Chapter 2

The role of big data in elucidating learning cities ancient, present and future

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> Educational history, like many other areas of human activity, has a habit of moving in cycles and the idea of whole communities learning for and throughout life follows this pattern.
>
> (Longworth and Osborne 2010, 369)

Introduction to 'Learning Cities'

Although the concept of the *learning society* in recent times can be traced back nearly five decades to Hutchins (1970), it is an educational philosophy which has permeated the ethos of cities and regions through many eras of history. For Hutchins, the need for a learning society was founded upon a belief that formal education could no longer respond to the increasing demands upon it, particularly in times of rapid change, and when formal educational opportunities may be the privilege of the few. He called for continuous and inclusive education, drawing on ancient Athens as an inspiration when he argues:

> education was not a segregated activity, conducted for certain hours, in certain places, at a certain time of life. It was the aim of the society. The city educated the man. The Athenian was educated by culture, by *paideia*.
>
> (Hutchins 1970, 133)

Hutchins's suggestion that education is in and of itself *the* aim of society may be contested, as societies have multiple priorities and goals, crossing economic and social domains. Perhaps a better expression of the idea is that whatever the goals of a society – in a specific era – there is a need for a bedrock of learning for the society to flourish. The important distinction here is between learning and education, the former referring to an expansive, active and self-directed activity that is not institutionally bound. There is perhaps no better illustration of this than in the recent United Nations (UN) Sustainable Development Goals (SDGs; UN 2015). Not only do SDGs focus on a broader conception of learning in Goal 4 'to ensure inclusive and quality education and promote lifelong opportunities for all', but there is a widespread view that all global challenges are underpinned by a lifelong learning dimension.

Perhaps the first notable modern reference to the learning society is from the UN Educational, Scientific and Cultural Organisation (UNESCO), which draws on the influential Faure Report of 1972, *Learning to Be*.

> If learning involves all of one's life, in the sense of both time-span and diversity, and all of society, including its social and economic as well as its educational resources, then we must go even further than the necessary overhaul of 'educational systems' until we reach the stage of a learning society.
>
> (Faure *et al.* 1972, xxxiii)

This highly influential report appealed to all countries within UNESCO to reorganise their education systems, such that all agencies (not simply the formal sector, mandated to offer provision) become providers of education, to ensure that all citizens are involved in learning, whatever their motivation or outcome. The concepts being promoted were those of *lifelong and lifewide learning*; the former refers to continuous learning through life and the latter to the

ubiquity of the potential location of learning, beyond formal educational structures. It is striking that within this report, the importance of place within such an ambition was highlighted, and as was the case with Hutchins, a classical reference point was drawn upon.

> All sectors – public administration, industry, communications, transport – must take part in promoting education. Local and national communities are in themselves eminently educative institutions. As Plutarch said, "the City is the best teacher". And especially when the city is capable of remaining within human proportions, it does indeed contain immense educational potential – with its social and administrative structures and its cultural networks – not only because of the vitality of the exchanges that go on, but also because it constitutes a school for civic sentiment and fellow-feeling.
>
> (Faure *et al.* 1972, 162)

A further report to UNESCO from the International Commission on Education for the Twenty-First Century – *Learning: The Treasure Within* (Delors *et al.* 1996) – expanded the link between the concept of lifelong learning and that of a learning society, within a modern urban context:

> The concept of learning throughout life is the key that gives access to the twenty-first century. It goes beyond the traditional distinction between initial and continuing education. It links up with another concept often put forward, that of the learning society, in which everything affords an opportunity of learning and fulfilling one's potential.
>
> (Delors *et al.* 1996, 38)

Jordan, Longworth and Osborne (2014), Osborne, Kearns and Yang (2013), and Longworth and Osborne (2010), among others, have traced parallel and subsequent developments in this territory of place or geographically based learning concepts. These concepts have been posited not only

by UNESCO but by other intergovernmental organisations, such as the Organisation for Economic Co-operation and Development (OECD) and the European Commission (EC) as well as national government departments in various parts of the world. The step from positing the creation of a learning society, supported by lifelong and lifewide learning, to the creation of the learning region or city has been a relatively short one, with the concept of the *educating city* as an intermediary. The work of the OECD in the 1970s led to use of the term *educating cities* and supported a project in seven cities in its member states: Adelaide, Edmonton, Edinburgh, Gothenburg, Kakegawa, Pittsburgh and Vienna (OECD 2000). A later OECD conference in 1992 in Gothenburg led to the creation of the International Association of Educating Cities (IAECs), based in Barcelona. One of the aspirations of this conference was to 'promote a learning city in which communities attempt to learn collectively as a means of changing their own futures' (OECD 1993, 10). The OECD's report, *Lifelong Learning for All* (OECD 1996), subsequently stressed the economic outcomes of lifelong learning and supported further work via a project concerned with learning regions at five European sites: Andalusia, Øresund, Jena, Thames Gateway and Vienna (OECD 2000).

