the library increasingly become "virtual", they shrink in cost and expand in potential availability. The degree that these economic and engineering factors are a reality is the real foundation on which a CMC "community of inquiry" can be applied.

2.5 Literature Review Synthesis

The first review, primarily focussing on the history of technology in the university, noted that even seemingly comprehensive studies of the university played scant regard to the influence of technology on the development of university structures, systems, and learning even when the influence is hand-waved in terms of its importance. It is notable that specific journal articles can be more attentive to these concerns than voluminous studies, suggesting that there's still an enormous ground for the history of technology to develop as a research project, at least when it comes to reviewing the history of information and communication systems in the university context. Whilst this study was initiated between the living history of the SARS-COV-2 pandemic, a supplementary text on technology and education, as teachers were forced in online delivery, provides a useful supplement with the insight that teachers, more than students, required additional support. So much of online education is orientated towards the learner, evident not just in the title of applications ("Learning Managements Systems" rather than "Teaching Management Systems") but also the experiences of 2020 and onwards has illuminated this imbalance where it was shown that whilst teachers experienced the most difficulties.

The review of public economics for the university sector noted the importance of public financing and reviewed the contribution of theories related to externalities, especially positive externalities. Education in this perspective is seen partially as a private good with private benefits, but also as a

social good whose benefits would not be captured in a classic transaction. The theory of externalities was strengthened by consideration of the theory, not just in the abstract model, but also, with a greater of externality types, in terms of the influence of institutions and in terms of the geography of spillover effects. As a dis-economy, attention was also drawn to the practise of rent-seeking, where income is drawn without an equivalent contribution to production with differentiation between the classic Ricardian model, and the Schumpeterian model, noting that both are, again, subject to the influence of power and institutions to protect and extend vested interests of a political-economy in a non-optional manner. This especially applies in this context to the knowledge economy.

The review of online education literature emphasised learners of a particular cognitive maturity, through andragogy, noting that this is a continuum, that there are individual differences, and that cultural difference may lead to a suppression from the ideal state (for example, a background where educators have a higher social position and are not to be questioned). Adding to this the theory of transactional distance with its quantitative evaluation of the structure, dialogue, and autonomy that is in a course design, so as to reduce transactional distances, regardless of geography, and thereby produce more optimal learning outcomes. The combination of the influence of a specific cognitive range in learning, combined with the quantification in design for transactional distance for online learning is necessarily concluded with recognition of cultural differences in design, the distinction between high-context and low-context communication, and the application of cultural awareness into online course design and delivery.

With regards to the history of technology and the university, the contributions and influence when noted, are almost like an afterthought and are insufficiently grounded in a systemic social-theoretical manner. With regards to the public economics of education everything is based on abstract models of self-referential criteria (e.g., utility, price-levels) without a connection to the reality of instructional content and delivery. With regards to the study of online educational culture everything is based on the high-level design elements with a tendency to overlook issues of latency, bandwidth, signal to noise ratios etc, which do affect user experience. Elaborating the theories of andragogy, transactional distance, and online cultural content is usually phrased in a manner that is essentially idealistic, ignoring that online culture is transmitting through a medium. To overcome this is a must for physical reality, which will strengthen the ability of designers to account for the underlying realities of the prosaic matter of geography, but also contribute to accessibility. It is with this perspective that the research gap and the research question is considered in a literature review, even if it illustrates that the underlying matters of economics, engineering, and data delivery are overlooked.

2.6 References

[1] Hilde de Ridder-Symoens and Walter Rüegg (eds.), A History of the University in Europe, Cambridge University Press, 1992-2011.
[2] Hilde de Ridder-Symoens, in A History of the University in Europe Volume I, Cambridge University Press, 1992, pxix
[3] Gavin Moodie, Gutenberg's effects on universities, History of Education, 43: 4, pp450-467, 2014
[4] Richard E. Ferdig, Kristine E. Pytash (eds), What Teacher Educators Should Have Learned From 2020, Association for the Advancement of Computing in Education, 2021
[5] Manar Abu Talib, Anissa M. Bettayeb, Razan I. Omer. Analytical study on the impact of technology in higher education during the age of COVID-19: Systematic literature review. Education and information technologies 26.6, 2021, p6719-6746.

[6] Thomas Farnell, Ana Skledar Matijevic, and Ninoslav Ščukanec Schmidt. The Impact of COVID-19 on Higher Education: A Review of Emerging Evidence. Analytical Report. European Commission. 2021.

[7] Arthur C. Pigou, The Economics of Welfare, Palgrave Macmillan, 2013 FP 1920

[8] Andreas A. Papandreou, Externality and institutions, Oxford University Press, 1994.

[9] Jordi Surinach, Rosina Moreno, Esther Vaya, Knowledge Externalities, Innovation Clusters and Regional Development, Edward Elgar Publishing, 2007

[10] Paul A. Samuelson, "The Pure Theory of Public Expenditure". Review of Economics and Statistics. 36 (4): 387-389, 1954.
doi:10.2307/1925895. JSTOR 1925895.

[11] Malcolm S. Knowles, M. S. Andragogy, not pedagogy. Adult Leadership, 16(10), 350–352, 38, 1968

[12] Insung Jung, Charlotte Nirmalani Gunawardena (eds) Culture and Online Learning: Global Perspectives and Research, Stylus Publishing, 2014

[13] Roy Porter, The Scientific Revolution and universities, in A History of the University in Europe Volume II, Cambridge University Press, 1996, p540

[14] Gavin Moodie, Gutenberg's effects on universities, History of Education, 43: 4, pp450-467, 2014

[15] Herbert C. Macgregor, The Biological Sciences in A History of the University in Europe Volume IV, Cambridge University Press, 2011, p468

[16] Don Ihde. Technics and Praxis: A Philosophy of Technology, Springer, 1979

[17] Adrian Kirkwood, Linda Price. Technology-enhanced learning and teaching in higher education: what is 'enhanced' and how do we know? A critical literature review, Learning, Media and Technology Volume 39, Issue 1, 2014
https://www.tandfonline.com/doi/full/10.1080/17439884.2013.770404

[18] Arthur C. Pigou, The Economics of Welfare, Palgrave Macmillan, 2013 FP 1920

[19] Jordi Suriñach, Rosina Moreno and Esther Vayá (eds), Knowledge Externalities, Innovation Clusters and Regional Development, Edward Elgar Publishing, 2007

[20] Philip G. Altbach, Globalization and the University: Realities in an Unequal World, Tertiary Education and Management, Issue 1, 2004

[21] M. A. Landesmann, "Ricardian and Schumpeterian rents: fundamental ingredients for structural economic dynamics" in Resources, Production and Structural Dynamics, M. L. Baranzini, C. Rotondi, and R. Scazzieri, Eds. Cambridge: Cambridge University Press, 2015, pp. 186–197.

[22] Gert Verschraegen, Michael Schiltz, Knowledge as a Global Public Good: The Role and Importance of Open Access, Societies without Borders, 2 (2), p157-174., 2007

[23] Malcolm Knowles, E. F. Holton III, R.A. Swanson. The adult learner: The definitive classic in adult education and human resource development (6th ed.). Elsevier. 2005

[24] Michael G. Moore, Theory of transactional distance. In D. Keegan (Ed.) Theoretical principles of distance education. Routledge. Theoretical principles of distance education, 1993

[25] Michael G. Moore, G. Kearsley. Distance Education: A Systems View, (3rd Edition), Wadsworth, 2012

[26] Paul, R., Swart, W., Zhang, A., & MacLeod, K. Revisiting Zhang's scale of transactional distance: refinement and validation using structural equation modeling, Distance Education, 2015 DOI: 10.1080/01587919.2015.1081741

[27] Insung Jung, Charlotte Nirmalani Gunawardena (eds) Culture and Online Learning: Global Perspectives and Research, Stylus Publishing, 2014

[28] Charlotte Nirmalani Gunawardena and Insung Jung, "Perspectives on Culture and Online Learning", p1-15.,

[29] Charlotte Nirmalani Gunawardena, "Online Culture and Interaction", p34-44., and Casey Frechette, Ludmila C. Layne, and Charlotte Nirmalani Gunawardena, "Accounting for Culture in Instructional Design", p54-67

[30] D.R. Garrison, T. Anderson, W. Archer. Critical Inquiry in a Text-Based Environment: Computer Conferencing in Higher Education. The Internet and Higher Education 2(2-3): 87–105, 2000.

[31] D.R. Garrison, T. Anderson, T. E-Learning in the 21st Century: A Framework for Research and Practice. Routledge/Falmer, 2003

3. Methodology and Methods

3.1 Defining Methodology and Methods

A distinction is initially drawn between methodological and methods. Often these terms are annoyingly conflated, and some commentators speak very harshly of the conflation, for example Frankfurter [1] who says that methodology is increasingly used as a "pretentious substitute for the word method", where "only semi-literates do not know the difference between the two words". In a less blunt manner, a working definition of a methodology is the logic and theoretical understanding of the appropriateness of particular methods to a study [2]. Deriving from a strong philosophical grounding, a methodological approach must consider what the problem is, before selecting what methods to use in the investigative research. An incorrect methodology will almost certainly lead to incorrect methods chosen, and thus lead to less optimal research outcomes.

A systematic and discipline-appropriate discussion on methodology is necessary, such as that elaborated by Daniel and Harland [3]. Deriving from Grix, ontology is presented as the foundation of research. Defining one's ontology, of what exists, is logically followed by epistemology, how we know it exists, then methodology, the means to acquire and determine particular knowledge, then methods, the specific procedures, and finally sources, the data that the research will collect. It may seem to be a simple progressive sequence however, there is an element of feedback and recursion. Epistemologies may, in a sense, become ontologies, as they provide new ways of seeing, which reveals a reality. A temporal aspect must be considered as well; it would not be unusual to understand reality as having an empirical component, insofar that all events in the universe occur in space and time and involve matter and energy. However, this is defining what currently exists, and it is through the process of rational abstraction that models for future states can be predicted, and the degree that they are inaccurate when actual events occur provides for a classic dialectical approach (abstract, negative, concrete) that encourages an iterative process of forecasting and hindcasting.

Table II: The Building Blocks of Research

The interrelationship between the building blocks of research				
Ontology	Epistemology	Methodology	Methods	Sources
What's out there to know?	What and how can we know about it?	How can we go about acquiring that knowledge?	Which precise procedures can we use to acquire it?	Which data can we collect?

(after Grix, 2002, in Daniel and Harland, p23)

Research Paradigms that combine ontological and epistemological approaches are suggested by Daniel and Harland, ranging from positivism (objective reality, testable theories), critical realism (objective reality, may be non-testable, individual understanding), interpretative (individual reality, unique interpretations), critical theory (socially constructed reality, knowledge not separated from power), and pragmatism (reality driven from experience, knowledge needs utility). All of these can be considered as worthwhile contributions in their own way to the overall questions of philosophical groundings and the development of methodological considerations, especially in reference to particular contexts. It may be tempting then to take a mixed methods approach, but special caution is requisite to ensure that mixed methods doesn't become "muddled methods", where an inappropriate an research method is selected for a particular portion of the research. Further, and this is overlooked by Daniel and Harland, all of these research paradigms are founded very much in a individualist approach to phenomenon of consciousness in ontology and a formal semantic approach to epistemology.

An especially appropriate alternative philosophical approach is the contemporary pragmatic philosophies of transcendental or formal pragmatics, as initially developed by the Karl-Otto Apel [4] and the social-theorist Jürgen Habermas [5], deriving heavily from Wittgenstein's linguistic turn, which is wonderfully encapsulated in the pithy statement: "Most of the propositions and questions of philosophers arise from our failure to understand the logic of our language." [6] The philosophical framework of formal pragmatics is particularly appropriate as a logical method for selecting specific methods as it unites ontological and epistemological concerns. Formal pragmatics develops a rationalisation complex of ontological world orientations ("the objective world", "our intersubjective world", and "my subjective world") with specific epistemological verification claims (factual propositions, normative propositions, aesthetic propositions). Unlike the classic pragmatic paradigm in philosophy, formal pragmatics makes extensive use of pragmatics in linguistics. The following table provides the disciplinary complexes across the orientations and verifications.

