



THE UNIVERSITY *of* EDINBURGH

Edinburgh Research Explorer

Policy networks, performance metrics and platform markets

Citation for published version:

Williamson, B 2019, 'Policy networks, performance metrics and platform markets: Charting the expanding data infrastructure of higher education', *British Journal of Educational Technology*, pp. 1-16.
<https://doi.org/10.1111/bjet.12849>

Digital Object Identifier (DOI):

[10.1111/bjet.12849](https://doi.org/10.1111/bjet.12849)

Link:

[Link to publication record in Edinburgh Research Explorer](#)

Document Version:

Peer reviewed version

Published In:

British Journal of Educational Technology

Publisher Rights Statement:

This is the pre-peer reviewed version of the following article: Williamson, B. (2019), Policy networks, performance metrics and platform markets: Charting the expanding data infrastructure of higher education. Br J Educ Technol. doi:10.1111/bjet.12849, which has been published in final form at <https://onlinelibrary.wiley.com/doi/full/10.1111/bjet.12849>. This article may be used for non-commercial purposes in accordance with Wiley Terms and Conditions for Use of Self-Archived Versions."

General rights

Copyright for the publications made accessible via the Edinburgh Research Explorer is retained by the author(s) and / or other copyright owners and it is a condition of accessing these publications that users recognise and abide by the legal requirements associated with these rights.

Take down policy

The University of Edinburgh has made every reasonable effort to ensure that Edinburgh Research Explorer content complies with UK legislation. If you believe that the public display of this file breaches copyright please contact openaccess@ed.ac.uk providing details, and we will remove access to the work immediately and investigate your claim.



Policy networks, performance metrics, and platform markets: charting the expanding data infrastructure of higher education

Ben Williamson, University of Edinburgh

ben.williamson@ed.ac.uk

Author's version of research article published in *British Journal of Educational Technology*: <https://doi.org/10.1111/bjet.12849>

Abstract Digital data are transforming higher education to be more student-focused and metrics-centred. In the UK, capturing detailed data about students has become a government priority, with an emphasis on using student data to measure, compare and assess university performance. The purpose of this article is to examine the governmental and commercial drivers of current large-scale technological efforts to collect and analyse student data in UK higher education. The result is an expanding data infrastructure which includes large-scale and longitudinal datasets, learning analytics services, student apps, data dashboards, and digital learning platforms powered by artificial intelligence. Education data scientists have built positive pedagogic cases for student data analysis, learning analytics and AI. The politicization and commercialization of the wider HE data infrastructure is translating them into performance metrics in an increasingly market-driven sector, raising the need for policy frameworks for ethical, pedagogically valuable uses of student data in HE.

Keywords *data, data infrastructure, markets, performance metrics, policy networks*

Structured practitioner notes

What is already known about this topic

- Learning analytics, education data science, and artificial intelligence are opening up new ways of collecting and analysing student data in higher education
- UK government policies emphasize the use of student data for improvements to teaching and learning

What this paper adds

- A conceptual framework from 'infrastructure studies' demonstrates how political objectives and commercial aims are fused to HE data systems, with data infrastructure becoming a key tool of government reform

- A critical infrastructure analysis shows that student data-processing technologies are being developed and deployed to measure university performance through student data

Implications for practice and/ or policy

- Educators and managers in universities need to prepare robust institutional frameworks to govern their use of student data
- Learning analytics practitioners, data scientists, learning scientists, and social science researchers need to collaborate with the policy community and education technology developers on new policy frameworks to challenge narrow uses of student data as performance metrics

Introduction

Digital data are increasingly powerful sources for policymaking, planning and pedagogy in higher education. In particular, as public quantitative measures of assessment, evaluation, and comparison, new metrics are used by HE policymakers, leaders, evaluators, the media, students, and wider publics to judge and rank individual institutions, courses, staff, or even the sector as a whole (Espeland & Sauder, 2016). As in many other countries, HE policy in the UK is increasingly centred on capturing data about the ‘performance’ of people, institutions, and the sector as a whole, reflecting wider shifts to a “society of rankings” where simplified and standardized metrics act as key reference points for decision-making (Esposito & Stark, 2019, p. 15). In the UK, research metrics are already used to audit, compare, and assess the quality of research outputs and impact (Wilsdon et al, 2015). Other metric exercises have expanded to the rating of university teaching quality and the ‘value’ of academic labour, increasing “quantified control” through “metricization of the academy” (Burrows, 2012, p. 356). Capturing detailed and granular data about students has now become a government priority, as student data have been reframed as key resources for performance measurement of universities, faculties, courses and staff, resulting in the production of a vast machinery for the enumeration of the university (Williamson, 2018).

The article offers a detailed analysis of current large-scale technological efforts to collect and analyse student data in UK HE. A network of actors from government, businesses, consultancies, agencies, and think tanks is promoting and producing a joined-up, interoperable data infrastructure to accomplish this task. Diverse forms of student data are becoming available, from historical records, library metrics,

learning management system logins, assessment systems, and plagiarism detection software, to learning analytics traces, learning gain data, longitudinal graduate outcomes data, and social media activity. Many sources of student data are being made interoperable, allowing extensive data-linking, time-series analysis, and aggregation of datasets, as they are connected into a large-scale networked infrastructure for measuring, evaluating and governing HE performance. This infrastructure, however, is not just a technical accomplishment, but the realization of a long-term political project to reform HE in the UK through performance measurement, accountability mechanisms, and market competition.

The article explores the values and politics encoded in the student data infrastructure through examining (1) the policy network of organizations driving its development, (2) the specific measurement technologies it includes and their production of performance metrics, and (3) how a new market is emerging for competitive data service providers. It highlights how developments in education, such as big data, learning analytics (LA) and artificial intelligence (AI), are being politically re-purposed as technologies of performance measurement, comparison and competition, as well as being appropriated into commercial expansion across the HE system. The analysis reveals synergies between governmental and commercial actors, as well as unresolved tensions with researchers and practitioners in university settings, concluding that rigorous forms of multi-stakeholder engagement are required to develop institutional strategies and policy frameworks for constructive use of student data (also see Tsai et al, 2018; Corrin et al, 2019).