Jordan, Longworth and Osborne (2014) argue that it was the Lisbon and Feira European Councils that triggered a focus within the EC, stressing the importance of policies centred on lifelong learning. The Lisbon Council set a strategic goal over the decade from 2000 to 2010 for the EU 'to become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion' (European Parliament 2000, 5). Geographic alignment was also put into place through place-based and, specifically, regionally based lifelong learning because of disparities between regions in the EU. In short, the argument in Europe was that strategies for lifelong learning should match

the diverse needs of each region. Such strategies are found in the *Memorandum on Lifelong Learning* (European Commission 2000), which led to an EU-wide consultation updating the implementation of lifelong learning policies. The EC's communication, *Making a European Area of Lifelong Learning a Reality* (European Commission 2001), brought developments together in one communal, overarching aim of a 'knowledge-based society'.

Biao (2013) argues that the 'the learning city concept … is an international initiative devoted to the promotion of sustainable, healthy, green and economically viable cities by the means of lifelong learning'. Globally, there have been also a number of initiatives within individual cities or regions; for example, in Canada (Faris 2005), across Africa (Walters 2009; Biao, Esaete and Oonyu 2013) and Australia (Kearns 2011). However, the most comprehensive developments in the last decade have been in Asia, most particularly in the Republic of Korea, China and Japan (Han and Makino 2013; Lee 2013; Osborne and Borokowska 2017). Many examples now exist of concrete, often government-driven initiatives in these countries. In Korea, learning city development is a direct consequence of legal frameworks that underpin policy, specifically, the Lifelong Education Law and the ordinances of cities. Lee (2013) provides a detailed case from Seoul, one of many designated learning cities in the country. In China the learning city concept is linked strongly with a focus on community education; many illustrations of such developments are available (see, for example, Ju 2011; Li 2011; Yuan 2012). As Han and Makino (2013) report, most Chinese cities have participated in one form of learning city development or another. They also provide specific examples from Japan in Iida City and Toyota City, and as is the case in China, they demonstrate how the learning city is linked to processes of community-building.

Recent work of UNESCO (2013a, 2013b and 2013c), within its Global Learning Cities initiative, sets out key features of learning cities and possible bases for evaluative metrics as shown in Figure 2.1.

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Overall UNESCO presents 42 learning city indicators, which can be classified into three domains using the visual analogy of the learning 'temple' architecture: (1) 'Pediment', focussing on the wider benefits of building a modern learning city in terms of social and economic outcomes; (2) 'Columns', reflecting the learning aspects, or building blocks, of a learning city; and (3) 'Foundational Steps', outlining the conditions necessary for a learning city to thrive, including political will and leadership. The 'Pediment' includes individual empowerment and social cohesion (e.g. community engagement and social mobility), economic development and cultural prosperity, and sustainable development (e.g. living conditions, transportation). The 'Columns' consist of inclusive learning in lifewide education, including learning in families and communities, 'indigenous learning' and government policies of support. This can be defined as reflecting a 'vibrant culture of learning throughout life'. Finally, the 'Foundational Steps' are comprised of strong political will and commitment of the people (e.g. through cultural and civic engagement), leadership, governance and participation of all stakeholders (e.g. voting, volunteering), and mobilisation and utilisation of resources (e.g. expenditure on education and public programmes).

As with the concept of lifelong learning, little work has been undertaken to operationalise these features (Mwaikokesya, Osborne and Houston 2014) and evaluate the success of cities past, present or future. The use of Big Data, however, provides a promising approach to explore such features in exemplars of learning cities (globally and historically) and will be explored in detail

in this chapter, highlighting the current work of the University of Glasgow's Urban Big Data Centre (UBDC), as well as the use of emerging technologies to explore ancient and modern urban centres. Such centres and global initiatives promoting novel approaches to exploring and understanding cities through their data help us to understand the success (and decline) of cities, particularly as technological advances lead to public (citizen) demands for transparency and self-efficacy in actualising the city-spaces which surround them.

Learning cities – past exemplars

> The history of education in antiquity is not without relevance to our modern culture, for in it we can trace the direct ancestry of our own educational tradition.
>
> (Marrou 1956, 11)

The notion of the learning society (and the related ideas of the learning city/region) is not a new concept; Longworth and Osborne (2010) outline this in what they have described as the *Age of Antiquity.* They suggest that the notion of learning is intimately linked to place and that this relationship can be traced at least as far back as 2,500 years ago to Ancient Greece and the writings of Plato. A more extensive discussion of the origins of the link between city-state and education in antique Athens and Alexandria is provided by Watts (2006). This begins with Roman approaches in the empire, moving on to Athenian approaches in the second and fourth centuries CE, up to Alexandrian shifts from the fourth into the fifth centuries CE and ending with the 'coming revolution' of Christian approaches and its inherent hierarchy. Watts argues that Athens in the fourth century CE hosted cultural resources 'unmatched' in the rest of the Mediterranean, and education formed a lucrative draw to a city, which financially was overall in decline.

From the early to the late fourth century CE Alexandria experienced a turbulent shift from pagan to Christian influence, contending with diverse factions of Platonic thought as well. However, it followed on closely from Athens as a revered centre of learning and boasted the *Museum* (founded in the reign of Ptolemy I Soter, fourth century BCE), which included the great library (Marrou 1956). Marrou claims that not only was it a centre for poetry, literature and schools of philosophical learning but also that the Lagidae founded a unique centre for the advancement of scientific and technical learning as well as social space for interdisciplinary and international contact, thus knowledge-exchange.