Table III: Rationalisation Complexes of Formal Pragmatics

Unverifiable Metaphysics	Physicalist, Symbolist, Idealist Theology		
Verifiable Reality	Logical and Empirical Philosophy		
Orientations/Worlds (verification)	1. Objective or "The" External World	2.Intersubective or "Our" Social World	3. Subjective or "My" Internal World
1. Propositions of Truth - Sciences (correspondence)	Scientific facts	Social facts	Unverifiable
2. Propositions of Justice - Laws (consensus)	Unverifiable	Legal Norms	Moral Norms
3. Propositions of Beauty – Arts (sincerity)	Aesthetic Expressions	Unverifiable	Sensual Expressions

As much of this inquiry is multi-disciplinary and orientated towards providing prescriptive solutions clarity is required in what sort of questions are being asked. For example, when reviewing the throughput of, say, various video-conferencing technologies, it is impossible to provide a coherent evaluation on whether the objective facts can be evaluated according to normative principles. Certainly one can say that one particular technology is more efficient than another, assuming equivalent signal-noise ratios, and that would be a better choice than the less efficient one. However, this is a very different question to the normative question of the moral justification for intellectual property rights, or the sincerity of contributors to interview questions on their

experiences of a particular online educational technology. There are of course, areas of concern that do cross rationalisation complex boundaries, but increased clarity is gained when these are separated into their pragmatic elements. For example, the question of the cost-disease in the service sector and the degree that this can be overcome through technological means can lead to the normative question of the input of workers in higher-education decision-making.

Whilst formal pragmatics provides a philosophical foundation to the sort of questions that can be asked and the means for verification, specific methods must be selected from this framework. Typically, the division in research is between quantitative and qualitative methods, and that division will also be utilised here, although it is noted that the traditional division, derived from fact-value distinctions, does not sufficiently elaborate in the latter between universal normative and subjective expressions. This said, when addressing questions relating to computer and network engineering and positive economics a quantitative approach is taken. In computer science, quantitative methods evaluate according to signal-noise ratios, network performance, speed-ups due to parallel processing, with verification through simulation and tests [7]. In positive economics, the sub-discipline of econometrics in particular emphasises the use of regression analysis against increasingly sophisticated models to explain economic phenomena and the dependence of events on variations on input variables [8]. When reviewing qualitative information, such as user evaluation of online learning systems, experiential methods such as phenomenological analysis [9] can be coupled with interpretative schemas derived from hermeneutics [10].

Source evaluation and source criticism will also perform a role as a select method. Following the insights from historiography in particular [11] a source close to the event is more credible than a distal one. This will be particularly appropriate for evaluating qualitative interviews and some of aspects of computer engineering of online tools. A primary source, any information-artefact that was created at the time under study, will carry more credibility than a secondary source, which builds and comments on primary sources. Secondary sources are, however, certainly necessary, as some of the advanced econometric studies, are beyond the resources of this inquiry. To further minimise the possibilities of bias, non-partisan sources are usually more credible than pre-disposed advocates or detractors, although there they are by no means axiomatic. This consideration will be of particular importance when reviewing intellectual property concerns.

Ultimately, the choice of methodology and selected qualitative and quantitative methods is focussed on answering the core research question, the degree that the contemporary university will be changed with the provision of online content. The application of particular methods to the research questions will also draw from the literature review that provides a background foundation to the questions of investigation. Whether it is using the history of information and communications technology and its use in the university and current usage to posit trends, or the application of relevant issues from public economics, or the experiences of learners and educators with online learning systems, the analysis will seek to draw upon the findings of the research to provide a coherent body of informed opinion that will provide prescriptive solutions. There is a sense that the study is "mixed methods" but rather than running the risk of becoming "muddled methods", the allocation of a particular method depends on the formal pragmatics of the question raised. It is insufficient to simply have statistical methods with interpretative methods present, rather the factual information is analysed statistically, and the experiential is analysed with interpretation. As the objectives form the foundation from which the qualitative hypotheses are raised, this becomes an explanatory sequential design.

3.2 Quantitative Methods for Research Questions 1-3

Quantitative methods are defined here as those that engage in empirical and objective measurements, with the use of mathematical or statistical analysis and is are commonly used in natural, applied, formal, and social scientific investigations [12]. It is worth mentioning in advance that this study makes no such claims of the quantitative validity and warns against deriving any suggestions that they are representative of a population; quality, not quantity, is literally the goal here. The general purposes of quantitative measurements includes the elucidation of anecdotal claims to numerical values and to generate trends, and to test hypotheses regarding phenomenon. However, determining relationships between exogenous, or independent, variables and endogenous, or dependent, variables is arguably the most important goal, where the variation in the dependent variable is examined in relationship with the variation in the dependent variable. It is, of course, quite possible to multiple independent or multiple dependent variables, such as in multi-variable calculus [13].

The process of this quantitative research will involve collection of relevant data and their statistical treatment with a view to answer research problems that are specified in the following paragraphs. The scope of the study is necessarily limited to particular geographical locations;, however the design principles should be applicable independent of geography.; Only further studies can, of course, confirm this. This is a descriptive study and the results can only seek association between variables, even if prescriptive conclusions are offered to the research problems. Data collection is is variable and described for each research question raised; as is extensive use of previously published material, especially that which is well beyond the capacity of this study to engage in data collection. The methodology of formal pragmatics is applied throughout to those questions relating to public and macroeconomic policies, and both scientific facts for computational infrastructure as well as social facts (e.g., licensing regimes, business logic).

<u>Research question 1 – Projected trends for university participation, globalisation, and lifelong learning</u>

The following data sources from the Australian Bureau of Statistics from 1991 to 2016 were used to study these projects:

1. University participation – No. of Australians aged 20-64 who hold a bachelor's degree
2. Globalisation – The percentage of overseas students in Australia, New Zealand, US, and UK
3. Lifelong learning - The percentage of Australians who hold a postgraudate degree.

The statistical techniques of regression analysis are particularly important in this context, not only for their capacity to engage in forecasting and hindcasting, but also their capacity to infer causal relationships between the independent and dependent variables in a fixed dataset. University participation was predicted with linear regressions expressed as ($y = \alpha + \beta x$), where $\alpha = \bar{y} - \beta\bar{x}$ and β is given as: $\text{Sum}(x-\bar{x})(y-\bar{y})/\text{Sum}(x-\bar{x})^2$ is especially important to show stronger causal relationships or even trends. With a forecast, the time series is treated as an independent variable (insofar that its value is independent of any other variables) and the forecast will be the same as the hindcast.

An attempt are made here to correlate estimated public expenditure (in constant billions of 2018 dollars) with the growth of enrolments. As available data was incomplete between the two fields a linear interpolation was undertaken. Correlation (expressed as $\text{Corr}(X,Y) = \text{Cov}(X,Y) / \sigma\_X\sigma\_Y$,

where σ represents the standard deviation of X and Y), defines the strength of the relationship and with a limited range (-1 to +1) it is not affected by the scale of variables and less affected by variation to the mean. Where data points are absent a simple linear interpolation can be provided given from the equation of the slopes (expressed as, $y - y\_0 / x - x\_0 = y\_1 - y\_0 / x\_1 - x\_0$). To determine trends in globalisation, correlations were computed for the percentage of overseas students in the OECD countries of Australia, New Zealand, United States and United Kingdom.

Although the choice of measures may themselves be subject to qualitative interpretation, the measurements themselves are quantitative. Indeed, measurement is the most important process to determine accuracy and reliability, and with a sufficient attention to both, the quantitative aspects of a research study should be replicated or repeated under the same conditions. Reference must be made here to the replication crisis in scientific and other quantitative studies [14], where there is an ongoing and multi-disciplinary problem with the ability of experimental results to be replicated by others. In part, this is due to questionable research practices, questionable practices in data analysis, and sometimes outright fraud (although this is more readily detected compared to past times). One issue, that is invariably overlooked, but relevant in this inquiry, is the replication of computer-generated results with most researchers unaware of the degree that results can change when software versions, or even compilers, change.

Research question 2 – Presence of cost-disease and positive externalities in University education

With this research question, two major issues are addressed:

1. Whether the relative increase in the cost of university education can be explained by a revenue cost model or a cost disease model?
2. To what degree does university education provide positive public externalities compared to private benefits.

To answer the first question, comparative data from the United States was initially applied to compare the possibility of alternative interpretations, the most prominent being a revenue theory of costs, that is, the cost of university education has increased as available revenue increases, in contrast to the cost-disease hypothesis using other personal service sectors analysis from the US Bureau of Labor Statistics. Whilst it would be preferable to use more local figures one must use what is available and is sufficiently close to make at least a tentative evaluation because variability will depend on industry rather than country. To compare the two competing claims a longitudinal cross-section test using disaggregated price data from a broad set of industries is required. If the revenue theory of costs has greater explanatory power, then the costs of higher education will follow an idiosyncratic time path, whereas if the cost disease model is accurate then the time path of costs in higher education should be very similar to the time paths of costs in industries that share the characteristics creating cost disease, that is, similar to the evolution of prices of other services that use highly educated labour and in contrast to the prices of good that use standard manufacturing.

For the second question, there has been application of regression analysis to determine the public returns from higher education. On a simple level, deriving from more extensive studies in the private benefits from higher education [15], this is often translated as gains in public finances with the association of higher incomes generating high tax revenues. However, the positive externalities, where there is an correlation between increased GDP from increased participation in higher education, is a rarer inquiry. In the context of this inquiry, where the fundamental research question is to what degree online learning can replace traditional methods at the university level, establishing the level of these positive externalities can help determine what sort of public funding is justifiable

with reference to expected increases in the proportion of the population taking university-level studies. An even more sophisticated analysis will further differentiate according to qualification level and disciplinary field.

A justifiable level of public funding however is not an optimal level in itself, as it presupposes existing allocations and technologies. A more optimal level can be evaluated through quantitative consideration of the cost disease of the service sector ("the Baumol effect"). Simply expressed, this occurs due to differential productivity growth in different economic sectors, with those sectors that have below average economic growth may experience increased prices, declining quality, and other financial pressures [16]. Various service-orientated professions in the public sector, such as university teaching, can be particularly prone to the Baumol effects, as they are relatively labour-intensive compared to other economic sectors, with typically little scope to improve productivity, and with quality difficulties to substitute technology for labour (e.g., quality arguments for reduced educator-learner ratios). However, labour market competition encourages that service sector wages are close to those in high-production sectors. Quantitative calculation of the costs can be relatively simple; a comparison on the number of graduates versus the expenditure involved, and it can be compared against positive externalities.

Research Question 3 - Effective Engineering and Software Licensing

With this research question, three major information systems issues are addressed:

1. What is the physical throughput available for university-level MOOCs and LMSs?
2. What is the attention given to information engineering issues by educational journals?
3. What is the licensing and architecture structure of the major LMS and MOOC providers?

A surprising experience of the literature review was the relative dearth of information concerning the provision of online educational technologies from a quantitative information technology perspective and a surplus of descriptive texts concerning user-experience in terms of linking interface with pedagogical or andragogical considerations. Despite this apparent lack of consideration because reality has an empirical foundation certain engineering metrics are a prior dependency to the actual provision of content. It is not even a matter of "both are equally important", it is simply not possible, outside of magical thinking, to engage in subjective experiences of transactional distance when there are physical transactional distances in terms of data throughput, network latency, and bandwidth considerations. Rather like how the psychology of the mind has the physiology of the brain as a dependency, so too does the user experience of an online learning system have a dependency on the network and operating system infrastructure. In other words, university online learning tools are an information system with a hierarchy of dependent physical requirements at the base, and with the twin elements of interface and andragogical principles subsequent.

These considerations suggest further quantitative studies into technological capacity of computing systems, networks, and the requirements of learner-management systems and related technologies. Despite such grounding in physical reality being a necessary condition for any LMS or delivery of content in whatever medium, it is surprisingly overlooked. The numerous journals of technology and education rarely, if ever, take this prosaic interest in the actual capacity to deliver in preference to matters of pedagogy or user interfaces. Whilst these are important in their own right, especially from an qualitative and phenomenological perspective, it must be recognised that the most important user experience is the ability to access content in the first place. There is now plausible argument for pedagogy or user experience to even be a mid-point in the delivery of the educational

product; all are dependent on the technological capacity in the first instance and from there it is a matter of more optimal implementations. Therefore, a longitudinal study of technological capacity is conducted in order to determine capacity, which is then compared with the requirements of learner management systems. It is expected that this quantitative review will confirm "Wirth's Law", which states that software is becomes more resource-intensive more rapidly than hardware capacity is improving [17] and, on a related matter, the capacity of networks to carry this load, including concerns in signal-to-noise rations, and the Shannon-Hartley theorem, which can be evaluated through ICMP tests.