Researchers of LA, AI and education data science have established their potential to reshape and improve teaching, learning and curriculum (Cope & Kalantzis, 2015; Lang et al, 2017; Daniel, 2019), recognizing the ethical challenges that need confronting (Slade & Prinsloo, 2013; Kitton & Knight, *this issue*), values-based approaches to analytics (Richards & Dignum, *this issue*), and the importance of theory-building (Buckingham Shum & Knight 2017). Some assessments of digital data in HE have led to ideals of the ‘smarter university’ (Lane 2014), while others more critically analyse ‘neoliberalizing’ processes of ‘marketization’ (Komljenovic 2018), ‘unbundling’ (McCowan, 2017), and commercialization made possible by ‘datafication’ (Selwyn, 2014; Czerniewicz, 2018), and their role in creating a “student-consumer” as an “active service-user” of HE (Tomlinson, 2017, p. 457). Political aims and business objectives are becoming aligned as common aspirations. While governments might gain sectoral insight into the HE marketplace from

accessing student data (Clark, 2015), businesses that help extract the data can use it for commercial advantage as insights for product development of monetizable ‘HE data services solutions’ (Robertson, 2019). As such, current large-scale government-led projects in HE data infrastructure, learning analytics and AI are part of an ongoing reassembling of HE in relation to the wider data environment, policy context, and political economy (Bacevic, 2018; Berry, 2018; Muellerleile & Lewis, 2019).

The key argument in this article is that while LA and AI practitioners advocate the positive potential of data infrastructure-building for student-empowering learning in HE (Johannes & Thille, *this issue*), the synchronous appropriation of student data for purposes of accountability assessment and commercial advantage is reinforcing metric practices of performance comparison, evaluation and ranking that induce anxiety at all levels of HE institutions, reframe HE as a competitive market, and produce perverse consequences (Burrows, 2012; Busch, 2017; Espeland & Sauder, 2016; Muller, 2018). These are not dichotomous positions. The ideal of student-empowering analytics co-exists with the political priority to make HE more metrics-powered. The purpose of this article is to highlight through empirical documentation how the politics of metrics-powered HE thoroughly infuses current efforts to embed student data systems across the UK HE sector, and to concentrate critical attention on the politics of the infrastructures involved in the collection, calculation, and communication of student data.

Recent sociological research on HE metrics, rankings and comparative performance measurement raises two critical points: pressures to measure performance as a form of accountability incentivize the replacement of professional judgment and expert authority with oversimplified numerical ratings (Busch, 2017; Muller, 2018); quantitative accountability measures “change what they are designed to reflect” by altering the definition of a ‘good university’ or a ‘good course’, thereby reshaping how people think about the quality and worth of higher education and producing different kinds of ‘reactive’ behaviours in response (Espeland & Sauder, 2016, p.16). The ‘reactivity’ produced by measurement is especially significant in the UK HE data infrastructure documented below, as technologies of student quantification such as learning analytics are put to the task of not merely ‘reflecting’ the performance of courses and institutions but to stimulating ‘reactions’ that change how universities operate according to political definitions of what constitutes competitive performance in a sector of rankings.

Simply put, HE data systems are not neutral: both political and business interests are encoded in their software architectures.

Data infrastructures

The empirical aim of this article is to document how political and commercial actors have begun to repurpose student data and analytics for comparative performance measurement and public accountability, particularly by examining the HE data infrastructure under construction in the UK to accomplish this aim. Theoretically, the paper is situated in ‘infrastructure studies’, a branch of the sociology of science and technology dedicated to conceptualizing the technical, social, political and economic work involved in producing large-scale networked systems and their subsequent effects (Slota & Bowker, 2017). Studies that adopt an ‘infrastructural optic’ foreground the power, knowledge and expert assumptions of the producers of infrastructures; the labour required for their functioning, repair, and maintenance; the scales at which they operate; their relations with other systems; and the ideological work involved in imagining, assembling, and maintaining infrastructures (Plantin & Punathambekar, 2018).

Infrastructure studies have become especially significant in the analysis of large-scale data systems as they have become “hubs of command and control over production, consumption, and exchange” of data (Bigo, Isin & Ruppert, 2019, p.13). Data infrastructures encompass the various aspects involved in the collection, connection, calculation, communication, and consumption of data, or, as Kitchin (2014, p. 32) defines them, “the institutional, physical, and digital means for storing, sharing and consuming data across networked technologies”. These networked elements are rarely stable, as infrastructures provide the ‘sockets’ for other programs, applications and software to be ‘plugged in’, thereby expanding the infrastructure, changing its form, and reworking the possibilities of its use (Plantin et al, 2016). Data infrastructures evolve and mutate over time, through significant effort and investment, continually adapting to new technical innovations, organizational changes, new business models, market fluctuations, and the dynamics of the political economy (Kitchin & Lauriault, 2014).

A data infrastructure, then, consists of more than just technical systems. It includes technological objects, data standards, administrative procedures, and long-term organizational work, and is thus always “braided with social, cultural and political actors and their values” (Slota & Bowker, 2017, pp. 531-32). As such, a data infrastructure is integral to how “social facts” about a society are generated, which

also changes the possibilities of social action because “the preferences, values and practices” of those who built the infrastructure shape how it can be used: “infrastructural work is fundamentally and pervasively political” (Slota & Bowker, 2017, p. 545). The insight that politics and infrastructure are inseparable is important in studying data infrastructures created to realize governmental authority in sectors such as education (Gulson & Sellar, 2018).

Understood as political machinery, data infrastructures are integral to a modern form of authority termed ‘metric power’ (Beer, 2016). Acknowledging the long history of statistics in society, Beer (2016, p. 3) argues that the machinery of enumeration has intensified rapidly in the last decade, “allied with a set of cultural changes in which the pursuit of measurement is seen to be highly desirable”. Central to metric power is the use of data in ‘neoliberal’ forms of governance, with measurement facilitating the forms of comparison and ranking that realize neoliberalism’s emphasis on markets and competition. Defining neoliberalism as the “generalization of competition” and the extension of the “model of the market” from economics to other social domains, Beer (2016, p. 171) therefore argues, “the advancement of metrics has certainly unblocked the pathways of neoliberal governance today”. Within HE, university rankings function according to the neoliberal logic of metric power by “providing consumers with useful information” about the “specialized product market” of courses and universities to choose from (Espeland & Sauder, 2016, p. 11). The “metricization of the UK academy” has led to the HE sector not only “*mimicking* the market” but *enacting* “competitive market processes” (Burrows, 2012, p. 357).

Understood through this infrastructural optic, the emerging data infrastructure of HE consists of a complex of relations between technical systems, social actors, policies, politics and values which function together to instantiate neoliberal metric power and quantified control over universities in the UK. Moreover, as new elements are plugged in, its form and functions are expanded. Although practitioners in education data science have articulated the positive benefits of LA, AI and big data analytics, their potential uses and purposes shift as they are braided into the wider infrastructure and fused with its governmental and commercial objectives.

Policy networks

Neoliberal governance is rarely achieved by state centres alone. Instead, governments achieve their objectives through expansive networks and relations

with other sectors, organizations, and technologies, such as think tanks, arms-length agencies, consultancies, businesses, and the techniques and instruments they employ (Peck & Theodore, 2015). Understanding the HE data infrastructure and its fusion to governmental objectives therefore requires close attention to the cross-sectoral networks that have produced and promoted it, and to the painstaking work involved in transforming politics into technology.