> As it was under royal patronage it attracted not only poets and men of letters into the city, but the most eminent scholars of the day – geometers, astronomers, physicians, historians, critics and grammarians. These 'museum pensioners' … lived in community, close to the palace. They had no taxes to pay and no other duties to perform … and a vast dining hall where they took their meals together.
>
> (ibid., 189)

Marrou is keen to point out that although the *Museum* was unique, it did not spring up out of a 'philosophical void' but rather was a more formalised institution related to earlier philosophical communities (e.g. Pythagoreans) and leading onto many more such institutions (e.g. the Academy, Lyceum and Garden of Epicurus). Barnes (2004) notes that Galen's *Commentarius in Hippocratis Epidemias III* includes several references to the library in the second century CE, and MacLeod (2004) reports that between the first and the sixth centuries CE, other libraries were established in Alexandria within the *Serapeum* and *Caesareum* temples. However, he notes that the first extended discussion that survives of the library is the *Letter of Aristeas* (c. 180–145 BCE). The latter, begun by Cleopatra and completed by Octavian, featured in Philo's *Legatio ad*

Gaium (*Delegation to Gaius Caligula*, 22.151); with the former, according to Brazil (2004), holding the overflow from the Great Library. MacLeod (2004) suggests that these were public institutions and, unlike other private library predecessors, were freely accessible (at least in theory) to the greater public, that is to anyone who could prove themselves a worthy scholar. However, much like modern barriers to participation in the formal education system, such inclusion would have been heavily biased towards those who were literate, elite and of course males of the dominant ethnicity.

Pritchard (2015) highlights this inequality in access and participation in such traditional education in ancient times. For instance, in ancient Athens, participation issues are seen from the late fifth century, persisting through various 'trends in education' over the centuries (from the traditional 'wrestling school' and 'gymnasium' to the more modern 'sophist' schools of thought). Pritchard suggests that the notion of social class in some ways parallels, but in other ways is distinct from, social classes which we would recognise today, for instance:

> Athenians divided themselves up on the basis of military roles, income bands, occupations, or places of residence (Vartsos 1978). But the distinction which they used much more often than others and which demarcated the most important social cleavage was between *hoi plousioi* ("the wealthy") and *hoi penētes* ("the poor").
>
> (ibid., 114)

Even when granted access, the family of a student would need to cover the fees of at least three teachers, pay by course of study and maintain their free time for education and exercise (ruling out those needing to work). Alternatively, Pritchard points out:

> Archaeology indeed confirms that many poor citizens had quite high levels of literacy and hence must have as boys attended the classes of a *grammatistēs.* On closer inspection, it appears that attending such classes was not prohibitively expensive nor something which stopped *paides* from helping out with the farms or the businesses of their families.
>
> (ibid., 121)

Despite such social barriers, city-states advocated centres of learning, and their use by citizens and visiting scholars, as signs of prestige for the city, as well as valuable resources for increasing the knowledge and potential of its citizenry. Although it is hard to disentangle information about the 'Great Library' of Alexandria from myth (MacLeod 2004), it is clear that its flourishing was associated with not only a display of wealth and success for the region but also with lofty goals of research and knowledge as status. Similarly, its destruction became synonymous with the demise of cultural and public knowledge. An analogy might be made with modern libraries, which in certain parts of the world are re-positioning themselves as the focus point for learning city developments. A modern equivalent is illustrated in Canadian cities such as Vancouver, where libraries have led learning city initiatives in that country.[1] Furthermore, the new Bibliotheca Alexandrina is an example of how the modern age seeks to continue the learning trajectory from the ancient city of Alexandria to modern, to help put Egypt at the 'center of the world of learning' (Mourby 1999), although this may reveal more about modern identity building, and the 'badge' of a learning city, rather than any historical or educational reality. Beyond the Mediterranean context for learning in past cultures, one can observe indigenous forms of learning, such as those existing in other parts of Africa that also provide interesting ancient parallels for learning cities. Several parts of Africa boast ancient cities that have been the centres of learning.

> Hermetic frontiers were drawn between the civilizations of Ancient Egypt and Nubia and those of the peoples south of the Sahara. It is true that the history of Africa north of the Sahara has been more closely linked with that of the Mediterranean basin than has the history of sub-Saharan Africa, but it is now widely recognized that the various civilizations of the African continent, for all their differing languages and cultures, represent, to a greater or lesser degree, the historical offshoots of a set of peoples and societies united by bonds centuries old.
>
> (Ajayi 1989, xxiii–xxiv)

Biao, Esaete and Oonye (2013) argue that most parts of Sub-Saharan Africa can provide illustrations of such cities. They cite, in West Africa, Timbuktu, Oyo, Ife and Songhai – and in Central Africa, the cities of Ndongo and Luba, which they argue 'dazzled human minds with their promotion of knowledge and trade' (470). Moreover, between the twelfth and fifteenth centuries in Southern Africa, it is said that the Monomotapa city-state, 'stood out as not only a city of lovers of knowledge but also a city that exported knowledge to surrounding states' (470). A more detailed discussion of African civilisation, from pre-history and ancient civilisations to post-colonialism, is found in the magisterial eight-volume *General History of Africa*, published by UNESCO (1981–1993); specifically the work of Mokhtar (1981) on ancient civilisations and El Fasi (1988) on the period between the seventh and eleventh centuries, and the introduction of Islamic influences is of relevance.