The final area of quantitative investigation involves a review of business logic according to licensing systems, ranging from those that are entirely in the public domain without restriction, to permissive FOSS licenses, reciprocal FOSS licenses, proprietary licenses, and trade secrets. Drawing from previous studies [18], a summary of general longitudinal trends in licensing in productivity software is compared against licensing trends in university-level content provision, such as academic journals, learner management systems, MOOCs, etc, which elaborates from the previous review of technological capacity of various systems. A further quantitative analysis reviews total-cost-of-ownership of the different systems accounting comparing the adaptability of more bespoke open-source implementations versus the feature-richness of more proprietary systems. There is, interestingly, apparent disciplinary conflict here between the logic in business studies, which argues for attaining "competitive advantage", i.e., a monopolistic position, and with economics, which argues for optimal levels of welfare from heightened competition and maximising consumer sovereignty, and also that of from information technology engineers with their interest in ease of implementation and adaptability.

3.3 Qualitative Interview Methods for Research Question 4

Broadly considered, the difference between the use of quantitative and qualitative methods in social research comes down to conceptual differences in positive and interpretative sociology. As theoretical yardsticks and idealised positions, positivist sociology emphasises the importance of social facts and that the actions of individuals is are explicable through social norms, institutional requirements, socialisation and integration. In contrast, the interpretative approach emphasises the importance of individual agency. For the positivist, the purpose of social research is to uncover trends in social behaviour that have predictive capability from independent samples that are representative of wider populations. In contrast, the interpretative approach prefers a close and in-depth understanding of a more select sample in a quest for validity, rather than representativeness. Whilst contrasted, it must be acknowledged that there is particular strength in a research project when the quantitative and qualitative approaches have commonalities.

Quantitative research is able to state and test hypotheses from factual information and elucidate trends. It cannot, however, provide interpretation, meaning, narrative, and motivation, and whatever explanations it can provide are those independent of human actors and are understood only in terms of non-conscious causal actions [19]. In this regard, research that only uses the quantitative will overlook the social lifeworld and engage in a naturalistic fallacy if moral claims are made from the facts, overlooking the interpretative and practical reasoning of conscious actors who experience the world of facts. Quantitative research also runs the risk of confusing the naturalistic and data results, expressed in its separate categories, from the holistic experience of the subjects affected by it. Further, quantitative can especially be subject to a confirmation bias through standardised questions; although it is based on facts, the framing of the content for investigation is very much a human activity.

In comparison, qualitative methods are the tools applied to overcome these pragmatic limits in quantitative theory. This will include analysis of interview transcripts, utilising phenomenological and critical hermeneutic [20] approaches orientated towards understanding (*verstehen*), of the subjects, that is, to "make sense" of commentary and observations. As an aside, it must be mentioned to avoid confusion that "phenomenological" refers here more to the philosophical tradition, rather than the method that has taken its appellation even in founded on the same principle as the exploration of lived experience. The critical hermenutic applies the expression of this lived experience through the lens of their context. The overall approach in this study however is a thematic analysis, where the interest is themes and sub-themes relevant to the research question [21]. It is not just any part of lived experience that is sought here, but rather the lived experience of participants in relationship to their experience of university-level online education.

Whilst quantitative analysis is independent, qualitative analysis is highly dependent on the comprehension skills of the researcher in both interpreting the content of the interview subject and their social context, but also the thematic issues of the discussion which suggests familiarity with the subject-matter. Whilst it is often overlooked, it is also necessary for the researcher to be sufficiently self-aware of their own unconscious biases when engaging in such analysis. One method used to overcome this potential of bias is to engage in reliability checks through critical peer-review, and one interesting manner to achieve this is through the re-framing of statements by participants in qualitative interviews as questions to other participants.

The qualitative interviews conducted in this study are aligned to the research questions, making use of that material in the literature review (e.g., transactional distance, culture and online learning) that are applicable. Whereas quantitative studies provide the demographic and economic trends and elucidate the technical limitations and possibilities, the qualitative interviews are designed to provide in-depth insight to the actual experiences of teachers, learners, and technicians. The scope of the study is limited to a relatively small cohort of a dozen individuals with a defining characteristics based on extensive experience of various online learning approaches, whether it is from open universities, MOOCs etc, but at a university-level of education. These are, of course, the most numerically significant means of delivering such education. Within the cohort an attempt is made to provide a balance of learners, educators, and technical professionals. It is noted that the latter group is usually overlooked in the delivery of the systems. A further limitation is that this is not a longitudinal study, although it would be a fascinating exercise in a qualitative comparison of delivery of learner, educator, and technical experiences as a retrospective prior to online delivery, the contemporary situation, and several years in the future.

The interview cohort is recruited by public request for information and personal networks. with initial requests for participation circulated at the start of September 2021. There are no criteria for age-range, sex, ethnicity, etc., although this too would be an interesting opportunity to ascertain whether there are group demographic differences on a quantitative criteria, although this would require a representative population same that is well beyond the scope of this inquiry. Interview questions are orientated towards the user-level experience in terms for learners and educators and the difficulties experienced on an operational level by the technical professionals, in terms of development, operations, and management. The latter in particular is inspired by anecdotal experiences and elaborations in popular, if often satirically insightful, popular technical management texts and their witty aphorism e.g., Putt's Law and Corollary [22]: "Technology is dominated by two types of people, those who understand what they do not manage and those who manage what they do not understand... Every technical hierarchy, in time, develops a competence

inversion ... ensuring that technically competent people remain directly in charge of the actual technology while those without technical competence move into management."

The interview method is semi-structured interviews through email correspondence over a period of two months. This is a deliberate choice, albeit one with practical advantages [23]. A semi-structured interview, it can combine the requirements for answers to specific questions concerning user experience, technical implementation, and management relations, whilst at the same time is not constrained by the specific questions, allowing a more free elaboration on particular points of interest to both subjects. However, unlike an unstructured interview, it is not a free-flowing conversation that can diverge into tangents which are not relevant to the research question. The asynchronous approach and time-scale allows the subjects the opportunity for reflection, the opportunity for the researcher to conduct the interviews concurrently with the aforementioned cross-referentiality. Often overlooked is are also the advantages in storage and bandwidth. The main disadvantage is that the researcher will not be able to pick up on unconscious cues in body language; however this is meant to be a reflective study, not a psychological assessment of the subject's triggers. The sincerity of the interview subjects are is assumed.

A further advantage of asynchronous semi-structured interviews is that emergent themes can arise from the interviews themselves. Whilst there are preconceived themes included, a deductive approach, (for example based on an evaluation of usage trends in LMS software according to licensing), the opportunity for an inductive approach where the data determines the themes, is not overlooked. Given the scope of interview subjects give an emphasis to semantic analysis, rather than latent analysis for coding, where thematic topics are identified within the interviews. Themes and patterns associated with user experiences of technology systems in higher education [21] was identified, using the recommended sequence of (1) a through review of written responses with multiple parses and recording of patterns (2) applying labels to describe content, (3) identifying patterns that arise from the content and labels, (4) reviewing the themes against transcript data, and (5) naming the themes. An advantage of the semi-structured interview meant that this process could be applied in an iterative fashion, with clarification and elucidation sought in the interview process from particular answers, protecting the responses from subjective interpretation from the interviewer. Often this was required multiple times over the three month interview period. These measures improve reliability and trustworthiness for the interviews.

The qualitative interviews constitute a primary evidence source for this study even if it is a minor portion of the overall study. As interviews, ethical questions are raised concerning anonymity, data privacy and curation. Whilst the interview subjects are primarily from an Australian context, the study is being conducted from New Zealand, and as a result compliance with The Privacy Act 2020 of New Zealand and, where relevant, the Health Information Privacy Code 2020. In preparation for conducting these interviews the guidelines and case studies of the British Sociological Association have been consulted, along with the literature review of standards, especially relevant for in-depth interviews such as is carried out in this inquiry [24, 25]. The process of interview is based around the principle of informed consent and voluntary withdrawal based on the interview subject's express desires, and without need for explanation, and stated prior to the conduct of the interview.

Names and emails was collected for purpose of arranging the interviews, but will not be published or made available to others. Other data such as designation, teaching experiences, or computer experiences may also be collected as background information to support data analysis. The data is stored for the purpose of allowing for retrieval by the subject for data analysis. Not used in any other manner nor will identifiers be reported. Participants will be informed of the purpose for which information is collected and its use. All data obtained during the research project will be stored on a

local computer using passphrase-protected files that will not be shared, except with the specific participant on request. The passphrase-protection will use GnuPG (GNU Privacy Guard), with Advanced Encryption Standard with a 128-bit symmetric cipher. The data will be stored for five years and may be destroyed at the completion of the research. All participants will receive a copy of the study within one month following completion of the study. Interview Subjects may share information that are is related to their challenges with technology in teaching and learning that are outside of the scope of the study. They will be asked to review notes of their interview and to advice if any of such information provided should be removed from data analysis. Confidentiality and anonymity is ensured through the publication and non-disclosure of identifying information and through the use of very strong encryption.

3.4 References

[1] George N Frankfurter, Theory and Reality in Financial Economics: Essays Toward a New Political Finance, World Scientific, 2007

[2] Kerry E. Howell, An Introduction to the Philosophy of Methodology, Sage Publications, 2015

[3] Ben Kei Daniel, Tony Harland, Higher Education Research Methodology, Routledge, 2018

[4] Karl-Otto Apel (trans. Glyn Adey, David Frisby), Towards a Transformation of Philosophy, Routledge and Kegal Paul, 1980 [FP 1972, 1973]

[5] Jürgen Habermas, Communication and the Evolution of Society, Beacon Press, 1979

[6] Ludwig Wittgenstein, Tractatus Logico-Philosophicus, 4.003., Kegan-Paul 1922 [FP 1921]

[7] Bruce B. Frey, Computer Programming in Quantitative Analysis in The SAGE Encyclopedia of Educational Research, Measurement, and Evaluation, Sage Publications, 2018

[8] C. Dougherty, Introduction to Econometrics (third edition), Oxford University Press, 2016

[9] Michael Bloor, Fiona Wood, Phenomenological Methods, Sage Publications. 2016

[10] Lawrence K. Schmidt, Understanding Hermeneutics, Acumen Press, 2006

[11] Torsten Thurén, Källkritik (Source Criticism), Almqvist and Wiksell, 1997

[12] Earl R. Babbie, The Practice of Social Research. 12th ed. Belmont, CA: Wadsworth Cengage, 2010;

[13] George Cain, James Herod, Multivariable Calculus. Georgia Institute of Technology 1997

[14] J. W. Schooler. Metascience could rescue the 'replication crisis'. Nature. 515 (7525). 2014

[15] For example; OECD, Education at a Glance 2014: Education Indicators, OECD Publishing, 2014., A. Leigh, C. Ryan., 'Estimating returns to education using different natural experiment techniques', Economics of Education Review, vol. 27, no. 2, pp. 149–160, 2008

[16] William D. Nordhaus, Baumol's Diseases: A Macroeconomic Perspective, NBER Working Paper No. 12218, May 2006

[17] Niklaus Wirth, A Plea for Lean Software. Computer. 28 (2): 64–68, February 1995.