Current government-led efforts to produce new systems of student data collection can be traced back to the Department of Business, Innovation and Skills (BIS, now Business, Environment and Industrial Strategy). Setting out a reformatory HE strategy, BIS (2011, 2016a) made collection and analysis of student data a key priority along with other reforms including student fees and the evaluation of university teaching. During this period, the Higher Education Statistics Agency (HESA, the official statistics body for HE) was tasked with upgrading the existing infrastructure for student data that it had managed since 1993. Its Higher Education Data and Information Improvement Programme (HEDIIP) produced a blueprint for a “new data and information landscape for higher education in the UK” to enable improved data capability (KPMG, 2015). HESA subsequently established the Data Futures project to realize the HEDIIP blueprint. Commenced in 2016 with a timeline to national rollout in 2020 and a £7.4million budget, Data Futures will deliver an “upgraded” national infrastructure for student data collection, consisting of a software data platform, data quality standards, a standard student model, cloud storage, analytical tools, and data dashboards and visualization capacities (HESA, 2016).

These data innovations are already actively being pursued and promoted by other key HE organizations, think tanks and agencies. These include collaborations between the Higher Education Commission and the Policy Connect think tank (Policy Connect, 2016), and Universities UK, the education data business Civitas, and the HE digital learning agency Jisc (UUK, 2017). Illustratively, the Higher Education Policy Institute—“the UK’s only independent think tank devoted to higher education”—reported with Jisc on the potential of learning analytics to help HE providers monitor progress in relation to the Teaching Excellence and Student Outcomes Framework (TEF), such as by using “big datasets” from learning analytics for “measuring excellence or identification and resolution of areas for improvement” (Davies, Mullan & Feldman, 2017, pp. 7-8). It noted “measures derived from learning analytics engagement data could become part of an institutional submission for the TEF” (p. 40), and additionally that TEF demands

for “student outcomes and learning gain” data could be addressed with “core metrics” on graduates’ employment destinations (p. 42). The conception of learning analytics as new performance rankings technologies is not entirely consistent with ideals of ethically-focused and values-led student empowerment advocated by researchers and developers of learning analytics (Corrin et al, 2019).

The policy-networking activities have culminated in the establishment of the Office for Students (OfS) as a ‘data-led’ regulator of higher education, with HESA as its ‘designated data body’ and the Qualifications Assurance Agency (QAA) its ‘designated quality body’. As a “non-departmental public body” operating “at arm’s length from Government” under ‘guidance’ from the Department for Education (DfE), the OfS is an “explicitly pro-competition and pro-student choice” organization, as well as a “consumer focused market regulator” (BIS, 2016b). Improving student information and data is its key strategic priority (OfS, 2018a), which includes HESA data, official statistics, other administrative data, textual data such as student surveys, and “unstructured and big data from sources such as social media and web analytics” (OfS, 2018b, p.4). Increasingly focused on linking these datasets, the OfS strategy is to monitor and regulate HE institutions and the sector overall according to indicators of quality and performance. In 2019 the OfS placed 55% of all HE providers in England under ‘enhanced monitoring’, requiring them to produce extensive additional data on their performance (Parr & McIntyre, 2019).

As this brief survey of the policy network associated with the expanding HE data infrastructure demonstrates, HE governance is accomplished by a distributed web of agencies, think tanks, consultancies, and businesses alongside governmental authorities, typifying a neoliberal “policymaking condition characterized by the intensified and instantaneous connectivity of sites, channels, arenas, and nodes of policy development, evolution, and reproduction” (Peck & Theodore, 2015, p. 223). This does not mean the policy network is free of hierarchy or its own power structures and struggles. Government has retained a strong steering function, while delegating infrastructure-building to its agencies. Think tanks and consultancies have become supportive nodes, sometimes as outsourced contractors and other times as advocates with indirect influence. Crucially, within this networked policymaking condition, data infrastructure is the connective network to which all these actors and activities are linked, translating their various programs into a set of aligned interests, agendas and objectives. HE data infrastructure gives material form to the priorities of all the actors in the policy network, making their

aspirations operational and encoding politics in technology. It allows data to flow through the system, enabling government centres and their agencies to link up to universities, gather their institutional data, and use them for purposes of comparative performance measurement.

Performance metrics

Metric technologies and experts in measurement are integral to neoliberal governance as they are able to enumerate, compare, rank and evaluate the ‘market competitiveness’ of actors in a range of sectors (Davies, 2017). Higher education in the UK is increasingly treated as a market sector (Burrows, 2012), as exemplified by the recent emphasis on market-like performance rankings, demands for market competition, and the establishment of the OfS as a dedicated market regulator. In this context, HE data infrastructure is both a product of neoliberal fast policy, and an enactment of neoliberal metric power that treats HE as a measurable market. Although the aspirations behind it are often expressed in terms of efficiencies, value, cost-saving, student-centredness, and improved policymaking, these objectives also rely on the data infrastructure to generate metrics of the comparative market performance of universities as required by political demands.

HESA’s large-scale Data Futures program illustrates how student data are used in the production of performance metrics, and in making HE resemble a market. Data Futures fulfils demands for more useable and timely data, more efficient collection, and an acceleration in the collection of student data. However, as HESA’s chief executive has argued, developments in ‘big data’ will expand on it over time, as Data Futures provides the infrastructural sockets for linking governmental datasets and plugging in other innovations such as ‘real-time’ data reporting, learning analytics, and adaptive platforms (Clark, 2015). In particular, he highlighted the benefits in terms of enhancing market competition:

As we move further towards a marketised sector in England, the importance of data becomes ever more pronounced. Good data allow students to make informed choices, allow policymakers and regulators to make better decisions, promote public trust and confidence in the system, enable institutions to be competitive ... through providing competitive data for benchmarking purposes. (Clark, 2015, n.p.)

As a performance-enhancing program for a marketized sector, Data Futures positions ‘big data’ to improve students’ choice, policymakers’ decisions, and, especially, institutional competitiveness through comparative benchmarking. The

data strategy of the Office for Students, too, highlights its proposed uses of big data and machine learning in HE market regulation (OfS 2018b).

HESA's agency partners, Jisc and the QAA, are also key suppliers of performance data. A membership organization providing "digital solutions for UK education and research", Jisc's strategic "vision is for the UK to be the most digitally-advanced higher education, further education and research nation in the world" (<https://www.jisc.ac.uk/about>). Jisc's chief executive has described "the potential of Education 4.0"—an adaptation to the "fourth industrial revolution" of AI, big data, and the internet of things—where lecturers are displaced by technologies that "can teach the knowledge better", are "immersive" and "adaptive" to learners' needs, and include "virtual assistants" to "support students to navigate this world of choice and work with them to make decisions that will lead to future success" (Feldman, 2018).