Longworth and Osborne (2010) argue for another shift in the focus of learning cities during the period of growth of Islam, from the eighth to the thirteenth centuries CE, although it should be noted that, as with many other regions, such learning practices were deeply influenced by those of ancient Greece. Cities within which learning was pre-eminent in this period include, among

others, Damascus, Cairo, Tripoli, Jerusalem, Cordoba and Fez. Citing Hill (1993) they report that:

> By the 10th century, Cordoba had 700 mosques, 60,000 palaces, and 70 libraries, the largest of which had 600,000 books. The library of Cairo had two million books, while the library of Tripoli is said to have had as many as three million books before it was destroyed by Crusaders. The number of important and original medieval Arabic works on the mathematical sciences far exceeds the combined total of Medieval Latin and Greek works of comparable significance.
>
> (Longworth and Osborne 2010, 368)

Elsewhere in the Middle East, the example of Gaza is of interest. Butt (1995) notes its position on the north-south highway (the *Via Maris* or *Way of the Sea*), its strategic importance as a crossroads and centre of trade throughout much of early history, and suggests its cosmopolitanism, as travellers and merchants shared information and ideas, as being of importance to its reputation as a place of learning. It was seen in the times of Darius (c. 517 BCE) as a bridge between Persian Egypt and Persian Asia, and after its conquest by Alexander the Great and its organisation as a polis or city-state (332 BCE), it developed a reputation as a flourishing centre of Hellenic philosophy and learning.

The Hellenistic/Greek influences of Alexander and his successors were supplemented by other cultures, often through invasion: for example by the Egyptians under Ptolemaic rule (301–198 BCE) and then after a period under the Hasmonaeans around 62–3 BCE. There were further socio-cultural influences in the form of Rome under whom Gaza retained its importance as a centre of trade and where cultures of east and west continued to mix (ibid.). By the fifth and sixth centuries CE under Byzantine Christianity it was known for its inhabitants' artistic skills as well

as for culture and learning and continued to be an important trading centre. Lawson (2004, xxi) cites the examples of Procopius of Gaza (c. 465–528 CE) ‘a polymath who wrote on earthquakes, mechanical devices and theology’. Procopius was noted as a teacher, a rhetorician and a leading member of the Gaza School and is seen as developing a synthesis of pagan (Hellenic) and Christian philosophy and culture (ter Haar Romeny 2007, 174). Quiroga Puertas (2011, 1) links the work of Procopius more specifically to modern notions of learning cities:

> Modern scrutiny of the works of Procopius of Gaza highlights the methodological concerns which permeate studies on late antique literature: the study of the intellectual and religious life of important urban centres such as Gaza; the labelling of a prolonged succession of teachers and educational centres as “schools”.

In addition, also looking to the past, we can see that Rome had many parallels with modern cities in terms of the planning and administration of daily life. If we think of modern learning cities as learning organisations, which seek to harness all stakeholders to drive the city’s socio-economic growth and development, we can see many parallels with Ancient Rome. Issues of well-being, economic growth, security, culture and social cohesion continue to be matters of concern and the focus of policy initiatives in the modern Learning City. Robinson (1994) in her comprehensive study of city planning and administration, and the legal juridical frameworks and legislation that underpinned such structures in Ancient Rome, suggests that a concern with similar issues, and for similar reasons, can be observed.

In relation to issues we would recognise as related to the modern conception of health and well-being, Robinson (ibid.) notes the concern of the city’s rulers, both under the Republic and during the Imperium, and their efforts towards the supply of clean, fresh drinking water through the building of aqueducts and the creation of sewer systems, drains, public baths, open spaces and

latrines as well as the encouragement of exercise and access to fresh air. This parallels modern concepts as laid out by UNESCO (2013) in its Key Features of Learning Cities in which promoting sustainable development (Focus Area 1.3) is argued to be one of wider benefits of such development. In relation to economic growth and security, it created an environment where merchants and traders could operate in relative safety within a system of relative legal oversight of contracts and tenders; regulated the provision of services, including markets, prostitution, eating houses and inns; and instituted controls over trades and professions. In terms of social cohesion, we may note not only the opportunity such spaces afford for knowledge-exchange and cross-cultural contact but also their role in meeting the cities' more basic needs, such as feeding the city with the distribution of free grain (although eligibility criteria existed, and these changed over time):

> In 5 BCE Augustus issued a largesse to the urban plebs, of whom there were then 320,000 eligible members. In 2 BCE there was another special census by neighbourhoods which left a list of perhaps 200,000 recipients of free grain.
>
> (Robinson 1994, 153)

In relation to culture (and as a force for social cohesion), Robinson (ibid.) draws attention to the provision of shows and spectacles including the *ludi* and provides an alternative view to that commonly held noting that the majority of days of public games were devoted to theatrical performances. The number of spectators attending events at the *Circus Maximus* (capacity 150,000) and the *Colosseum* (capacity 50,000) would require special planning and the deployment of security and police in current times, and Robinson indeed notes the efforts of the state to enforce law and uphold public order.