[18] Lev Lafayette, Is the Future of Business Software Proprietary or Free and Open-Source? A Macroscopic Information Systems Investigation, Master's Dissertation, University of Salford, 2019

[19] Alan Bryman, Social Research Methods, 5th edition, Oxford University Press, 2016

[20] John P. Thompson, Critical Hermeneutics: A Study in the Thought of Paul Ricoeur and Jürgen Habermas, Cambridge University Press, 1981

[21] Virginia Braun, Victoria Clarke. "Using thematic analysis in psychology". Qualitative Research in Psychology, 3:2, 77-101, 2006 DOI: 10.1191/1478088706qp063oa

[22] Archibald Putt, Putt's Law and the Successful Technocrat: How to Win in the Information Age, Wiley-IEEE Press, 2006 [FP 1981]

[23] K. Louise Barriball, Alison While, Collecting data using a semi-structured interview: a discussion paper, Journal of Advanced Nursing, 19, 328-355, 1994

https://doi.org/10.1111/j.1365-2648.1994.tb01088.x

[24] P.J Allmark, J. Boote, E. Chambers, E., Clarke, A. McDonnell, A. Thompson, A., Tod, A., Ethical issues in the use of in-depth interviews: literature review and discussion, Sheffield Hallam University, 2009

[25] M. Sanjari, F. Bahramnezhad, F.K. Fomani, M. Shoghi, M.A. Cheraghi, M.A., Ethical challenges of researchers in qualitative studies: the necessity to develop a specific guideline, Journal of Medical Ethics and History of Medicine 7: 14., 2014

4. Quantitative Findings, Qualitative Discussion

4.1 Research Question 1: Participation, Globalisation, Lifelong Learning

Quantitative demographic data provides empirical evidence of past situations and allows for the mathematical elaboration of trends on a probabalistic basis as actual circumstances cannot be fully determined ex-ante. Applying a hypothesis of this study, it is expected that participation, globalisation, and lifelong learning will increase in the university sector over a time period represented by the "age of the Internet", that is, the mass availability and increasing utilisation of the TCP/IP suite as an international network, of which 1995 is considered a pivotal date, representing when the the US NSFNet was decommissioned [1]. This establishes a temporal baseline; for a spatial baseline Australia is selected as a point of concentrated for purposes of familiarity and the limited scope that this study can conduct; other OECD countries are taken for illustrative purposes.

The first value of consideration is participation in university-level education. The Australian Bureau of Statistics (ABS) provides a helpful indicative level of Australians aged 20-64 who hold a bachelor's degree or above. As the definition suggests this does not include people who have started a degree but who have not completed it. Accepting this limitation does provide sufficient evidence of a trend, and as the ABS itself comments:

"In 2016, close to one-quarter (24%) of Australians had completed a Bachelor degree or above, almost 10% had an Advanced diploma or diploma, and just under 21% had completed a Certificate level qualification. The largest growth was in Bachelor degrees or above (up from 18% in 2006). This growth is likely to continue considering one-fifth (21%) of all students in Australia were attending university in 2016, compared with 16% ten years ago." [2]

The trend of completed degrees can be determined provided a predicted value by using a linear regression . Whilst the growth from 2011 to 2016 of the total number at the Bachelor degree level had increased by 23.2%, the Graduate Diploma/Certificate level had increased by 27.0%, and the Postgraduate degree level by 45.9% [3]. Whilst these total numbers should be revised downwards as a percentage to account for population, the illustrative purpose is to note that not only is a greater percentage of Australians completing education at the university level, but also there are even larger relative increases in the postgraduate level, with a 46 per cent increase in the proportion of Australians with postgraduate qualifications between 2011 and 2016. Notably, from the ABS, the number of Australians with a postgraduate degree in 2016 is similar (7.0%) to percentage of Australians with a Bachelor's degree in 1991 (7.6%). An attempt are made here to correlate estimated public expenditure [4] with the growth of enrolments. As available data was incomplete between the two fields a linear interpolation was undertaken. The result is a strong Pearson correlation coefficient (0.969). This should be expected; more students means high expenditure. However, what is notable is that this cannot be seen as a result of "expenditure-push", as degree completion continued to increase even when public expenditure declined (e.g., 1998-2002). The demographic increase is relatively independent of the enticement of public funds, leaving a residue of knowledge-economy drivers.

Table IV: Percentage of Australians (aged 15+) with a Bachelor's Degree and Public Expenditure

Year	Percentage	Expenditure
1989		6.5
1991	7.6	
1996	10.4	
1998		9.5
2001	12.9	
2002		9.0
2006	17.6	
2008		12.5
2011	20.8	14.5
2016	24.3	16.5
2018		18.5
2021*	27.5	
2026*	30.9	

* Extrapolated value.

The increase in the percentage of the population with degree qualifications is often seen as part of a transition to a knowledge economy, where physical capital is metaphorically represented as "human capital" [5] (interpreting the value literally brings in some interesting and reactionary claims of political economy [6]). The knowledge economy, according to the OECD, "Within an outside of the education sector, the discourse often refers to higher educational attainment in general, focussed on the development of broadly-based competencies that can support further lifelong learning. From a labour market perspective, there is also an increased attention given to specific competencies such the ability to use information and communication technologies (ICT), to solve problems, to work in teams, to supervise and lead and to undertake continuous learning". The development of a knowledge economy and the accelerated rate of technological change contribute to a decreasing half-life of knowledge [7], necessitating competencies to be updated and revised and thus furthering lifelong learning, or more correctly, lifelong education [8].

As expected, these increases in qualifications largely correlate with values from other OECD countries, with the OECD average if adults with tertiary education (theoretical and vocational) increasing from 23.56% in 1998 to 44.89% in 2019 [9]. For select countries this includes New Zealand (40.4%, 2014; 43.8%, 2019), the United Kingdom (24.7%, 1997; 51.8%, 2019), the United States (23.8%, 1991; 50.4%, 2019). Again, this data is for illustrative purposes. A stronger association for the purpose of this study extrapolated to the international level would concentrate only university qualifications and with correlation with Internet metrics (e.g., percentage of the population with access, average data throughput); at this stage such data is not immediately available, but should be flagged for an item of further research.

This correlation (rounded to two decimal places) of multiple variables does not necessarily apply to matters concerning globalisation of the student population to the same degree. In this regard, both Australia and New Zealand have been significant leaders on a global level (at least prior to the

SARS-Cov-19 pandemic), with Australia's international student proportion the highest in the world, generating the lowest correlation with select countries (and even, in the case of New Zealand, a negative correlation). Global student mobility statistics from the OECD [10] the proportion of international tertiary students enrolled to the total tertiary students enrolled in the destination (host) country. The select countries (AU, NZ, US, UK) compare with OECD averages of 7.6% (2005) to 9.2% (2018). Australia's international student intake is primarily from China (2018, 29.5%), India (12.9%), and Nepal (6.2%). China and India are also the primary and secondary source of international students from the select countries United States, the United Kingdom, and New Zealand. Again, however, the observed trend matches the expectation of the thesis, that the age of the Internet is part of a general trend towards globalisation which means an increased shared on international students over time in the university sector. What is particularly notably, and which is not obvious from first principles is that the dominance of student populations from developing countries attending universities in developed countries.

Table V: Percentage of Overseas Students in AU, NZ, US, UK and Correlation

Year	Percentage (AU)	Percentage (NZ)	Percentage (US)	Percentage (UK)
2005	18.0	17.0	3.5	13.9
2010	22.1	14.7	3.5	16.0
2011	19.8	15.6	3.5	16.9
2012	18.3	15.8	3.6	17.1
2013	18.0	16.1	3.9	17.5
2014	18.3	18.7	4.2	18.2
2015	15.5	21.1	4.6	18.5
2016	17.5	19.8	5.0	18.2
2017	21.5	19.6	5.2	17.9
2018	26.5	19.7	5.2	18.3

Correlations	Australia	New Zealand	United States	United Kingdom
Australia	1			
New Zealand	-0.06	1		
United States	0.29	0.87	1	
United Kingdom	0.05	0.61	0.70	1

4.2 Research Question 2 - Cost-Diseases and Positive Externalities

It is a matter of quantitative demographics that the participation rate in university, and other, tertiary education is increasing, along with an increasing emphasis on lifelong learning, indicated by an increased proportion of the population with postgraduate degrees, and finally, that there is an

increased internationalisation of university education. However, as resources are not infinite it must be established to what degree these significant demographic changes have in terms of economic benefit. In considering this matter, two particular considerations from economics are employed, namely (a) that services, such as education, have a cost-disease i.e., costs in the service sector increase at a relatively higher rate than capital-intensive production, and (b) that education has positive externalities, that is, there are additional positive benefits external to the individuals in a transaction and a purely discrete market relationship between a consumer and educator whill result in sub-optimal levels of investment. An exploration of the theory and an application of these methods is described in section 3.2, "Quantitative Research Methods" of this study, which are taken in turn with some concluding observations.

Consideration must be given of other potential explanations, such as a revenue theory of costs [11]. This argument posits that the source of cost increases in higher education is due to the availability of a higher revenues stream, whether from private or public expenditure. Political pressure from the university sector suggests a claim that university bureaucrats are at least partially motivated by maximisation of the institutional wealth that they are part of, thus they seek to to increase the size of their bureau. Rather than profit and productivity, revenue and staff numbers are the priority. However, empirical investigations in the United States [12] notes that "[c]ost per student in higher education follows a time path very similar to the time path of other personal service industries that rely on highly educated labor", which is consistent with the cost-disease perspective. Indeed, the university sector is even more prone to the cost-disease than many other sectors. Data from the US Bureau of Labor Statistics, based on 1979 prices, show that by 2016 the price of college tuition had increased by almost 275%, and health care by 100%, whereas for capital-intensive goods such as new cars the cost had dropped by 50% and for toys to less than 25% [13]. Limiting university revenues (e.g. through funding caps) therefore will not limit the pressures for increased costs. Further, non-technological approaches to solve the cost-disease such as increasing the student-staff ratios, results in a reduction in the quality of the relevant course.

According to the cost-disease thesis, technology provides a solution to improve productivity in service sectors. In higher education this can take the form of physical technology (e.g., information and communications technology), institutional technology (e.g., process efficiencies, beneficial restructuring). Independent of technology, although arguably as "human capital", there are individual productivity gains (e.g., recursively, through education). Evidence for relative improvements for the first two elements in the sector is not immediately conclusive. Institutional reform is, for example, largely political and ideological when the guise of "efficiency" is employed. According to widespread OECD surveys, institutional reform in the sector "is driven by a set of partisan choices within a trillema between the level of enrollment, the degree of subsidization, and the overall public cost of higher education." [14] On the other hand, information technologies may seem to be a most promising candidate, with the opportunities to improve efficiencies both within the administration of institutions and also with the provision of educational content. However, as noted in the literature review, institutional behaviour in their quest for monopolistic advantage against competitors can reduce these potential gains, a matter which applies equally to cost-disease solutions as it does to externalities. As an example, the imposition of contractual obligations from journal publishers preceded the decline of library budgets in the United States, and over a twelve year period the proportion of budgets spent on books and journals moved in favour of the latter from 16% to 72% of the total [15].

Whilst staff training of technology is as inevitable initial cost and itself prone to educational efficiency metrics, such as the teaching of techniques rather than concepts which requires re-training with new versions, vendor lock-in to particular technologies results in additional anti-

competitive inefficiencies. It is from such a systemic institutional *telos*, the mismanagement of expectations, time lags in pay-offs, redistributive activities (e.g., workers using information technology for their their private benefit), that the productivity paradox of information technology [16] becomes evident, where the introduction of information technology systems may lead to reduced productivity rather than an improvement. Initial studies in the productivity paradox suggested that "a closer examination of the principal studies and the underlying data underscores the possibility that measurement difficulties may account for the lion's share of the gap between our expectations for the technology and its apparent performance." This has certainly been the discovery in higher education with evidence that investments in information technology to lead to increases in productivity, with an average two-year lag-time, but primarily as research and service improvements, and especially as positive externalities [17], instead of the usual metrics such as the number of enrolled students or the number of degrees conferred.

A number of empirical studies, especially from Australia, have attempted to calculate the level of benefit. Initial recent studies looked at private and public benefits, sometimes differentiated by discipline and qualification levels, and according to an accounting method for private benefits (e.g., calculation of life-time earnings, discounted according to net present value, etc) and net government receipts for public benefits [18, 19]. Such studies can over-estimate the value from higher education as they do not incorporate demographic and ability vectors from those prone to undertake higher education in the first place. Removing such cohort biases leads to a more econometric approach with regard to private benefits, however of additional interest in this study is the effect of public educational externalities from which comprehensive studies have been made over the years, making extensive use of social rates of return by international comparisons from wage differentials [20, 21, 22], suggesting that the average ratio of public-private benefits is roughly even with the value of public positive externalities not captured in the accounting of net returns in taxable income.