Toward this vision, Jisc has positioned itself as the sector's key driver of learning analytics and AI services, as demonstrated by its 2018 launch of a 'national learning analytics architecture' for further and higher education (<https://www.jisc.ac.uk/learning-analytics>). It "uses real time and existing data to track student performance and activities" and to "monitor where, when and how students learn. ... This AI approach brings existing data together in one place" (Jisc, 2018). The integrated 'architecture' includes cloud-based storage and 'data explorer' functionality "that brings together the data from your various sources and provides quick, flexible visualisations". Its 'learning analytics predictor' helps teaching and support staff to use "predictive data modelling to identify students who might have problems" and "to plan interventions that support students". The learning analytics architecture is marketed to universities as an internal performance monitoring service, allowing institutions to monitor individual student performance, cohort performance, and course performance, as well as to use those performance data for risk-based predictive modelling and targeted intervention. Early 2019, HESA and Jisc announced a proposed organizational integration, so that "parallel developments in HESA's Data Futures and the Jisc Learner Analytics offering" would mean "even more value could be unlocked by bringing together a number of data transactions between institutions and a central data platform" (Youell, 2019).

Alternative sources of student data are also being sought as proxy performance measures. The QAA released a 2018 study into student satisfaction using social

media data. Based on a large sample of over 200,000 student reviews of HE providers scraped from Facebook, Whatuni.com and Studentcrowd.com (plus unpublished Twitter data), it produced a close-to-real-time “collective-judgment score” for each institution (Griffiths, Leaver & King, 2018). These new performance scores were then compared with government datasets such as TEF and National Student Survey (NSS) rankings, and found to have a strong positive association. Crowdsourced big data from the web, it suggested, are as reliable as large-scale student surveys and bureaucratic quality assessment exercises, and could therefore complement annual, retrospective performance metrics and rankings. It concluded, “the timely and reliable extraction of the student collective-judgment is an important method to facilitate quality improvement in higher education” (Griffiths et al, 2018, p. 22). As such, sentiment data scraped from social media have become legitimate performance data for rating universities, and for use by providers to identify under-performing areas for improvement between annual cycles of official evaluation.

Jisc, HESA, and QAA have established themselves as data-focused HE agencies. With their official links to the OfS, they are key actors in the data and analysis supply chain required to regulate the sector, as demonstrated by the OfS regulatory and data strategies (OfS, 2018a, b). As such, student data collected and held by HESA, Jisc and QAA have become potential regulatory resources for the OfS to mobilize as performance measures. Another example is the OfS program to measure ‘learning gain’, as political attention turns from degree awards as a metric of university performance to ‘value-added’ scores determined by measures taken at the beginning and end of students’ degrees (Evans, Kandiko Howson & Forsythe, 2018). Among the learning gain pilot projects, “several are using learning gain data to feed into learning analytics systems”, or “student-level dashboards on progression”, and other “data platforms” for “institutional analysis on student attainment gaps”, while future possibilities include “learning gain metrics feeding into future iterations of the TEF, either as core metrics, as part of the qualitative submission, as subject-level measures or in a new design of the exercise all together” (Kandiko Howson, 2017, n.p.). A major component of the OfS learning gain program is the Higher Education Learning Gain Analysis (HELGA), using linked government datasets to produce a ‘learning gain proxy’ allowing performance comparisons between institutions (Hawkins, 2018). These OfS activities demonstrate that “measuring learning gain is considered a policy panacea”, as further evidenced by “global appetite from government ministries and the media for a universal tool to measure learning outcomes at the institutional

level to permit comparisons across HEIs in the UK and internationally” (Evans et al, 2018, pp. 1-2). The fact learning analytics platforms are being trialled alongside the development of learning gain measures demonstrates how learning analytics are being governmentalized to produce performance metrics.

The OfS is also seeking to expand use of long-range data, especially the Longitudinal Education Outcomes (LEO) dataset, “as an important source of information about graduate outcomes” (OfS, 2018a, p. 25). LEO consists of experimental statistics on employment and earnings, using matched data from different government departments, controversially used to suggest that students can choose courses based on future earnings potential (Morris, 2017). Like HELGA, LEO is a significant methodological accomplishment, linking datasets about education, personal characteristics, employment, income, and benefits, gathered from the departments of education, revenue and taxation, work and pensions, and HESA. Moreover, the new centralized Graduate Outcomes survey led by HESA, considered the “the single biggest social survey outside of the 10-yearly national census”, will also collect longitudinal data on graduate outcomes, destinations and employment, and will be analysed through data-linking with other HESA and LEO datasets (Grey, 2018). These and similar ‘Graduate Tracer Studies’ utilizing linked student data, salary data and administrative data are being pursued around the world, supported by international organizations including the World Bank (Hewitt, 2019). In 2019 the Bill and Melinda Gates Foundation announced a Postsecondary Value Commission to define the financial value of HE in the US using program-level average earnings and loan repayment rate data (Tampio, 2019).

As signalled in its data strategy, the OfS is already ambitiously extending the data infrastructural capacity of Data Futures to link to other administrative and governmental datasets, such as HELGA, LEO and other datasets held by HESA, Jisc and QAA, while seeking new sources of big data and machine learning methods to expand it further (OfS, 2018b). These key agencies are establishing the parameters of the HE data infrastructure to fulfil governmental objectives of performance measurement, accountability, market competition and value for money, and positioning themselves as key nodes in the expanding network of metric power and quantified control in higher education. They are casting an enumerative grid across HE to capture an increasingly detailed statistical picture of the sector, and becoming elite experts in HE numbers—with both the metrological machinery and analytical skills to process them—under an advanced form of

neoliberalism that seeks to make social worlds resemble markets (Davies 2017). This form of governance depends on data and metrics to render institutions and individuals visible as a competitive market, whose different performances may then be compared, evaluated, ranked, and targeted for improvement, reward, or regulation.

Platform markets

While it is clear performance metrics are making HE increasingly resemble a market, there remains a need to account more specifically for the role of technical services and platforms in HE marketization. The formerly non-market space of higher education has been reframed and re-made as an ‘education services market’ by a ‘global higher education industry’ of platform providers (Komljenovic, 2018) that is seeking to create a new ‘value economy’ in the academy through the production of ‘essential’ data solutions services (Robertson, 2019). Robertson and Komljenovic (2016) argue that HE markets do not simply appear as the outcome of market ideology, but instead are made and maintained through dynamic activity, as new products, services, and openings are imagined, invented, and implemented. This market-making process in HE involves considerable ‘investment’ at the macro-level by policymakers, politicians, agencies, education firms, and universities to imagine higher education as a market to be opened up and exploited. At the micro-level it also involves the ‘nuts and bolts’ of creating higher education products and services that can be exchanged in a range of marketplaces. As such, understanding HE marketization requires not just macro analysis of neoliberal political ideology, but micro analysis of the practical, material, technical and discursive effort of market-making and maintenance.