It is suggested that from this brief overview of Robinson's work the degree of planning and administrative oversight such a complex and populous city as Rome would require is quite clear. It required not just scribes and clerks, but mathematicians and engineers, highly skilled metalworkers and stone masons to name but a few of the specialised personnel, who, along with numerous labourers, did the actual work at hand. Importantly, it would also require systems and infrastructure to train such skilled and technical personnel. However, according to Robinson (1994, 212),

> … we know relatively little about the clerks, the office staffs, who were busy with the very large quantities of paperwork that the institutions of local government required, issuing licenses, putting out jobs (which varied from the tiny to the very large) to tender and keeping records.

Moreover, and this reinforces the parallels between ancient and modern Learning Cities, Robinson in her conclusion suggests:

> There were opportunities for recreation and leisure, freely or cheaply open to all inhabitants of the City; public health was an aim of public policy … basic food was provided regularly, again either freely or cheaply, for a significant proportion of the population … Rome could not have grown and survived as a city if social stability had not been normal.
>
> (Robinson 1994, 212)

In conclusion, when we analyse the features of learning in ancient cities in aiming to draw parallels with modern conceptions, we find more than simply libraries and scholars with their small coterie of followers at the centre of city learning. We can also find examples of broader notions of learning as it related to health and well-being, socio-economic development, security,

culture and social cohesion, just as in the features that UNESCO is currently promoting in its Global Network of Learning Cities.[2] This and other modern models we now consider.

Modern learning cities

In addition to the *Age of Antiquity*, in the domain of learning regions/cities, Longworth and Osborne (2010) highlight further ages towards defining such concepts: the *Age of Innocence*, the *Age of Experimentation*, the *Age of Advance*, the *Age of Understanding* and the *Age of Consolidation*. They point out that although in the 1970s some initiatives arose, it was only in the 1990s during the *Age of Innocence* that significant fuelling occurred for the modern conception of learning cities, which advocated for a generalised culture supporting various forms of lifelong learning. The early 1990s was marked by seminal conferences in Gothenburg held by the OECD, in Rome by the European Lifelong Learning Initiative (ELLI), and in North America by the American Council on Education. The IAECs was established in Barcelona and a charter for learning cities and regions created by ELLI. During the *Age of Experimentation* around the turn of the last millennium, the Department for Education and Employment (DfEE 1998) in the United Kingdom published practice and progress guidance for Learning Cities, and the first EC-funded projects were carried out; the OECD's (2000) learning regions project was initiated and the characteristics of learning cities began to be explored. In the *Age of Advance* in the first decade of this century preliminary experimentation extended into implementation with the Learning Regions developments, with Germany and Australia among the most significant. The *Age of Understanding* throughout the same decade was marked by an explosion of European projects with firm objectives and an increasing focus on benchmarking and measurement of the contribution of stakeholders and the development of training. The *Age of Consolidation* referring to the present (at that time 2010) referred to the process of integrating the work of many

individual towns with countries and wider initiatives to achieve cohesion among the proliferation of learning city/region efforts. This included much of the work that involved the PASCAL International Observatory, which emerged from the OECD's Learning Regions initiative of 2000, and later that of the UNESCO Institute for Lifelong Learning (UIL) in Hamburg (Yang and Valdes-Cotera 2011; Yang 2012).

Current dominant themes of the learning society, learning region and learning city

The idea of the learning society framework is comprehensive in its perspective and is not tied to formal learning or a formalised space. Therefore, it includes formalised learning (for instance those leading to recognition, qualifications, etc.) as well as informal (structured but not leading to formal qualifications) and non-formal (unstructured and often self-directed learning; National Adult Learning Survey 2012) learning. In this sense it is a *lifewide* concept, an idea crystallised in the EC's *Memorandum on Lifelong Learning*, which suggests that this

> enriches the picture by drawing attention to the spread of learning, which can take place across the full range of our lives at any one stage in our lives. The 'lifewide' dimension brings the complementarity of formal, non-formal and informal learning into sharper focus. It reminds us that useful and enjoyable learning can and does take place in the family, in leisure time, in community life and in daily work life.
>
> (European Commission 2000, 8)

Such frameworks, and the models within, also routinely conceptualise learning as not time-limited but rather occurring continuously throughout one's life (the *lifelong learning* concept), and importantly it is place (i.e. community, city or region) which many researchers highlight as

the ‘catalyst’ to facilitate learning. Current literature defines the learning city/region in various ways, but crudely we can think of it as a continuum. At one end there is an economic focus on creating an infrastructure of education and training provision that might attract inward investment from business, with an emphasis on institutional environments that support private and social learning at all levels (Wolfe 2002) and an infrastructure that supports the flow of knowledge and ideas (Florida 1995). Such perspectives also draw upon theories of innovation and systems that promote innovation (Larsen 1999).

