

CHAPTER 5

Accessible Inclusive Learning: Futures

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The previous chapter on Accessible Inclusive Learning: Foundations outlined some key approaches and challenges when conducting research that seeks to make learning accessible to all. Here, we explore newer trends that are directing our current research and practice in this area. These promising directions include devising models for global networks, the potential to collect and use data to understand learning experiences in new ways, and new opportunities arising through artificial intelligence. By exploring current and recent projects around these areas, we also highlight some emerging tensions. Finally, we return to thinking about how we conduct research, considering how concepts of bricolage and guerrilla research are important in our methodological palette.

The trajectory of the vision: Learning is accessible for everyone

At The Open University (OU), we aim to be open to all in our ethos for teaching, and we look for similar approaches in our research. This means seeking to engage groups who are currently underserved in education, such as refugees or people from low socio-economic backgrounds who may not traditionally

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access higher education. It also means we want to be open to engaging with people who have expertise and knowledge to offer, regardless of where or who they are. It means sharing and discussing our work through networks in ways that allow others to easily engage with it, or build on it (Weller, 2011).

We begin by considering how institutional practices and research can be enhanced or driven by global and local collaboration. We follow this by exploring how new approaches to data gathering and analysis are required to realise the practice and process based views of accessibility described in the previous chapter. We then explore how research can broaden its audience, and broaden its impact, by moving from particular audiences and bricolage towards mainstream use.

Working together through global and local networks

We have argued in the previous chapter that understanding and adapting to the specific contexts of individuals, and of particular populations, is essential to create accessible education. At the same time, the advantages of working together around the world, and creating an impact at scale through mutual interest and discussion, are particularly visible in this area.

Global collaboration has led to the Web Content Accessibility Guidelines (WCAG) that provide a common standard and criteria (W3C, 2018). The widespread application of this in education and elsewhere provides a means to promote and define expectations of accessibility that any website should be able to achieve.

The development of Open Educational Resources (OER) also benefited from collaboration from stakeholders around the world, (e.g. Cape Town Open Education Declaration, undated). It has provided a well-defined means for anyone to share educational content and courses which supports other educators or students to reuse and adapt these (Creative Commons, 2016). OER provides a great example of the power of working together over time in a loosely-coupled way. This means that institutions, projects and individuals have declared enough consensus on their aims, and developed and adopted shared principles and models, such as the use of Creative Commons licencing.

Because anyone can become involved in open education, and the collaborations can be loose or sporadic, it can be hard to understand what people are doing and the impact it is having. The OER World Map project tackles this issue and offers an example of working differently in the open, alongside insights into the way in which such a service can be designed to garner and sustain interest. The platform is designed to collect and visualise data on actors and activities in the open education space, providing a means to understand what initiatives, people and resources are available to engage with. While global in scope, it does not ignore local requirements. Tailored, country-specific maps can be produced, which provide insight that might be of specific interest to

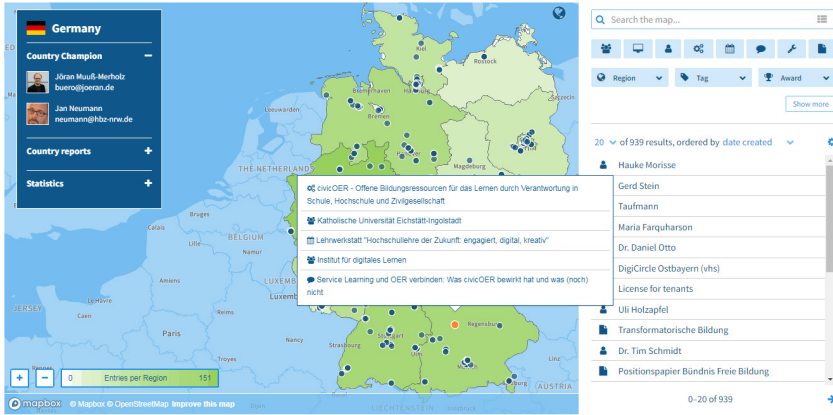


Figure 5.1: OER World Map – screenshot of Germany portal from <https://open-educational-resources.de/karte/>.

practitioners in a particular region. There is functionality to display ‘Country Champions’ who are members engaged with the project in a particular region. The project combines a bottom-up approach to engage end users to contribute, alongside work to develop worldwide partnerships and strategic alignment to priorities. As OER becomes a mainstream approach for education, the availability of information about resources and actors will become even more valuable (Neumann & Farrow, 2018).