One key mechanism of market-making is data visualization. Data dashboard platforms have become core technologies in HE, acting as mediating devices to enable users—such as HE leaders, sector agencies, public bodies, and government departments—to interact with graphically presented data about institutions. For example, HESA, QAA and Jisc have collaboratively designed the ‘Provider Healthcheck Dashboard’ to allow providers to perform ‘in-house healthchecks’ by comparing their institutional performances, on many metrics, against competitors (HESA, 2018). The metrics used in the Healthcheck dashboard include TEF ratings, QAA quality measurements, NSS scores, league tables, degree rankings, and graduate employment. The dashboard allows university leaders to examine time series performance data and benchmarked data with other providers, demonstrating in visual, easy-to-read format how an individual provider is situated

in the wider market of HE performance. In this way, the Healthcheck dashboard is prototypical of the marketization of the sector through data visualization made possible by the wider data infrastructure. Data visualization makes it possible to ‘see’ HE as a competitive market.

The OfS also has a strategic priority to enable students and potential applicants to access relevant visualized performance data. One example created by Jisc, as part of its learning analytics architecture, is the student app Study Goal. As described on the Google Play app store, “Study Goal borrows ideas from fitness apps, allowing students to see their learning activity, set targets, record their own activity amongst other things”. In addition, it encourages students to benchmark themselves against peers, and can be used to monitor attendance at lectures. Study Goal translates the phenomenon of fitness and health monitoring into student self-tracking and surveillance, and like fitness trackers ‘gamifies’ the idea of the individual comparing and benchmarking against the competition.

The potential market for student-facing apps is set to grow, as the data infrastructure extends from statistical centres into the hands of HE consumers. In summer 2018 the Department for Education announced an ‘Open Data Competition’ allowing software developers access to longitudinal student employment and earnings outcomes data (the LEO dataset administered by HESA) in order to create apps or online services to support degree choice by prospective students. On its launch, the universities minister announced: “We want students to be better informed about degree choices & the returns—today, we’re officially launching a competition for tech companies to take graduate data & create a MoneySuperMarket for students, giving them real power to make the right choice” (Gyimah, 2018). Its logic is that student choice is best made on the basis of projected future earnings, as a form of return-on-investment from one’s educational choice in the market of providers and courses. The finalists announced late 2018 all emphasize the interactive presentation of graduate earnings data, along with other HE metrics, to shape and ‘nudge’ the choices of prospective students (Gov.uk, 2018). They encourage prospective students to think of HE as a marketplace, and to see themselves as future ‘human capital’ whose university choices are a form of self-investment which will affect their future prospects and value in labour markets. As Kernohan (2018) notes, graduate earnings data has become “political data designed to act as a signal in the still fondly hoped for HE market”.

A growing market of similar online services and app-based platforms aimed at matching student graduates to labour markets already exists (Williamson, 2019), including those using “cognitive psychometric intelligence” data about students alongside machine learning and “predictive talent analytics” (Olson, 2018). These and similar apps look set to expand the HE data infrastructure in years to come, with universities minister Sam Gyimah noting there is “clearly a market opportunity” for them (McDonald, 2018). The Department for Education’s ‘EdTech Strategy’ has made international market growth in UK-based educational technology products a key priority and is actively incentivizing, funding, and promoting the industry (DfE, 2019).

As part of the active growth of the edtech industry and market, the global education business Pearson has become a key player in UK HE. A multi-billion dollar company experiencing significant growth in its HE division, Pearson offers online degree infrastructure, with several UK universities entering into long-term 10-year deals with the company to deliver courses. Through its “full-service approach to creating online degree programs or individual learning solutions”, Pearson claims its online learning services are “in demand by the labor market”, deliver “measurable improvements in outcomes”, help to “improve your rankings by elevating your brand”, and strengthen “market awareness” to boost universities’ reputational advantage (<https://www.pearson.com/us/higher-education/why-choose-pearson/thought-leadership/online-blended-learning/online-learning-services.html>). Pearson also released a report predicting a shift to ‘demand driven education’, which would “focus more strongly than ever on ensuring graduates are job-ready and have access to rewarding careers over the course of their lifetime” (Deegan & Martin, 2018, p. 7). As part of its approach to education as labour market preparation, Pearson even encourages the use of AI-driven predictive talent analytics to “identify potential matches between learners and specific career paths” (p. 20). Notably, too, Pearson is changing its business model to focus more on the student as a market consumer of platform services and on-demand media:

‘Silicon Valley companies create the benchmark for the digital experience by being platform businesses. Our vision is to leverage the opportunity to transform along similar lines in terms of having a single platform globally that ... would allow us to move into a more personalized experience that delivers high-quality education outcomes. It would be game-changing for not only Pearson, but for the entire industry if we could create that single platform, similar to Netflix, Spotify, and Amazon’. (High 2018)

Pearson is building a Silicon Valley-inspired platform with potential reach to millions of students, who it addresses explicitly as social media consumers, at the same time as treating universities as long-term partners in its online learning services infrastructure and as labour market preparation centres.

From these examples, it is apparent how software platforms themselves are both plugged in to the expanding HE data infrastructure and are extending the measurement of the university and the sector. These platforms open and exploit new markets, turning universities into buyers of seemingly ‘essential’ data services in a global higher education industry. Dashboards visualize HE itself as a competitive market in which institutions must compare and benchmark against others. Student apps invite students to act and see themselves as consumers from a market of value-for-money HE purchases, and to choose based on maximizing their potential for return-on-investment in labour markets. As new market spaces for platforms have opened up in HE, global data-driven firms including Google, Oracle, and Salesforce have all developed new products and services to sell to universities, enabling them to extract value from the student data they collect, with support from multinational consultancies including McKinsey & Company (Krawitz, Law & Litman, 2018). Underpinning many of these innovations are commercial business plans and business logics associated with the new political economy of ‘platform capitalism’—the generation of value and profit from the extraction of data from users (Srnicsek, 2016). In this sense, the university is reassembling in a new formation as it adapts to the political economy of neoliberal competition, markets, metrics, and platform capitalism, all enabled by the software platforms, data analytics, algorithms, and apps that are plugged together as an interoperable data infrastructure. Marketization of HE has become inseparable from the expanding data infrastructure which makes measurement and valuation of the sector possible.