This innovation emphasis is perhaps a major difference between modern initiatives and ancient learning cities, although the cities of antiquity also championed certain innovations. The ‘entrepreneurial’ aspects of the ‘knowledge-economy’ are perhaps less overt but can be seen underlying some urban advances. For example, Robinson (1994) cites technical advances and innovation in the areas of drainage and sewers in relation to public health (101) and related civil engineering innovations in the form of bridges, aqueducts and canals (71). The requirement to attract and retain commerce and trade suggests other similarities in terms of rule of law, weights and measures, facilities for credit and banking (as in Imperial Rome), and both, it could be argued, have to reproduce labour power, protect property and maintain social cohesion (114, 171). At the other end of the continuum for modern learning cities is the creation of learning cities/regions surrounding the needs of supporting learning networks, promoting and enhancing social cohesion/inclusion, and enabling empowerment and social justice, which were at the core of the EC’s R3L initiative (Smith 2003). It is perhaps in this area particularly in relation to empowerment and social justice, alongside innovation and socio-economic development, that we see a distinction between our conceptualisation of ancient and modern learning cities.

As yet, steps to operationalise key features of learning cities, through their existing data, have been limited. Harnessing novel technology and methodological approaches (such as in the fields of archaeology, urban planning and social sciences) from the field of Big Data offers possibilities to provide more holistic views of urban life (past, present and future). Furthermore, Big Data offers possibilities to explore both ancient and modern cities in ways that until recently might have previously been unimaginable.

Big Data

Big Data refers to the complex sources of information created and stored by organisations, including traditional databases (such as transportation use, education metrics and social services use), and more technologically diverse sources of data, such as social media, geographical mapping data and weather (see Lido *et al*. 2016 for review). According to Lynch (2008) there are various ways in which data can be 'big'; experts agree that the determining characteristic is not size, although such data sets are likely to be beyond the capacity of most 'traditional' database systems to manage. The more defining feature is the complexity of the data, such as its variety and form; the rapidity of its development and change; and the need for novel methods to capture, analyse and visualise it. This section seeks to introduce the conceptions of Big Data and describe how modern techniques for Big Data collection and analysis have been applied to ancient cities, before then moving to its recent applications in modern learning city initiatives. This will lead in a final section to identifying the need for repositories to capture, link and make available historical urban data.

As Mayer-Schonberger and Cukier (2013, 14) state in their recent book:

> Since Aristotle, we have fought to understand the causes behind everything. But this ideology is fading. In the age of Big Data, we can crunch an incomprehensible amount of information, providing us with invaluable insights about the what rather than the why. We're just starting to reap the benefits: tracking vital signs to foresee deadly infections, predicting building fires, anticipating the best moment to buy a plane ticket, seeing inflation in real time and monitoring social media in order to identify trends.

The recent work of Boeri (2013) places the recent concept of 'Big Data' within the framework of information processing theories of philosophers, such as Aristotle, Marshall McLuhan, and Thomas Aquinas. His book links these theoretical concepts of modern-day big business data analytics to those of the past. For instance, we could exploit existing historical Big Data on Ancient Rome, including administrative data on grain shipments, army records, water provision and miles of sewage to contrast with modern data. In this way, we can see that the new zeitgeist surrounding Big Data approaches is not used exclusively in the pursuit of examining contemporary phenomena. Modern Big Data visualisations and simulations can help us to better immerse ourselves within the traditions of ancient learning cities, including the applications of spatial analysis to archaeological findings to identify areas of urbanisation, trade routes and historical links of occupation between sites. Additionally, computer modelling allows more immersive three-dimensional (3D) visualisations of antiquity and allows us to 'travel back in time' and experience the built environment and travel routes of the past. For instance, Sargent and Malcolm (1997) developed a simulation to travel north through the six divisions of the Nile River.

The work of Sir Alan Wilson and colleagues is an example of applying modern Big Data collection and analysis to our understanding of past city success. Wilson and colleagues highlight the use of Big Data and current modelling techniques in evaluating the success (and failure) of

ancient cities. Bevan and Wilson (2013) present a case study from Bronze Age Crete in order to 'consider the evolutionary trajectory of settlements and physical routes over time' (2415). Further to this, Davies *et al.* (2014) have used Big Data analytics to investigate the past and contrasted Middle Bronze Age versus Iron Age settlements in Syria. They were able to identify factors affecting the size, importance, movement and site interactions of various settlements. 'The results suggest the importance of [changing] political and historical factors in these periods' (ibid., 141). Fry and Wilson (2013) used Big Data modelling to determine modern production levels of international trade and national economies using four sectors: food, natural resources, manufactured goods and labour, whilst Pagliara *et al*. (2012) modelled employment locations within cities and regions. Therefore, the work of Sir Alan Wilson, when taken as a whole, indicates how novel approaches using big, complex data sets and modern statistical, analytic and modelling tools can tell an interesting story regarding why certain cities/regions thrive, and others fail. In more detail they can work across disciplines, historical, archaeological and modern urban studies, to move beyond simply extrapolating historical processes from modern data but rather give a richer context to existing archaeological and historical evidence when describing how regions might interact with each other and identify physical and cultural exchange of cities ancient and contrast this with modern urban models of sustainable development.