Funding university education exists within an "iron triangle" of access, quality, and cost. If access is increased at the same quality, then cost must go up. If costs are reduced, this must affect either the number of learners and researchers in the institution or quality must decline, or a combination thereof, and so forth. However, such an overview is not longitudinal and does not take into account the effects of the cost of university education relative to other sectors. On an initial view, it would seem that the the cost of providing university services increases as the direct gains in productivity are not something that can be intrinsically automated. However, there is a variety of innovative technologies, both in terms of the provision of information goods as a digital products and institutional reforms that potentially could overcome the cost-disease and expand the vector of access with minimised change to quality and aggregate cost (i.e., cost per learner would decline). This is hampered by partisan approaches to institutional reform, and the apparent productivity paradox of information technology. The latter, however, is an illusion due to a calculation problem where positive public externalities are not incorporated, thus shifting the focus on determining their value, and thus calculating a potential shortfall in public expenditure to the university sector.

4.3 Research Question 3 - Information Systems : Engineering and Licensing

Fortunately, from information technology engineering, there are well-established quantitative metrics available for calculating network throughput and, indeed, they are a product of necessity with many dating back to the earliest days of computer engineering and even telegraph. The Shannon-Hartley theorem [23, 24] is a critical starting point. Expressed in a formal manner, the

theorem states that channel capacity (C) or throughput (i.e., the quantity of data that can be provided in bits-per-second) is equal to the bandwidth of the channel (expressed in in hertz), multiplied by the a logarithmic expression using base 2 against the signal power (S) in watts (or volts squared) divided by the noise and interference (N) also measured in watts (or volts squared). That is; $C = B_{log\_}2(S/N)$. A common analogy is to describe a road; where the bandwidth (B) represents the number of lanes and the latency (S/N) represents the smoothness of the surface, and the two combined provides the potential number of vehicles that can travel a particular distance in a unit of time.

It should be intuitively obvious how such an objective measure determines, prior to interface design, the potential degree of translucence in transactional distance. Most obviously it is quantitative measure that occurs in the network between the server system that hosts an online learning system. But it also is present in the programmatic design of the application itself. It can be expected that a poorly-designed program, with plenty of latency, will be subjectively experienced as "clunky" by the end-user because objectively it is "clunky", or doesn't make use of hardware and software features that could improve performance (e.g., GPGPUs, multi-threading, etc). The theorem also applies to the operating system, the architecture of the processor cores and system board, and especially the physical distance between where the educational application is stored relative to the learner. The closer the installation of the application is to the learner's device the better, *ceteris paribus*. The following Internet Control Message Protocol (ICMP) tests using the ping utility from ten 64-byte packets illustrate some differences with localhost with the loopback interface used to represent LMSs installed on the author's device in Melbourne, but also through a shell account (freeshell.org) hosted in the United States. A colleague conducted the tests from their shell account in the United Kingdom. Results will, of course, vary with the geographical location and network connection of the user, but with the same principles applied. Form this simple test elaborations can be made on equality of access on a purely physical level, as well as noting how particular sites (University of Melbourne is the obvious example here) whether for security or "user-friendliness", actually reduce accessibility.

Table VI: ICMP Packet Tests

Site	Melbourne ICMP (average, ms)	US ICMP (average, ms)	UK ICMP (average, ms)
localhost	0.090	N/A	N/A
lms.unimelb.edu.au	33.414	41.067	22.97
www.edx.org	15.625	1.709	20.354
www.coursera.org	16.294	21.392	20.758
www.futurelearn.com	15.257	6.791	20.840
classroom.google.com	15.502	1.827	20.447

To determine the attention given to information engineering issues, an initial search was conducted across titles and content in the major education technology journals for relevant keywords (latency, throughput, bandwidth) from the past five years (2016-2020). The determination of what constituted the major journals was determined by the h5-index in a selected sub-category in Google Scholar for Educational Technology as a sub-category of Engineering and Computer Science. The longitudinal scope was selected as this determines the h5 index. The journals included (with h5-index) were Computers & Education (109), British Journal of Educational Technology (62), The Internet and Higher Education (59), Journal of Educational Technology & Society (54), Education and

Information Technologies (52), The International Review of Research in Open and Distributed Learning (51), Educational Technology Research and Development (47), Interactive Learning Environments (47), Computer Assisted Language Learning (45), and International Journal of Educational Technology in Higher Education (43). The results for the keywords are as follows, and speak for themselves without need for much elaboration. The critical and dependent element in providing online educational, that is, effective data throughput, is rarely considered even in educational technology journals. It would seem self-evident that this lack of consideration has affected the effective implementation of online learning systems.

Table VII: Leading Educational Technology Journal Articles That Refer to Bandwidth, Latency, or Throughput

Journal (h5-index)	Total Articles	Articles with Keywords	Titles with Keywords
Computers & Education (109)	1,010	39	1*
British Journal of Educational Technology (62)	679	22	0
The Internet and Higher Education (59)	137	5	0
Journal of Educational Technology & Society (54)	318	12	0
Education and Information Technologies (52)	1110	74	0
The International Review of Research in Open and Distributed Learning**	NA	NA	NA
Educational Technology Research and Development (47)	443	13	0
Interactive Learning Environments (47)	868	20	0
Computer Assisted Language Learning (45)	514	6	0
International Journal of Educational Technology in Higher Education (43)	283	9	0

* The title of the one article that had bandwith in the title from all the journals was: "Automated essay scoring in applied games: Reducing the teacher bandwidth problem in online training", that is, it was educator cognitive load rather than physical bandwidth.
** The International Review of Research in Open and Distributed Learning articles are not recorded by Google Scholar, hence NA, "not available".

Technical engineering provides part of an information systems equation. Another part is the legal infrastructure, which information technology is more strongly tied than what would be expected. Specifically, what is reviewed here is the licensing used for various online learning systems, which can be broadly described as being either "proprietary" or "free and open source", with a variety of licenses occupying the continuum with admixture (e.g., public domain, permissive FOSS, reciprocal

FOSS, freeware, proprietary, trade secrets). Relating to the thesis question, it is a matter of some interest of whether the license of a particular online learning system affects the ability of that learning system to generate a community ecosystem, develop, and ultimately deliver content. A powerful argument in this context is the recognition [25] that in the open-source software world the purpose is not primarily an ideological commitment to free and open information, nor even the exceptional convenience in deployment, but rather a business logic that it is desirable to bring collaborative development, peer-review, criticism and improvement, to a product. This is engineers understand that user dissatisfaction has an underlying cause that manifest from problems in the software design: "the developer is the user".

Reviewing the licensing and architecture structure of the major LMS and MOOC providers is revealing of the influence of licensing approaches. From the MOOCs, Coursera, FutureLearn, Udemy, Udacity, and Khan Academy are all proprietary systems even if they offer free content. One exception is edX, which has open-sourced the platform (see: http://openedx.org/). All are based on a model where content is remote from the client and all, with the exception of Khan Academy, are commercial for-profit entities, whereas Khan Academy is a non-profit organisation. Using the differentiation between a "cathedral" versus a "bazaar" model of software development [26], MOOC providers are very much in the "cathedral" approach, where code and content of the offered courses is strictly controlled by the sponsoring organisation, but with EdX being an exception allowing the formation of new organisations using the platform and being open to code improvements from the userbase. This "bazaar" model in terms of code is the norm with major independent LMS systems such as Sakai, eFront, Moodle, and Canvas, with Blackboard, Desire2Learn, and Google Classroom being exceptions, the latter leveraging existing products (Gmail, Hangouts, Meet, Calendar, Drive, Docs, Groups, News, Sites, Vault etc) in the Google suite for the Google for Education service.

The development of software products over time, from the supercomputers, to the server-level services, to user-devices, to embedded systems, all suggest a gradual trajectory over the past twenty years towards licenses that are more orientated towards the "free and open source" end of the continuum [27]. This should be replicated in online learning systems, and is already evident with EdX opening its code, the declining usage share of Blackboard, despite aggressive acquisitions, and the lack of strong uptake of Desire2Learn or even Google Classroom, despite its market position in other areas [28]. As a response to these costs a number of academics are increasingly adopting open access with the Directory of Open Access Journals increasing its number from 300 in 2003 to 16,868 indexed journals at the time of writing (September 2021), not to mention library file sharing sites of questionable legality such as Library Genesis which, with a direct lineage from the underground samizdat culture in the former Soviet Union, held a catalogue of some 80 million journal articles by July 2019 primarily from the scientific domains [29].

4.4 Research Question 4 – User Experiences

Much of this inquiry is conducted on a macrological scale, discussing matters such as broad principles of andragogical teaching and learning, public economics, information and communications technology infrastructure, and intellectual property assertions. However, it is is also necessary to account for perspectives at a micro-level, the world of the visceral and cognitive experience of natural persons. After all, something would surely be amiss if institutional and engineering metrics would suggest failure or success if the reported experiences of actual people with online learning systems was at significant variance. The only was to determine whether this is the case, of course, is to ask the affected people. Thus this section of the study begins with

providing a statement of scope of subject interviews, and the qualitative method, followed by a summary of the process and the characteristics of the subjects. After this groundwork the bulk of the section, however, is taken up with the the comments of the subjects themselves, expressed as findings of structured questions, followed by unstructured elaborations on topics of particular interest. The combination of these qualitative and the quantitative findings suggest common threads which are identified in the final, and prescriptive chapter of the study.

Two have the same sort of validity as a macrological quantitative study a wide-ranging qualitative study would also be required. Quantitative studies, by their nature, are somewhat easier in terms of data collection in that regard, even when derived from the answers of conscious subjects. However, a qualitative study of such persons is well beyond the scope of this study which is broad enough already, although would certainly make for a fascinating and on-going research endeavour. Instead, the qualitative section study is only part of the overall study, and rather than sheer volume of participants, it seeks to engage in a small number of administrators, learners, and educators with greater depth through interviews to illustrate their experience, rather than a survey. In part the approach also provides an opportunity for those who have direct experience with various online learning systems to illuminate particular aspects of the environment that the study's author may have otherwise overlooked due to their own subjective limitations and regardless of their own experience. As explained previously (section 3.3 Qualitative Interview Methods), qualitative studies provide for interpretation and can elucidate meaning, narrative, and motivation. For this purpose an asynchronous semi-structured interview has been selected as the appropriate method, balancing the requisite questions with optional elaborations.

Once agreement and understanding of the conditions of the interview was reached, structured questions sought to ascertain the subject's breadth and depth of online learning systems in a university setting, and then their opinions on the learning systems in terms of usability, layout, connectivity, etc. The combination of experience and variety in the subject cohort was sufficient that by this stage the interview process could move into a semi-structured part, where particularly interesting and insightful remarks were identified for further elaboration and, following a principle of cross-referentiality, matters raised by one subject could be referenced in discussion with other subjects. In two cases the subject indicated that they preferred a final telephone call with notes taken and confirmation of their veracity by email. Notification was provided that interviews would be completed by the beginning of November with final correspondence received.

Participant Profile
The cohort consisted of eleven individuals, six women and five men, all from Australia and all English-speaking. From the cohort of which three were current learners, five who are current educators (with experience as online learners), three of whom were designers and administrators of online learning programmes, and one who evaluated psychometrics from online learning. One of the cohort dropped out early in the interview process before their specific experience could be determined. Whilst the request from the cohort was specifically for university-level education, in the case of two members their experience as was with senior secondary education. Of the various online learning platforms Canvas, Moodle, WebCT and Blackboard, Sakai, Coursea, Articulate Rise and custom systems all mentioned by the subjects, with ubiquitous experience by learners and educators of video-conferencing tools with Zoom being most prevalent, but Teams and Blackboard's Collaborate Ultra also mentioned. One very interesting response from one educator was the use of Twine, usually used for the development for interactive non-linear stories as an educational tool. Notably, all the learners and educators indicated that they had experience with multiple online systems and thus were able to draw subjective comparisons of their experience.

Whilst the cohort was small, the following table illustrates a coded distribution of participant responses according to experiences of LMS users according to licensing of the product and the stated experiences of of external control of the LMS product, regardless of licensing. The unexpected (inductive) thematic consideration of "control" is notable.