Implications & conclusion

This article has examined the politicization and commercialization of data-driven educational technologies. As other papers in this special issue attest, learning analytics, AI and other software for data collection and analysis hold potential to increase understanding of learning processes, inform pedagogy and enhance curriculum design. At the same time, however, student data are being repurposed as proxies for performance measurement and accountability assessment in the current UK governmental environment, as HE becomes a sector of rankings embedded in a “society of rankings” (Esposito & Stark, 2019, p.9) and subjected to

increased “quantified control” (Burrows, 2012, p. 356). The expanding student data infrastructure, learning analytics and AI in UK HE face two ways at once: toward a student-empowering future of greater choice, personalized feedback, and customized teaching; and toward a metrics-powered future of performance comparison and competitive forms of neoliberal governance. The political preference for a metrics-powered HE is now reshaping the potential of student-empowerment that learning analytics practitioners advocate. It should concern educational data practitioners that perception is growing that the uptake of learning analytics in universities is largely driven by regulatory demands for performance data and new ways of rating higher education. Increasingly, too, commercial providers are reinforcing and enabling political ambitions to subject HE providers to enhanced performance monitoring, while simultaneously exploiting profit-making opportunities by generating commercial advantage from extracting valuable data from student and staff practices and then selling ‘essential’ new data services to universities.

Under neoliberal metric governance, universities are reshaped to behave as competitive businesses with consumers to attract and marketable results to report. Students are addressed as rational consumers choosing from a ‘HE services market’ based on measurable ‘value’, and as competitive individuals comparing their performance with peers. As a result, degree choice is reframed as an ‘investment’ with ‘returns’ that are measurable as ‘marketable outcomes’ and long-term earnings; university subject knowledge and degree awards are downplayed; and ‘learning gain’ metrics and other measurable outcomes are elevated as market-relevant indicators of student success. Business is being done inside the sector by for-profit vendors, making universities into buyers of essential data services and producers of student data. Consequently, academic work is becoming subject to the new forms of performance measurement made possible by these purchases, and the HE sector is increasingly being governed and regulated through rankings metrics based on the student data they produce. In short, the contemporary university is being reassembled through the expansion of the HE data infrastructure, with the pedagogic goals of learning analytics, AI and education data science being reworked as practical governance techniques of performance measurement. In this sense, the emerging HE data infrastructure generates ‘reactivity’ in the same way as other forms of HE ranking (Espeland & Sauder, 2016): its measurements do not just reflect what they set out to measure but alter how HE is understood, actively change behaviours in universities, and influence perceptions of the value and worth of education. Along the way, learning analytics

and AI technologies are reframed and reshaped too: as extensions or ‘plug-ins’ to existing metric techniques of performance measurement, accountability by numbers, and market-like comparative ranking.

Clearly a range of potential alternative uses, policy implications, and data practices may be made possible by the expanding data infrastructure. A different kind of university could be assembled around data, one that takes seriously the potential of student-empowering data uses while challenging, rather than reproducing, the politics of metrics-powered higher education. The European Union project Supporting Higher Education to Integrate Learning Analytics project offers a detailed policy framework for mature ‘student data informed’ HE (Tsai et al, 2018) that universities can consult in producing institutional strategies for constructive student data use. Based on extensive stakeholder engagement across the sector, SHEILA concluded that more dialogic approaches are required to deal with the social, ethical and cultural challenges of LA implementation. It highlighted how students and educators seek benefits of pedagogic and curricular improvement, while institution leaders emphasize performance improvement, and argued for the involvement of pedagogical expertise to “equip key users with reflective skills to interpret data and turn it into constructive actions” (Tsai et al, 2018, p. 5). As the report concludes, tensions remain between using LA to empower students to make learning-related decisions, and ‘datafying’ students by treating them as numbers for institutional performance evaluation. The latter brings the risk of ‘spoon-feeding’ students by implementing short-term targeted interventions in the pursuit of better performance metric scores.

In conclusion, the key implication of this tension between student-empowerment and metrics-powered HE is that the expanding data infrastructure needs to be approached through dialogue among institution leaders, policy professionals, academics across disciplines, pedagogic experts and students. Critical analyses by social scientists must also inform these debates, bringing greater understanding of the political, commercial and economic framing of student data as proxy performance metrics, and seeking other ways of engaging with data for the good of students and staff. Issues of data privacy, ethics, and other equity factors also need further interrogation and elaboration (see Kitto & Knight, *this issue*). The repurposing of learning analytics data as “blunt tools for such evaluative purposes” as performance auditing itself presents pressing ethical tensions for future resolution, while additional ethical questions regarding data ownership “can also be raised about the role of vendors of educational technology and learning analytics

systems in relation to the interests of students, academics and institutions” (Corrin et al, 2019, p.9). The positive alternative prospects of ‘student data informed’ HE depend on better future interdisciplinary collaboration and multi-sector dialogue between data scientists, policy officials, learning scientists, education technology developers and social scientists, challenging narrow governmental and commercial objectives to measure universities’ performance and students’ outcomes as numerical values based on the economic values of the market.

Statements on open data, ethics and conflict of interest

This article is based on analysis of publicly available documentary sources. It does not pose any risks to individuals or institutions. No potential conflict of interest was reported by the author.

References

- Bacevic, J. (2018). With or without U? Assemblage theory and (de)territorialising the university. *Globalisation, Societies and Education*: <https://doi.org/10.1080/14767724.2018.1498323>
- Beer, D. (2016). *Metric Power*. London: Palgrave Macmillan.
- Berry, D. (2018). The Data-Intensive University. Stunlaw, 14 September: <http://stunlaw.blogspot.com/2018/09/the-data-intensive-university.html>
- Bigo, D., Isin, E. & Ruppert, E. (2019). Data Politics. In Bigo, D., Isin, E. & Ruppert, E. (eds). *Data Politics: Worlds, subjects, rights* (pp. 1-18). London: Routledge.
- BIS (Department of Business, Innovation & Skills). (2011). *Students at the Heart of the System*. Gov.uk, June 2011: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/31384/11-944-higher-education-students-at-heart-of-system.pdf
- BIS (Department of Business, Innovation & Skills). (2016a). *Success as a Knowledge Economy: Teaching Excellence, Social Mobility and Student Choice*. Gov.uk, May 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/523546/bis-16-265-success-as-a-knowledge-economy-web.pdf
- BIS (Department of Business, Innovation & Skills). (2016b). Case for the creation of the Office for Students. Gov.uk, June 2016: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/527757/bis-16-292-ofs-case-for-creation.pdf
- Buckingham Shum, S. & Knight, S. (2017). Theory and learning analytics. In Lang, C., Siemens, G., Wise, A. & Gasevic, D. (eds) *Handbook of Learning Analytics*, 1st edn, 17-22. Society of Learning Analytics Research.
- Burrows, R. (2012). Living with the h-index? Metric assemblages in the contemporary academy. *The Sociological Review*, 60(2), pp. 355-372.
- Busch, L. 2017. *Knowledge for Sale: The neoliberal takeover of higher education*. London: MIT Press.