While technology is often harnessed in pursuit of learning city objectives in contemporary society, whether as Intelligent Communities (ICF 2012), Smart Cities (European Commission 2012) or the exploratory tools mentioned earlier, technology is also increasingly being harnessed to provide us with new insights and information on ancient cities and civilisations. The use of remote sensing technologies, satellite imagery, is allowing archaeologists the ability to reassess

and, in some cases, discover new information about infrastructure, planning and resource use in ancient cities and civilisations (Parcak 2009; Wilkinson 2009):

> When using satellite remote sensing for excavation … the archaeological team can use the electromagnetic spectrum and broader visual detection to reveal features not apparent on the ground. Satellite remote sensing, in a sense, acts as an aerial geophysical sensor, identifying potential buried features such as walls, streets, or houses.
>
> (Parcak 2009, 5)

Parcak (ibid.) provides details of some of the recent developments in satellite remote sensing and presents case studies which include the Angkor Wat complex in Cambodia, the city of Homs in Syria and the Nile Delta and Middle Egypt. Directly related to our comments on Ancient Rome, recent work on Portus (Salomon *et al*. 2014), established under Claudius, enlarged by Trajan and the principal maritime port for the movement of goods to Rome from the first to the sixth centuries CE, has provided new insights into the size, scale and scope of this ancient infrastructure. In such instances, space- and ground-sensing technologies, in combination with prior knowledge, have provided researchers with new insights into the complex infrastructure of roads, canals and aqueducts to be found alongside massive harbour towns (Keay, Parcak and Strutt 2014). And yet, such knowledge is often limited to the few experts within specific disciplines, rather than as an interdisciplinary starting point for a conversation on what this might mean globally.

Urban big data for learning cities

Increasingly there has been government policy and academic research emphasis pushing for transparency and opening data to the public (Lido 2014). For example, the Economic and Social

Research Council (ESRC) funded the 'Big Data Network' initiatives as a vehicle to address societal challenges. Part of this initiative has been the creation of the UBDC at the University of Glasgow in 2014. The UBDC seeks to address issues such as sustainability, social mobility, transport efficiency, communications, sense of place and links with a variety of education-related variables and outcomes. In the field of education – as well as philosophy and history – Big Data is still a 'niche topic' (Eynon 2013, 237). Mostly Big Data has been applied in education towards 'learning analytics' to improve the efficiency and cost-effectiveness of education delivery (e.g. Niemi and Gitin 2012). Yet recent work has begun moving beyond simple conceptions of 'big' to more complicated pictures of learning embedded within place (Osborne *et al*. 2016). Eynon suggests that future Big Data work must apply its tools to 'empower, support and facilitate practice and critical research' (ibid.). It can embed learning, not only in place but within historical and social context as well, building broader, more naturalistic pictures of urban life and city-engagement.

The UBDC hosted the integrated Multimedia City Data (iMCD) project to create an open-use 'data resource' for academics, policy practitioners and the general public to access, and to learn more about their city, exploring who is engaging with it and how to improve the lives of its citizens. The data is housed alongside other large, publicly available data sets within the UBDC data archive (e.g. satellite, cycling app and educational participation and outcome data). The iMCD created a large data set of essentially 'learning city metrics' (and measures of urban participation). This was accomplished first with a large-scale data crawl capturing social media (textual and visual), covering a range of learning city hashtags (capturing urban events, such as the Commonwealth Games and the Scottish independence referendum).

The social media capture was undertaken alongside a large-scale survey of the greater Glasgow area. This survey of 1,500 households investigated the extent to which values, attitudes, beliefs, behaviours and literacies influence behaviours and activity within the greater Glasgow area. In the field of learning, the survey generated data regarding many of the 42 UNESCO indicators for learning cities, as well as cultural, civic and sustainable area engagement. The social media and survey data were supplemented by global positioning system (GPS) tracking (geolocating travel patterns for one week) and lifelogging camera images (a wearable camera taking images every few seconds over 48 hours' worth of travel). Thus, the iMCD resource provides rich and complex data regarding the lives of these citizens. It provides a more holistic 'snapshot' of modern urban life for representative households in the Greater Glasgow area.

Such data, as an opus, provide a 3D picture of peoples' daily activity and mobility. Education participation can be examined alongside wider attitudes, behaviours and participation (physically and socially) in the city. This repository was created as a model for how such data can be utilised, not just by academics but by other key stakeholders, to improve the quality of life within the city of Glasgow and contiguous region, as well as provide global comparisons in future. From such repositories, visual and statistical models can be developed to explore the relationship between education, place, transport, sustainability, cultural and civic engagement and other demographic factors in and around the city of Glasgow. Whilst our initial case is Glasgow, we envisage that the model can be adapted for other cities, recognising that each city may wish to create an index using selected key features relevant to its priorities.