Table VIII: LMS Experience Coding Results

Positive Experience of FOSS LMSs (deductive)	8
Negative Experience of FOSS LMSs (deductive)	0
Positive Experience of Proprietary LMS (deductive)	2
Negative Experience of Proprietary LMS (deductive)	2
Positive Experience of LMS Control (inductive)	0
Negative Experience of LMS Control (inductive)	4

N=11 initially, 10 completed.

These objective and descriptive cohort characteristics formed part of the structured interviews. More qualitative questions referred to their subjective experiences of such technologies. Among those who had used WebCT and Blackboard all mentioned significant issues and was often ranked last in terms of preference, taking into account interface, accessibility, speed, and flexibility. In one case the issues were associated with the monopolistic strategy of proprietary software: (e.g., "Blackboard was fine with importing, exporting not so much. WebCT was bad at importing and awful at exporting"), although this could at times provide an advantage when integrating other proprietary products into the suite. One subject commented "I don't know whether it's a limitation of the system or a configuration issue, but TurnItIn was much more integrated in Blackboard from the Marker's perspective". This correlates with actual design; Turnitin is integrated with Blackboard via an special interface (called "Direct) designed to be similar to that of Blackboard or with Turitin's own interface (called "Basic"). Other tools must rely on the external tool ("LTI").

Two designers from the cohort who had experience with Moodle noted that it provided the opportunity for structure. "What makes Moodle work for collaboration is the group's functionality, forums (simple single and single), moodle mobile, linear formatting, backend monitoring and reporting". However, this praise was not as strong among learners who, whilst rating it positively ("Easy to use, easy navigation, integrated mobile app worked fine") but did not express the same sort of enthusiasm as the designers. Instead, it was Canvas which was ranked highest among learners, with performance and ease of navigation positively identified. Across learners and educators, opinion on Zoom as a video-conferencing tool was acceptable, but lukewarm with one subject mentioning that it is difficult to conduct real-time education (e.g., music) as "it does not stay stable during internet dips, and regularly freezes or drops in quality", resulting in online lessons taking twice as long as they should.

The results and comments from the structured questions were extremely valuable in themselves, but also provided a necessary foundation for providing interesting and unexpected opportunities for elaboration. Without out the unstructured components, these insights would not have bene gained. The can be addressed along three main topics of concern. The first, from a designer and instructor level, dealt with matters of control on the server side. The second, from an instructor and learner perspective, relates to the degree that LMSs have incorporated educational theory. The third, almost entirely derived from a single learner, makes a strong case for a return to client-based applications

combining both the control and educational concerns in the current web-based frameworks. In the process of asking the unstructured questions, points raised by subjects were referred to as questions to other subjects to see if there was a correlation of experiences.

With regards to the matter of server-side control, a number of designers and educators noted that not only are applications limited to the degree that they are proprietary, but also with the additional layer of IT administrators at their institution, which applied even in open-source products. "[D]espite being open source, actually changing them is not that easy, as they tend to be managed by the IT Service group and they don't make it easy for reasons of the standardisation of services that all central IT groups seem to push. In a couple of cases it does seem that with Canvas (or Moodle), if you were granted the right permissions (e.g., the APIs), you could manage the workflow in your own way, *if* the IT management and administrators provided those options". Notably designers and educators both expressed a positive experience with platforms that they had the most control over, even to the extent that significantly older, custom-designed LMSs were preferred over contemporary products.

The issue of control over the environment also affected the preferences of educators with regard to their ability to apply pedagogical and andragogical theory in practise: "I get the impression that Canvas in particular was designed as a 'toolkit' and is trying to provide functions and modules for people to use in multiple ways according to their own models of teaching practice and administrative preference". The educator who used Twine as a teaching tool found it particularly useful in this regard: "I found Twine to be particularly useful as an assessment tool because it took the learner on a 'journey'. They were given a scenario and asked what course of action would be best in that scenario. If they went down the wrong path, they would need to loop back to a point where they had to think about the optimal response again before proceeding further". Others were less convinced of the value of LMSs in terms of being designed for teaching and learning; that they have not yet matured as a product that incorporated teaching theory with the technology, and video conferencing technologies suffered an issue of learner engagement:

"Tutes and seminars on zoom are even more difficult. The old 'read and discuss' model really doesn't work online. Most of the students won't speak up and most won't turn their cameras on either... The most effective tutes (my opinion) are the ones that are tightly scripted and use the technological bells and whistles. Quizzes, breakout rooms, the shared whiteboard, video clips, etc. Keeping students engaged in an online tute is very different to face-to-face, you can't rely on generating class discussion or getting them to answer questions verbally, so it's really about designing an interactive activity set that achieves the same learning goals"

Both educational and control issues are also raised in the learning experience through the advocacy of LMS clients, which is contrary the "cloud" (i.e. web) based model that is prevalent through major LMSs. The direct words of the learner summarises sufficiently their preferences without the need of further elaboration in terms of controlling their own environment according to their educational learning preferences.

"If given the option to download a standalone, client, program, application thingy-mi-bob. I'll always take the downloadable client option. To me. It just feels, more stable. I can troubleshoot far better, if something goes odd with a client, than I can a webpage. Which, as a student, I have stuff-all access to. Something not right? Too bad. Log a ticket, and wait. SO many apps these days support dark mode, or the option to stick to the OS preference (which, again, on my laptop, and Android, is dark mode!... A client could do that! And then no more stupidly bright, white webpages in the middle of the night. Because. Canvas. Which is only doing more damage to the users

circadian rhythm and holding back melatonin. And realistically, the yellow-toned night light change, doesn't do a great deal, if the screen is so close to you...

... a client makes complete sense IF PEOPLE LOSE INTERNET ACCESS!!! Power outages are probably going become an increasing problem. It was difficult enough sitting at my desk, trying to watch a lecture, when both of the guys were on the bandwidth too... Also, obviously students who are remotely studying, or taking one or two units whilst backpacking, would potentially benefit from having an offline client, vs unorganised folders and files.. Or, a student may have to suddenly rush off to look after grandma, after she's had a bad turn. But also knowing that, even though gran watches the old "Picture Wireless" every evening, before bed. There isn't any stable wifi around Nan's place. So they'd plan ahead, and when Nana goes to sleep, at 6pm, the student can study, write, do quizzes ahead of time and offline, that will have a save state! And they can submit when they next are online!

Also, there are areas of study, graphic design for example, where most of your work would be folio based. So the student could sit there, drawing and designing on Adobe Illustrator, but might need to duck into the uni/course client, have a quick look at the brief, which would have been saved for them, when they chose "keep for offline mode". Without having to be distracted or tempted by the rest of the internet that day.... And!! And!! What about if your damn laptop crashes! And for some reason, your webpage tabs can't be restored! GAHHHH! Or likewise, whenever Canvas techs are doing maintenance on the servers or particular courses, whatever, (and we do get tonnes of notice in advance), that's still time that students are unable to access online."

It should be clear from the above that there are significant advantages for educational software to follow a client-server architecture in preference to a cloud infrastructure model. If this is already evident in educational environments that are still orientated towards the provision of text, it should become increasing evident where multimedia XR systems are increasingly utilised for highly immersive content for the educational experience. As should be quite obvious from the ICMP packet tests, distance is a factor in computing and where data is not close (in terms of throughput) to processing there is a physically unavoidable necessary time delay.

4.5 References

[1] Susan R. Harris, Elise Gerich. Retiring the NSFNET Backbone Service: Chronicling the End of an Era. ConneXions, Vol. 10, No. 4, April 1996.
[2] Australian Bureau of Statistics, 2071.0 - Census of Population and Housing: Reflecting Australia - Stories from the Census, 2016
https://www.abs.gov.au/statistics/people/education/education-and-work-australia/latest-release
[3] Australians pursuing higher education in record numbers. Australian Bureau of Statistics, October 2017
https://www.abs.gov.au/AUSSTATS/abs@.nsf/mediareleasesbyReleaseDate/1533FE5A8541D66CC A2581BF00362D1D
[4] 2020 Higher Education Facts and Figures, Universities Australia, 2020
[5] OCED Education Policy Analysis, OCED, 2001 and 2002
[6] "The counterpart for education would be to 'buy' a share in an individual's earning prospects: to advance him the funds needed to finance his training on condition that he agree to pay the lender a specified fraction of his future earnings. In this way, a lender would get back more than his initial investment from relatively successful individuals, which would compensate for the failure to recoup his original investment from the unsuccessful. There seems no legal obstacle to private contracts of

this kind, even though they are economically equivalent to the purchase of a share in an individual's earning capacity and thus to partial slavery." Milton Friedman, Rose Friedman. Capitalism and Freedom. University of Chicago Press, 1982 p103

[7] Samuel Arbesman. The Half-Life of Facts: Why Everything We Know Has an Expiration Date. Current, 2013

[8] Stephen Billett. The perils of confusing lifelong learning with lifelong education, International Journal of Lifelong Education, 29:4, 401-413. 2010

[9] OECD, Population with tertiary education (indicator), 2021. doi: 10.1787/0b8f90e9-en https://data.oecd.org/eduatt/population-with-tertiary-education.htm

[10] OECD, International student mobility (indicator), 2021. doi: 10.1787/4bcf6fc3-en https://data.oecd.org/students/international-student-mobility.htm

[11] Howard R. Bowen. The Costs of Higher Education: How Much Do Colleges and Universities Spend per Student and How Much Should They Spend?. Jossey-Bass Publishers, 1980.

[12] Robert B. Archibald, David H. Feldman. Explaining Increases in Higher Education Costs. College of William and Mary, Department of Economics, Working Paper Number 42. September 2006

[13] Robert Bolton. Universities have to work harder on their reputations. Australian Financial Review. March 2, 2020.

[14] Ben W. Ansell. University Challenges: Explaining Institutional Change in Higher Education. World Politics , Jan., 2008, Vol. 60, No. 2 (Jan., 2008), pp. 189-230

[15] Modern Language Association Report from the Ad Hoc Committee on the Future of Scholarly Publishing, Profession 2002 Modern Language Association, 2002, p 172-186.

[16] Erik Brynjolfsson. The Productivity Paradox of Information Technology: Review and Assessment. Communications of the ACM, December, 1993

[17] Justin C. Ortagus, Dennis A. Kramer, Mark R. Umbricht. Exploring the IT Productivity Paradox in Higher Education: The Influence of IT Funding on Institutional Productivity. The Journal of Higher Education . Volume 89(2), 2018, pp129-152

[18] Anne Daly, Phil Lewis, Michael Corliss, Tiffany Heaslip. The private rate of return to a university degree in Australia. Australian Journal of Education 2015, Vol. 59(1) p97–112

[19] Andrew Norton. Graduate Winners: Assessing the public and private benefits of higher education. Grattan Institute. 2012

[20] WW McMahon, Education finance policy: Financing the nonmarket and social benefits Journal of Education and Finance, 32(2), 264-284, 2006

[21] WW McMahon, Higher learning, greater good: The private and social benefits of higher education, JHU Press, 2009

[22] B Chapman, Lounkaew. Measuring the value of externalities from higher education, Higher Education, 70(5), 767–785, 2015

[23] David J.C. MacKay. Information Theory, Inference, and Learning Algorithms. Cambridge University Press. 2003

[24] Olivier Rioul, José Carlos Magossi. On Shannon's Formula and Hartley's Rule: Beyond the Mathematical Coincidence. Entropy, 16(9), 4892-4910, 2014 https://doi.org/10.3390/e16094892

[25] M. Fink, The Business and Economics of Linux and Open Source. Prentice Hall Professional. 2003.