- Clark, P. (2015). The Green Paper needs big data. *Times Higher Education*, 18 November: <https://www.timeshighereducation.com/blog/green-paper-needs-big-data>
- Cope, B. & Kalantzis, M. (2015). Interpreting Evidence-of-Learning: Educational research in the era of big data. *Open Review of Educational Research*, 2(1), 218-239.
- Corrin, L., Kennedy, G., French, S., Buckingham Shum S., Kitto, K., Pardo, A., West, D., Mirriahi, N., & Colvin, C. (2019). The Ethics of Learning Analytics in Australian Higher Education. A Discussion Paper. <https://melbournecshe.unimelb.edu.au/research/research-projects/edutech/the-ethical-use-of-learning-analytics>
- Czerniewicz, L. (2018). Unbundling and Rebundling Higher Education in an Age of Inequality. *Educause Review*, November-December, 10-24. Available online: <https://er.educause.edu/articles/2018/10/unbundling-and-rebundling-higher-education-in-an-age-of-inequality>
- Daniel, B.W. (2019). Big Data and data science: A critical review of issues for educational research. *British Journal of Educational Technology*, 50(1), 101-113.
- Davies, S., Mullan, J. & Feldman, P. (2017). *Rebooting learning for the digital age: What next for technology-enhanced higher education?* HEPI Report 93. Oxford: Higher Education Policy Institute. Available online: https://www.hepi.ac.uk/wp-content/uploads/2017/02/Hepi_Rebooting-learning-for-the-digital-age-Report-93-02_02_17Web.pdf
- Davies, W. (2017). Elite Power under Advanced Neoliberalism. *Theory, Culture & Society*: <http://dx.doi.org/10.1177/0263276417715072>
- DfE (Department for Education). (2019). Realising the potential of technology in education: A strategy for education providers and the technology industry. Department for Education: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/791931/DfE-Education_Technology_Strategy.pdf
- Espeland, W.N. & Sauder, M. (2016). *Engines of Anxiety: Academic rankings, reputation, and accountability*. New York: Russell Sage Foundation.
- Esposito, E. & Stark, D. (2019). What's Observed in a Rating? Rankings as Orientation in the Face of Uncertainty. *Theory, Culture and Society*: <https://doi.org/10.1177/0263276419826276>
- Evans, C., Kandiko Howson, C. & Forsythe, A. (2018). Making sense of learning gain in higher education. *Higher Education Pedagogies*, 3(1), 1-45.
- Feldman, P. (2018). The potential of Education 4.0 is huge – the UK must take the lead, now. Jisc blog, 12 September: <https://www.jisc.ac.uk/blog/the-potential-of-education-4-is-huge-the-uk-must-take-the-lead-now-12-sep-2018>
- Griffiths, A., Leaver, M. & King, R. (2018). *The Wisdom of Students: Monitoring quality through student reviews*. Gloucester: The Quality Assurance Agency for Higher Education.
- Gov.uk. (2018). Universities Minister pledges to transform student choice. Gov.uk, 2 November: <https://www.gov.uk/government/news/universities-minister-pledges-to-transform-student-choice>

- Grey, M. (2018). Graduate Outcomes: necessity is the mother of invention. WonkHE, 8 November: <https://wonkhe.com/blogs/graduate-outcomes-necessity-is-the-mother-of-invention/>
- Gulson, K. & Sellar, S. (2018). Emerging data infrastructures and the new topologies of education policy. *Environment and Planning D: Society and Space*. <https://doi.org/10.1177/0263775818813144>
- Gyimah, S. (2018). Tweet, 26 June: <https://twitter.com/SamGyimah/status/1011530092965715968>
- Hawkins, Y. (2018). Plenty ventured, plenty gained. WonkHE, 2 October: <https://wonkhe.com/blogs/plenty-ventured-plenty-gained/>
- HESA (Higher Education Statistics Agency). (2016). Corporate strategy 2016-21. Cheltenham: HESA, https://www.hesa.ac.uk/files/HESA_Corporate_Strategy_2016-2021.pdf
- HESA (Higher Education Statistics Agency). (2018). Joint QAA, HESA, and Jisc new Community Dashboard is released. HESA, 23 April: <https://www.hesa.ac.uk/news/23-04-2018/qaa-community-dashboard>
- Hewitt, R. (2019). From Russia with LEO. HEPI, 23 April: <https://www.hepi.ac.uk/2019/04/23/from-russia-with-leo/>
- High, P. (2018). How 174 Year Old Pearson Is Developing The Netflix Of Education. *Forbes*, 20 August: <https://www.forbes.com/sites/peterhigh/2018/08/20/how-174-year-old-pearson-is-developing-the-netflix-of-education/>
- Jisc. (2018). National learning analytics service seeks to boost student attainment and cut drop outs. Jisc news, 18 September: <https://www.jisc.ac.uk/news/national-learning-analytics-service-seeks-to-boost-student-attainment-20-sep-2018>
- Johannes, P. & Thille, C. (2019). The Heart of Educational Data Infrastructures = Conscious Humanity and Scientific Responsibility, Not Infinite Data and Limitless Experimentation. *British Journal of Educational Technology* [this issue].
- Kandiko Howson, C. (2017). Measuring learning gain isn't easy, but it has become necessary. WonkHE, 17 July: <https://wonkhe.com/blogs/analysis-measuring-learning-gain-isnt-easy-but-it-has-become-necessary/>
- Kernohan, D. 2018. Higher education's absolute earnings benefit. *WonkHE*, 27 November: <https://wonkhe.com/blogs/the-ifs-on-hes-absolute-earnings-benefit/>
- Kitchin, R. & Lauriault, T. (2014). Towards critical data studies: charting and unpacking data assemblages and their work. *The Programmable City Working Paper 2*: <http://ssrn.com/abstract=2474112>
- Kitchin, R. (2014). *The Data Revolution: big data, open data, data infrastructures and their consequences*. London: Sage.