Conclusions: learning cities future

This chapter introduced the concept of the *Learning Society* (Hutchins 1970) as an educational philosophy, which has permeated the ethos of many regions throughout eras of history. Around

the world there are a number of discrete initiatives within individual cities or regions, from Canada to South Africa, Australia and beyond, with the most comprehensive developments in the last decade in Asia. International and interdisciplinary scholars, cross-culturally and across historical periods, have noted links between learning and place, developing geographically based learning concepts – but few explore how these links are expressed over time.

This chapter outlined conceptions of learning cities, with an overview of exemplars from the past, such as ancient centres of learning, illustrating how learning in antiquity placed an emphasis on the role of place, with implications for culture, health and well-being, social cohesion, inclusion and socio-economic success, as persistent learning city themes throughout the ages. However, it acknowledged cultural as well as historical specificity and that the ancient concept of the city is widely different from modern notions (which vary in themselves considerably). Unlike in modern times, evidence of urbanisation is not enough to be equated with ancient notions of cities, such as Greek notions of city as polis or 'city state'. The current use of novel Big Data techniques (analysis, modelling and visualisation) has been outlined, including using novel technology to revisit the success of cities past, contrasting them with modern urban approaches. Modern conceptions and exemplars of learning cities were explored for relevant themes which persist from antiquity to today. We now conclude with implications for future directions of learning cities and global implications of such initiatives.

Despite the aims of social and economic benefits of learning society approaches past and present, authors such as Preisinger-Kleine (2013) and Longworth and Osborne (2010) are quick to point out the pitfalls of such approaches by governments and smaller funding-bodies alike. The former points to inadequacies in evaluation and quality assessment: 'learning cities and regions manifest serious difficulties in rendering transparent the surplus value they generate, which is vital for

attracting investment into lifelong learning' (Preisinger-Kleine 2013, 521). The latter reference points to economic precarity, which affects funding and creates the need to constantly search new structures, regulations and 'ways of thinking' (Longworth and Osborne 2010, 398).

The work of Biao (2013) argues for a culturally embedded approach to developing learning cities, a point which is crucial to bear in mind and to operationalise in research – both for historical specificity as well as modern notion of cross-cultural differences:

> The learning city concept … is currently operational in Europe, the Americas, Australia and Asia but absent in Africa. The main point made by the chapter is that the introduction of learning city projects into Africa will succeed only if this continent's historical, cultural and epistemological realities are relied upon in the selection of an entry methodology. That methodology is here identified as 'transformative learning'.
>
> (ibid., 3)

Biao further highlights that such methodology would need to reinforce the link between conceptions of ancient and modern city-regions within Africa. And only once such cultural and historical links are created to modern lifelong learning and learning city objectives can true change occur.

In conclusion, we can see that the notion of the learning society is ancient in origins, and many of the same lofty social (and economic) goals of urban cities (and even smaller rural and developing regions) remain largely unchanged in modern learning city initiatives. Whilst there do seem to have been initiatives to put cities as learning hubs on the map, it is still important to note that ancient thinking did not have the notion of 'learning city', in our modern sense, as a category of thought. Yet ancient links between city-state, citizenship and public knowledge have common themes which persist today. As was evidenced with the Roman Empire, both Republic

and Imperium exhibited many characteristics and challenges which modern learning cities try to address – health and well-being – economic security and growth, culture and social cohesion/inclusion.

Advances in the use of novel technology to harness city data, open-data repositories and the use of Big Data in urban modelling have helped to shed light on key components of learning regions/cities past; evaluations of learning city initiatives present; and the work of designing, embedding and creating learning cities future. Big Data has an increasing role to play in examining more rich education and civic participation-linked metrics of past cities; in modern learning initiatives of a formal, informal and non-formal nature; and ultimately in future planning and maintenance of learning cities/regions. Such advances can help us to create operationalised and measurable indices and benchmarks by which flourishing learning cities/regions can be assessed.

However, we are at the very starting part of this journey, there is much work to be done to 'open up' data regarding cities of antiquity, as well as their modern counterparts. Such diverse data sources need to be collated, linked and made available through central data repositories. Bevan (2015) points to key developments that have amounted to a revolution in remote sensing approaches in the past decade, including greater spatial accuracy, greater geographical coverage and new kinds of 3D depth in archaeological imaging. This may, for example, provide new evidence on organisation of settlements and changes over time. Researchers must continue to push for such data being offered as 'open access' data sets for reuse by other researchers and thus promote opportunities for interdisciplinary working and knowledge-exchange. Although there are clear limits to what can be inferred from any data sets, particularly limits of historical and cultural specificity, yet this perspective offers the potential to help us better understand the

catalysts of learning in cities through the ages. In this way, we may be able to apply lessons from ancient cities to identify indicators of successful societies and citizens, to inform present urban practices and modern learning environs.

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Figure 2.1 The framework of the key features of learning cities (UNESCO Institute for Lifelong Learning, UIL, http://uil.unesco.org/fileadmin/keydocuments/LifelongLearning/learning-cities/en-unesco-global-network-of-learning-cities-guiding-documents.pdf).

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[1] See http://pie.pascalobservatory.org/pascalnow/blogentry/pie/vancouver-stimulus-paper.

[2] See http://uil.unesco.org/lifelong-learning/learning-cities.