[26] Eric S. Raymond. The Cathedral and the Bazaar: Musings on Linux and Open Source by an Accidental Revolutionary. O'Reilly. 1999

[27] Lev Lafayette, Is the Future of Business Software Proprietary or Free and Open-Source? A Macroscopic Information Systems Investigation, Master's of Science Dissertation, University of Salford, 2020

[28] Phil Hill, State of Higher Ed LMS Market for US and Canada: Year-End 2020 Edition, PhilonEdTech, https://philonedtech.com/state-of-higher-ed-lms-market-for-us-and-canada-year-end-2020-edition/

[29] Balázs Bodó, Library Genesis in Numbers: Mapping the Underground Flow of Knowledge in Joe Karaganis (ed), Shadow Libraries: Access to Knowledge in Global Higher Education, MIT Press, 2018

5. Prescriptive Conclusions

5.1 From Findings to Prescriptions

The purpose of quantitative and qualitative research is identical; to attain greater understanding of the phenomenon being studied [1][2], however the means are significantly different. To reiterate, quantitative attains understanding through objective data that can be expressed in a statistical manner allowing for trends to be elaborated (forecasting), past events to associate accuracy of a model (hindcasting), and for strength of correlations to illustrate causality. In contrast, qualitative research attains understanding through meaning and interpretation of phenomenal subjective experiences as primary data and its effects on behaviour. In this study, quantitative research is carried out on a macroscopic scale by reviewing the demographics, economics, engineering and licensing in university education, whereas the qualitative research is carried out on personal scale by interviews of teachers, learners, administrators, and designers of learning management systems.

Given the differences in scale and approach it would be expected that there would be significant differences in findings, and indeed as the inquiry moves from findings to prescriptions these differences will become evident as a counterfactual and idealised alternative with practical outcomes is presented. Nevertheless, there are perhaps unexpected thematic considerations where the quantitative and qualitative shared a common ground which is, of course, extremely pleasing from the perspective of desiring understanding of the subject matter. In order to elucidate these commonalities, it is necessary to report on the findings in summary form, covering the demographics, the public economics, the engineering and licensing, and the qualitative interviews.

The demographics of participation, globalisation, and lifelong learning all showed increases. In Australia, the 2016 value was 24.3% for the percentage of Australians with a bachelor's degree or higher, with a forecast extrapolation of 27.5% by 2021 and 30.9% by 2026. This change represents perhaps the single most significant demographic change in the last thirty years, as in 1991 the percentage was only 7.6%, and correlates also with increases in higher education participation in general. With regard to globalisation more modest values have also been noted from internationalisation in developed countries (e.g., for AU from 18.0% in 2005 to 26.5%, and in NZ from 13.9% to 18.3%). For lifelong learning, the increase in the proportion of people with a bachelor's degree is also matched with increases with people with postgraduate degrees, with a 46 per cent increase in the proportion of Australians with postgraduate qualifications between 2011 and 2016, reaching a total of 7.0% of the population.

The public economics of the university sector suggests that these institutions are subject to a cost-disease (in contrast to alternative explanations, such as a revenue theory of costs), where the increasing cost of delivering university-education, like other service sectors, is higher than of goods. The usual answer in industries where there is a high service sector component is to introduce physical and institutional technologies, however these are confronted by concerns that the former that IT systems can lead to a reduction in productivity ("the productivity paradox"), whereas the latter are subject more by partisan ideology, rather than actual performance improvements. In the case of information technology however, the benefit have been found to accrue in higher education after a time-lag averaging two years, especially in research and service improvements, and in particular in positive externalities. Econometric modelling from Australia suggests that, with modest difference between disciplines or graduate vs postgraduate degrees, and removing cohort biases, suggests the average ratio of public-private benefits is roughly even.

From information systems the well-established principle of throughput as a function of distance, latency, and bandwidth was illustrated noting that these concerns, whilst extremely important to actual user experience, do not feature even in journals specialised for educational technology. In addition to the physical engineering, there is also a matter of licensing using in for LMSs. With an equivalent trend in infrastructure, embedded devices, and general purpose business software, educational software too, is increasingly moving from proprietary systems to free and open-source software, which is also matters research content provision in Open Access Journals along with library sharing sites of questionable legality.

Finally, from the qualitative interviews, a distinction was drawn between learners, educators, and designers or administrators, noting that there is some overlap between the differing groups, especially among educators who have also been learners using an online system. Comparison between the different platforms indicated preferences towards Canvas or Moodle, in terms of preference, taking into account interface, accessibility, speed, and flexibility, although this came with the caveat that, among educators, often administrative and policy decisions hampered the benefits of using a FOSS product. Designers also tended towards Moodle for control over the architecture and design, whereas Canvas had a preference among educators as providing a tool-kit that one could control. This sense of a lack of control was likewise reflected in the learner experience where there was strong advocacy for client-side applications. Video-conferencing technologies (e.g., Zoom) were noted for having issues in real-time education, and with learner engagement. As a whole, LMSs were not considered a technology that either incorporates educational theory, and educational theory has not been developed to account for LMSs.

Quite clearly, there are differences between the quantitative and qualitative findings from scope and scale. It is not surprising, for example, to discover that the quantitative nation-level demographic trends are not something that was raise in the qualitative interviews with their concentration on LMS experiences, although one could note the relative ease in finding postgraduate educators to participate in the survey as an indication. Despite the differences, there is a number of commonalities, both on a direct and in a thematic consideration, the former limited to more specific examples and the latter in a broader sense. Two major commonalities include the direct experience of the use of free and open-source LMSs in preference to proprietary systems and the more thematic issue of control.

With regards to the use of FOSS LMSs, this is something that appears in quantitative surveys of increasing market share of products like Canvas and Moodle over Blackboard, but also in terms of personal preferences as providing a qualitatively "better" experience by educators and learners. Some explanation can be provided on how the quantitative fact of the increasing popularity of FOSS over proprietary software, and how it matches with the qualitative desire, and this comes down to the development cycle of a FOSS enterprise. A very sound argument is made by Fink [3] in this regard who notes that contrary to popular belief, the primary purpose of FOSS is not some sort of knowledge commons for its own sake, but rather to encourage collaboration into a particular project; "the developer is the user" is an argument that software engineers know that that dissatisfaction with a software product is manifest by underlying limitations that are a defining part of proprietary code. In the open-source world, when a software product is unable to perform a particular task the project either must adapt or lose client support, and developer collaboration. The alternative for proprietary software is to expand through business acquisitions and integration into a product, however the trajectories indicate that that FOSS is more agile, and more able to respond to consumer preferences.

This measure does lead into the wider thematic consideration that crosses the quantitative and qualitative inquiries, and that is the issue of *control*. One can even make an argument that, confronted with the opportunities of globalisation and at the same time the global inequality of wealth, that international students are trying to increase the control over the own lives, or that the increased number of university learners and postgraduate learners in developed countries is likewise an attempt by learners to increase control over their own lives. Of course, whilst there may be a central intuition to such propositions they were not part of the inquiry, and must be deferred to further investigations. What is evident from the qualitative interviews is that even in circumstances where FOSS LMSs were in place, there was a notable recognition that these could be limited by the university bureaucracy and also by the producers of such software itself who, under a managerialist assumption of "everything in the cloud" have neglected the learner experience and desire for a client-server architecture.

The majority of the findings of the inquiry do differentiate between the quantitative and qualitative approaches. However, the relationship between software licensing and user preferences and the overall theme of control and autonomy does provide a particular spotlight on a critical finding that is beyond mere empirical trends or, for that matter, subjective assertions on preferences. Combining all the findings into a coherent prescriptive become the aim of the next section; it is insufficient to be just descriptive in such an inquiry, even if in certain studies that would be sufficient in its own right. The trends and experiences cited suggest significant changes in the way that higher education will operate in a future environment with CMC technologies that are on par with the disruptions caused by the invention of movable type print. Providing an informed perspectives will make best use of the opportunities whilst avoiding the pitfalls.

5.2 The University of the Future: A Thought Experiment

Prescriptive approaches require thought experiments in which causes are associated with effects and vice-versa [4], of which several types can be elucidated by the use of hypothetical questions employing indicative conditional reasoning about future-directed antefactual speculation. This can include the short-run variant of "nowcasting" and the medium-run "forecasting", both derived originally from metereology and more recently from economics. Of course, there is a significant difference between the two, insofar that the former refers to natural behaviour that is subject to deterministic physics, whereas the latter includes human behaviours that are even contrary to rational expectations and which true experimentation cannot be conducted. In both nowcasting and forecasting accuracy of the prediction will be determined by (a) the correctness of the evaluation of the current condition, the antecedent, and (b) the correctness of the relationship between the variables. leading to an outcome, the consequent. In determining "The University of the Future" trends are been identified in terms of the demographics of the likely learner population, the economics and public funding, the engineering environment, and the licensing environment of intellectual property.

Baring the sort of disaster that would lead to a decline in technological capability, integration of the social system, and even knowledge itself, it should be evident that increasing social and technological complexity will require a population with increasing levels of participation in tertiary education, both in the theoretical and practical environments. Already we have seen trajectories ("nowcasting") that indicate that over 30% of the population in Australia will have a bachelor's degree at least, and a similar number with other tertiary qualifications. Increases in the growth rate in postgraduate education or learners taking up new tertiary studies in different fields are indicative of the increasing importance of continuous and lifelong learning, whilst the gradual proportion of

learners of developing to developed countries also suggests a desire for the further economic and social development as well as globalisation, pandemic conditions withstanding. Applying hindcasting, the changes represent one of the single biggest demographic shifts in advanced economies.

With the supply of university places primarily determined by public funding and the demand by potential learners, the optimal level is not a price intersection as would be the case with a private producer but rather the total positive externalities produced through the education system with social returns roughly equal to private returns to the learner. This will vary according to discipline, but the econometric models indicates that that the current status, in Australia at least, is that that the social benefit is roughly equal to the private benefit. This function will be both a sigmoid and also an opportunity cost to other expenditures that either provide positive externalities (e.g., public health, physical infrastructure) or mitigate negative externalities (e.g., defence, policing) and thus the precise figure will vary according to location and is beyond this study. Nevertheless, the econometric separation between social and personal benefits does provide an empirical value to determine an optimal level of learner contribution to the cost of university education.

There is however a particular conflict here; on the one hand the demographic evidence is quite clear that there will be increasing absolute and relative numbers of university learners, those engaging in lifelong education, and international learners. However, at the same token the cost of the university sector increases a greater rate than the economy. This cost-disease, common in industries where the product requires a significant service contribution, would be reflected in price of a consumer good but, following the econometric that university (and other higher education) should receive a Pigouvian subsidy. This is borne by the public, as part of government debt which will either be paid through through taxation revenue, or by money-creation by the central government with inflationary pressures if the economy is at full employment. In either case, a public policy decision has to be made when confronted simultaneously by a necessary public investment in university education in order for a society to reap the economic benefits of complexity and technological development, and the fact that the cost to pay for that investment will increase at a rate faster that the general level of growth. It should be quite obvious that if enrolments double or triple in decades to come that the university would find it very difficult to argue that their public funding should increase four or sixfold, let alone imagining the required expansion in campuses.

This is obviously unsustainable, and stands out as a central problem. Normally where a cost-disease is being addressed, the solution is to introduce institutional reforms or physical technologies that reduce the proportion of the service cost. Institutional changes could be, for example, amalgamations of universities and colleges of advanced education (such as was included in the Dawkins reforms in Australia in the 1980s [5]) to reduce administrative costs. In the provision of knowledge and information goods, such as in the university sector, the presumed physical technology of choice is computerisation. However, benefits from computerisation not only has a time-lag to account for user re-training, the evidence available suggests that the benefits are usually not in typical values (number of degrees, number of enrolled students), but in research outcomes and positive externalities from such research. The possibility however of large scale provision of university education through Internet-enabled technologies is plausible, overcoming the "iron triangle" of access, quality, and cost. When physical limitations come down to bandwidth rather than the need for a lecture theatre, when temporal limitations can be reduced by asynchronous provision of content, when content is provided digitally, etc., allow for the possibility of a massive improvement in access, with reduced cost-per-student, and a trade-off between the qualitative benefits of a more immediate distance for more flexible time.

The provision of information goods as digital products allows for component-cost differentiation. Content itself has the highest level of effectiveness with supplied at their near-zero marginal cost and with the best possible data throughput (e.g., fibre to the premises). This would effectively mean free content to any who wish to access it as a public good. Because of the differential in the cost of product versus the cost of distribution, the production of university-level content is an area where public funding is appropriate and is additionally justified by the public provision of content produced with said funding, with the sort of quality control that one would find in some specialist websites today (e.g., the Stanford Encyclopedia of Philosophy, Rice University's OpenStax, MIT OpenCourseWare) however, also in a structured manner (such as with most MOOCs). Indeed, there is a very good argument to be made that all university content be publically available with an open-source license (e.g., Creative Commons Non-Commercial Share Alike), including publications such as journal articles and books. With the addition of assessment, the provision of degrees would become available with the the cost of administration amortised as the learner's contribution, with additional fees for those who desire additional tutoring. In other words, the maximum free provision of content is encouraged, thus providing the widest distribution of university-level knowledge with the resulting improvements in production through positive externalities, with content creation provided through public funding, and with service-sector costs (assessment, tutorials) provided on a component basis to learner.