- Kitto, K. & Knight, S. (2019). Practical Ethics for Building Learning Analytics. *British Journal of Educational Technology* [this issue].
- Komljenovic, J. (2018). Making higher education markets: trust-building strategies of private companies to enter the public sector. *Higher Education* <https://doi.org/10.1007/s10734-018-0330-6>
- KPMG. (2015). *The blueprint for a new HE data landscape: Final report*. KPMG International.
- Krawitz, M., Law, J. & Litman, S. (2018). How higher-education institutions can transform themselves using advanced analytics. McKinsey & Company, August: <https://www.mckinsey.com/industries/social-sector/our-insights/how-higher-education-institutions-can-transform-themselves-using-advanced-analytics>
- Lane, J.E. (ed.) (2014). *Building a smarter university: Big data, innovation and analytics*. Albany: State University of New York Press.
- Lang, C., Siemens, G., Wise, A. & Gasevic, D. (eds). (2017). *Handbook of Learning Analytics*, 1st ed, 23-33. Society of Learning Analytics Research.
- McCowan, T. (2017). Higher education, unbundling, and the end of the university as we know it. *Oxford Review of Education*, 43(6), 733-748.
- McDonald, C. (2018). Government to award £300,000 to select startups as part of Open Data competition. *Computer Weekly*, 2 November: <https://www.computerweekly.com/news/252451842/Government-to-award-300000-to-select-startups-as-part-of-Open-Data-competition>
- Morris, D. (2017). A beginner's guide to Longitudinal Education Outcomes (LEO) data. WonkHE, 11 June: <https://wonkhe.com/blogs/a-beginners-guide-to-longitudinal-education-outcomes-leo-data/>
- Muellerleile, C. & Lewis, N. (2019). Re-assembling knowledge production with(out) the university. *Globalisation, Societies and Education*, 17(1), pp. 1-10.
- Muller, J.Z. (2018). *The Tyranny of Metrics*. Oxford: Princeton University Press.
- OfS (Office for Students). (2018a). Securing student success: Regulatory framework for higher education in England. Office for Students, 28 February: <https://www.officeforstudents.org.uk/publications/securing-student-success-regulatory-framework-for-higher-education-in-england/>
- OfS (Office for Students). (2018b). Office for Students data strategy 2018 to 2021. Office for Students, 29 November: https://www.officeforstudents.org.uk/media/83cf5ba5-e2ea-4787-a83b-44e048ddaf3c/ofs2018_50.pdf
- Olson, P. (2018). Recruitment App Debut Raises \$6.7 Million To Rip Up Résumés. *Forbes*, 21 May: <https://www.forbes.com/sites/parmyolson/2018/05/21/recruitment-app-debut-funding-ai-personalization/>

- Parr, C. & McIntyre, F. (2019) OfS puts more than half of providers under review. *Research Professional*, 26 April: <https://www.researchprofessional.com/0/rr/he/agencies/ofs/2019/OfS-puts-more-than-half-of-providers-under-review.html>
- Peck, J. & Theodore, N. (2015). *Fast Policy: Experimental statecraft at the thresholds of neoliberalism*. London: University of Minnesota Press.
- Plantin, J.-C., Lagoze, C., Edwards, P.N. & Sandvig, C. (2016). Infrastructure studies meet platform studies in the age of Google and Facebook. *New Media & Society*: <http://journals.sagepub.com/doi/full/10.1177/1461444816661553>
- Plantin, J.-C. & Punathambekar, A. (2018). Digital media infrastructures: pipes, platforms, and politics. *Media, Culture & Society*: <https://doi.org/10.1177/0163443718818376>
- Policy Connect. (2016). *From bricks to clicks: the potential of data and analytics in Higher Education*. London: Policy Connect. http://www.policyconnect.org.uk/hec/sites/site_hec/files/report/419/fieldreportdownload/frombrickstoclicks-hecreportforweb.pdf
- Richards, D. & Dignum, V. (2019). Supporting and challenging learners through pedagogical agents who know their learner: Addressing ethical issues through designing for values. *British Journal of Educational Technology* [this issue].
- Robertson, S. (2019). Comparing platforms and the new value economy in the academy. In Gorur, R., Sellar, S. & Steiner-Khamsi, G. (eds). *Comparative Methodology in the Era of Big Data and Global Networks*, 169-86. London: Routledge.
- Robertson, S. & Komljenovic, J. (2016). Unbundling the University and Making Higher Education Markets. In Verger, A., Lubienski, C., Steiner-Khamsi, G. (eds). *The Global Education Industry*. London: Routledge.
- Selwyn, N. (2014). *Digital Technology and the Contemporary University: Degrees of digitization*. London: Routledge.
- Slade, S. & Prinsloo, P. (2013). Learning Analytics: Ethical Issues and Dilemmas. *American Behavioural Scientist*, 57(10), 1510-1529.
- Slota, S.C. & Bowker, G.C. (2017). How infrastructures matter. In: Felt, U., Fouche, R., Miller, C.A. & Smith-Doerr, L. (eds) *The Handbook of Science and Technology Studies*, 4th ed, 529-54. London: MIT Press.
- Srnicek, N. (2016). *Platform Capitalism*. Cambridge: Polity.
- Tampio, N. (2019). New Gates-funded commission aims to put a value on a college education. *The Conversation*, 16 May: <https://theconversation.com/new-gates-funded-commission-aims-to-put-a-value-on-a-college-education-116930>
- Tomlinson, M. (2017). Student perceptions of themselves as ‘consumers’ of higher education. *British Journal of Sociology of Education*, 38(4), 450-467,

- Tsai, Y.-S., Gašević, D., Whitelock-Wainwright, A., Muñoz-Merino, P. J., Moreno-Marcos, P. M., Fernández, A. R., Kloos, C. D., Scheffel, M., Jivet, I., Drachsler, H., Tammets, K., Calleja, A. R., and Kollom, K. (2018). SHEILA: Supporting Higher Education to Integrate Learning Analytics Research Report. SHEILA Project, 30 November:
<https://sheilaproject.eu/2018/11/30/sheila-final-research-report/>
- UUK (Universities UK). (2016). *Analytics in higher education*. Universities UK, 3 November:
<https://www.universitiesuk.ac.uk/policy-and-analysis/reports/Pages/analytics-in-higher-education.aspx>
- Williamson, B. (2018). The hidden architecture of higher education: building a big data infrastructure for the 'smarter university'. *International Journal of Educational Technology in Higher Education*, 15(12): <https://doi.org/10.1186/s41239-018-0094-1>
- Williamson, B. (2019). The platform university: a new data-driven business model for profiting from HE. WonkHE, 9 April: <https://wonkhe.com/blogs/the-platform-university-a-new-data-driven-business-model-for-profiting-from-he/>
- Wilsdon, J., et al. (2015). *The Metric Tide: Report of the Independent Review of the Role of Metrics in Research Assessment and Management*. DOI: 10.13140/RG.2.1.4929.1363
- Youell, A. 2019. Jisc and HESA: an integration for the future of data. WonkHE, 10 January:
<https://wonkhe.com/blogs/jisc-and-hesa-an-integration-for-the-future-of-data/>