Obviously the provision of structured content in a course requires some sort of Learning Management System. The quantitative survey of this inquiry, matching the qualitative surveys, indicates that there are both learning advantages and trends that favour FOSS LMSs with modularity, speed-of-deployment, responsiveness to customer needs etc. However, there has been some suggestions from the surveys in particular that existing LMSs have not fully integrated the insights of andragogical theory into these systems, recognising that the learner has increasing levels of self-motivation, voluntarism, experiential resources, a research orientation, practicality of content, and social equality between teacher and learner [6]. A key component of this is the notion of educator and user control, which suggests localised administration of content, structure, and optional extensions, along with a client-server architecture to empower the adult learner and provide them the autonomy in managing their own learning environment. Indeed, just like the argument that publically-funded content generation for coursework and research should be publically available for the purpose of generating positive externalities, likewise the development of software within the university too should be treated the same with an eventual transition to a fully FOSS environment.

There is, of course, an obvious practical limitation with the this digital University of the Future, and that refers to the continued need for physicality in some cases. Certainly many engineering or chemistry experiments, veterinary science practical exercises, etc, would be difficult to conduct over an Internet-enabled classroom. Simply put, not all learning is "book-learning", and even then some of the books are archives dating from an era of undigitised texts, typed pages, vellum, scrollwork, inscriptions on pottery etc. The University, as a physical place, still has enormous justification to remain in existence not just for these purposes, but also as a site where a community of scholars can interact. This may be a very utopian perspective, but it also serves as a reminder that, in the final instance, the university is not an institution but rather the locus of knowledge:

"The real University ... has no specific location. It owns no property, pays no salaries and receives no material dues. The real University is a state of mind. It is that great heritage of rational thought that has been brought down to us through the centuries and which does not exist at any specific location. It's a state of mind which is regenerated throughout the centuries by a body of people who traditionally carry the title of professor, but even that title is not part of the real University. The real University is nothing less than the continuing body of reason itself." [7]

5.3 Leadership Through Praxis

Regardless of the grounded predictions that changes from an idealised thought-experiment can bring, or utopian perspectives of the university as "the continuing body of reason itself" the reality is that universities are institutions, subject to both external and internal governance, funding arrangements, and contracts with external parties. It has already been noted that widespread analysis from the OECD illustrates that when institutional reform occurs at the university-level, whether imposed from within or external directives, the purpose is invariably ideological and the claimed improvements do not eventuate. Likewise, it has been illustrated that a primary means of business expansion for closed source software in LMSs and elsewhere is through acquisitions of potential competitors, rather than improved functionality. The primary business model of journal publishing is through subscription models, to the point that they become the dominant acquisition expense for university libraries. In a nutshell, the assertion of protection of "intellectual property" claims for monopolistic profits on the level of content and software, and empire-building for the purpose of monopolistic profits on the institutional level, which are systemically higher than competitive profits, and reduce consumer power.

In this regard one finally must turn to the field of leadership studies. It is simply not enough to provide a superior vision, even if the evidence for that vision is quite clearly favourable in economic, educational, and engineering grounds. Humanistic sentimentality aside, it is not a concern of the university administrator whether or not there are extensive positive externalities to be generated by providing free and open-source educational content, or to have the cost of degree to the learner reflect the price of necessary inputs. To the line-manager, it is not their concern whether an LMS provides increased flexibility and options to the educator, or the ability to for the learner to manage their own environment. Their concern is primarily to have the security of contractual control, and to reduce real or imagined risks, and a preferred means to achieve this is to purchase what appears to be a stable software product with a large corporate backing, and even one which minimises the latent-knowledge that can be acquired by in-house IT workers; as the widespread 1970s cliché stated: "Nobody ever got fired for buying IBM".

Of course, this is only partially true for internal deployments, and one may note that IBM is one of the world's most significant contributors to open-source software. There is a notable telos within information goods noted in this inquiry that gives advantages in various open-source licenses that are difficult to replicate in proprietary software. As noted, there is already widespread evidence that across various levels of computing (supercomputing, server systems, personal computing, embedded systems) that the proportion of open-source operating systems and applications has increased to the point of overwhelming dominance in all environments except personal computing (where its position has merely improved). This is also evident, in this study, with the increasing installation share of LMSs with open-source versus proprietary licenses. In this regard, a technically well-informed strategic leader should be able to make the appropriate decisions to make use of the most effective information goods for the task at hand.

However, the same does not apply for positive externalities, that is, the provision of content or the physical infrastructure between the university provider and learners. Positive externalities tend to be under-supplied in discrete market transactions and this is clearly obviously in information goods which deliberately set up artificial barriers to content (e.g., paywalls). Overcoming such barriers (e.g., through websites of questionable legality) is, of course, a cultural norm from a consumer perspective but even then information publishers would certainly target institutional bodies that sort to circumvent such an advantageous market position. In such a situation, transformational

leadership can only come from the outside, that is, a directive that the content of publically-funded university education must be publically-available.

The provision of positive externalities and mitigation of negative externalities themselves are subject to vagaries of the political process even when their effects can be calculated with a high degree of accuracy. In Australia, two very significant examples stand out; the decision not to implement the National Broadband Network with a Fibre-to-the-Premises model was buried as it would have challenged existing media infrastructure [8], and the fate of carbon pricing in the Clean Energy Act 2011 [9]. The reality is that even if the the university sector provided well-grounded reasons for increased public funding and public content, the sector lacks proportionate institutional and therefore political power. A challenge for the university sector is to leverage the existing public sympathy, itself induced by increased participation rates, even if deep loyalty is mainly limited to those who are directly involved. To increase the transactional power, and therefore provide opportunities for transactional leadership, the university sector needs to widen its participation base and therefore the depth and width of public loyalty, and viability of protest. For it is a curious fact on how little attention is drawn in conventional leadership studies to the effectiveness of political protest [10] and certainly within the higher education sector literature reviews [11, 12, 13] indicate that leadership is more about the strategic vision of the university and human resource management, rather than the promotion of higher education. In other words, the university as a business in competition with other university businesses, the antithesis of free and accessible education to raise public wealth and knowledge.

Numerous philosophers of social action (e.g., Marx, Sartre, Arendt, Freire) have emphasised the need for praxis as a transformational strategy, the refection of knowledge of a social world and the action for transformation, that generates the results for further reflection, and action, and so forth. It is possible, even with some immediacy, that those convinced of the advantages of generating positive externalities and institutional loyalties can do so independently of the of the formalities and necessities for an ideal implementation; one should not let "perfect" be the enemy of "good". Indeed, from a perspective of the experience of the SARS-CoV-2 pandemic of the last two years it would be a case of justified anticipation of the possibility of continuing or future similar circumstances. Of course, objections can be raised on matters of minutiae, edge-cases, or those derived from a visceral dissonance; radical change is always disruptive and challenging to habits, but certainly few would doubt that the university sector can continue "business as usual" in the face of massive demographic changes, increasing economic and political pressures, all in the context of the rapid advances in information and communication technologies. The ultimate question is where, in either the political world or the university sector, is the sort of leadership that recognises the evidence of the value of freely accessible information in both the provision of physical infrastructure and the removal of legal fetters and that recognises the value of appropriate level public funding to support improved qualifications? This question, in many ways the antithesis of the EY report referred to in the initial chapter and subsection, is an ongoing research question, on whether our society will head towards a free and open university sector or one where the direction and funding is determined by access to capital, with external costs or benefits ignored.

It is in this situation that this largely macroscopic inquiry, supplemented by more detailed quantitative interviews, sought to explore. As a multi-disciplinary study it drew from demographics, public economics, computer engineering, intellectual property seeking to answer a question to what degree the contemporary university could or should be replaced the online provision of content. With an initial literature review that covered the historical relationship of between technology and the university, the relationship with public economics, and online educational theories, the study took up matters of methodology and selected appropriate quantitative and qualitative methods for

53

desktop and interview-based inquiries, respectively, with results illustrating the seriousness of the demographic challenges, the issues of public funding and externalities, engineering and licensing developments, and the subjective and experiential perspectives of learners, educators, and designers. The conclusion and recommendations provided suggested trajectories in increased participation, the conflicting vectors in university education funding the cost-disease of the service sector and positive externalities, trends in computational capacity and the increasing prevalence of open-source licensing but also with design (lack of andragogical perspective), architectural (cloud in preference of client/server models) and administrative decisions limiting their implementation. The concluding remarks here note that institutional power and leadership is essential for a more optimal implementation of online university-level education.

There are, of course, many limitations in a study of this size attempting a subject of this scope. Explicit limitations included a institutional limit of university-level content only, whereas a more challenging topic for future research would include higher education in general, for example. The geographical limits of the studies in demographics and public economics and benefits were largely limited to an Australian context, whereas it would be worthwhile to see to what degree the trends and econometric analysis would also apply in other countries, starting from the OECD nations. With regard to the discussion of cost-disease in higher education versus revenue theory of costs it would be preferable for more local data rather than the United States, however this limitation is alleviated due to the variation being largely industry-based rather than country-based. Whilst the Australian Bureau of Statistics does publish Producer Price Indexes, it does not include education in its summaries of service industries. It would have also been appropriate to engage in a thorough investigation into engineering and computational capacity and the capability to engage in online education. A much wider and deeper qualitative survey would have also been appreciated and, following the existing survey, a more developed exploration of the suggestion of a client/server model with andragogical inclusions as an open-source LMS or extension to existing technologies. Of course, identifying limitations in this manner provides opportunities for future investigations. Certainly, like this inquiry these too will be challenging and confronting, and can bring discomfort. But as Confucius said: "The scholar who cherishes the love of comfort is not fit to be deemed a scholar." [14]

5.4 References

[1] Mike Allen (ed), Purpose of Quantitative Research, in The SAGE Encyclopedia of Communication Research Methods, SAGE Publications, 2017.
https://dx.doi.org/10.4135/9781483381411.n476
[2] Janice M. Morse, Peggy Anne Field, The purpose of qualitative research, The purpose of qualitative research, in Nursing Research, Springer, 1996.
https://doi.org/10.1007/978-1-4899-4471-9_1
[3] Martin Fink. The Business and Economics of Linux and Open Source. Prentice Hall Professional, 2003
[4] Lindsay Bertram Yeates, Thought Experimentation: A Cognitive Approach, Graduate Diploma in Arts (By Research) Dissertation, University of New South Wales, 2004
[5] Australia Department of Employment, Education and Training, Higher education : a policy statement, Australian Government Publishing Service, 1988
[6] M.S. Knowles, E.F. Holton, R.A. Swanson. Beyond andragogy. In The adult learner: The definitive classic in adult education and human resource development (5th ed., pp. 153–179). Gulf Publishing Company, 1998

[7] Robert M. Pirsig, Zen and the Art of Motorcycle Maintenance: An Inquiry Into Values, William Morrow & Company, 1999 [FP 1974], p159

[8] Anthony Eales, The tragedy of Australia's NBN, Independent Australia, 24 May, 2018

[9] Kate Crowley, Up and down with climate politics 2013–2016: the repeal of carbon pricing in Australia, WIREs Climate Change, Volume8, Issue3, May/June 2017

[10] Daniel Q Gillion. The Political Power of Protest: Minority Activism and Shifts in Public Policy', Cambridge University Press, 2013

[11] M.J. Amey. Leadership in higher education. Change: The magazine of higher learning, 38(6), 55-58, 2006

[12] Alan Bryman. Effective leadership in higher education: a literature review, Studies in Higher Education, 32:6, 693-710, 2007 DOI: 10.1080/03075070701685114

[13] Black, S. A.. Qualities of effective leadership in higher education. Open Journal of Leadership, 4(02), 54., 2015

[14] J. Legge, (trans),The Analects Attributed to Confucius [Kongfuzi], 551-479 BCE, Chapter 14, 1893 [FP 1861]