In some contrast to the OER World Map, the Global OER Graduate Network (GO-GN) is focused on supporting the development of individual PhD researchers in a global context. Doctoral candidates are joined by experts, mentors, and interested parties to form a community of practice. The network uses online webinars and face-to-face meetings to raise the profile of research in open education, offer support to students conducting research in the area, and to develop openness as a process of research. Because of the relative novelty of OER research, expertise and support for a doctoral researcher at their own institution may be limited, and connecting with other students and experts offers potential for greater impact. Furthermore, the network can provide a community where openness in the process of research is valued (de los Arcos et al., 2016).

Networks such as GO-GN are not designed to be the exclusive ‘home’ of a researcher. People involved in GO-GN often belong to other networks and act as a bridge between these and GO-GN. For example, GO-GN has been an important further network for students who form part of the Leverhulme Trust funded Open World Learning (OWL) initiative. This initiative was devised to bring together diverse perspectives, with doctoral researchers coming to study at The Open University from all around the world (Institute of Educational Technology, 2018). Many of these projects explore inclusion in OER and MOOCs,

including how MOOC learning varies by geo-cultural and socio-economic factors, with differences identified in how learners behave based on location and prior education (Ritzi et al., 2019); and how OER presented in English may not be suitable for those for whom English is a second language, with the potential for language simplification to tackle this (Rets et al., 2019).

A further model of global collaboration is found in the Ed-ICT network. This explores the role that ICTs can play in creating or removing disadvantages for students with disabilities in post-compulsory education. The approach taken here has been for themed workshops to be hosted in five different countries (Canada, Germany, Israel, UK, and USA). A core team formed from each country attends each event to create coherent understanding across the workshops, but local practitioners, researchers, and students play an essential role in each workshop by sharing their perspectives and developing ideas and knowledge that are grounded in the local context. This is a wider instantiation of the ethos argued for by the network partners in their own work, which highlights the importance of student voice in research and technology development (e.g. Fitchen et al., 2014; Seale et al., 2013).

The network brings to attention similarities and differences between the ways in which different countries approach accessibility and the factors that influence these, such as government and institutional responsibilities, or common models of practice. Links can be drawn between prior research conducted in different countries and student populations, alongside practice-based issues.

One example of this, which became the focus of an Ed-ICT workshop, is transitions. This can encompass situations such as the transition between school and post-compulsory education, transitions between different modules, institutions, or years of study, and transitions from study to employment. In each case, there are challenges for disabled students as the support mechanisms, strategies, and expectations placed upon them may change. The design of technology and technology-related support can be a pivotal factor within this (Burgstahler, 2003). Examples of challenges raised included the removal of assistive technology that was loaned or supplied by one organisation as the person transitions into the remit of another, or the incompatibility of workplace systems with the assistive technologies and strategies that the person has developed as a student.

Attention should be drawn to resolving these types of gaps that emerge as a person moves through a transition. At the same time, it was argued that it is essential to support the development of self-advocacy – an individual's skills and capacity to describe their requirements, and the confidence to know their right to reasonable adjustments to support them. The experiences of network members, and prior research, both highlight that developing a person's capacity for self-advocacy plays a pivotal role in successful transition, because there is often no single consistent entity supporting them across the transition.

By bringing together students, practitioners and researchers, complex issues can be unpicked with discussion across stakeholders. One issue in which all

voices are required to build understanding is the adoption or rejection of technologies by students. In many countries or institutions, resources are spent on making specific assistive technologies available for students and providing training for these. However, research by network members has found substantial disparities between the technologies that experts suggest are useful and those students consider useful (Fitchen et al., 2013). Other work by network members has explored related issues, such as how mainstream and specialist assistive technologies can both be useful in making learning accessible (Seale & Cooper, 2010). In the Ed-ICT approach, students presented their views of which technologies were useful to them and how they chose and used these. Practitioners, including those supporting disabled students in education and technology developers, expressed their perspectives on how they supported students, and researchers presented findings and provocations. The proceedings of these workshops then became a basis for balanced analysis and agenda-making for continued work that includes all these perspectives (Ed-ICT, 2017; Ed-ICT, 2018a, Ed-ICT, 2018b). Proposals for further research or practice-based innovations can emerge that combine the different potential, resources, and expertise of multiple local contexts.

Each of the approaches outlined in this section – The OER World Map, GO-GN, OWL, and the Ed-ICT Network – provides a different example approach to how collaboration can respond to the potential for both global and locally situated research. They each build on an awareness that local context matters in terms of the available support for accessing learning opportunities, and in the ways in which research can have an impact. They also harness the value of openness through global networks.

Harnessing data to understand barriers and improve support for learning

While the increase of interactions with technology creates the potential for ever more data to be collected and analysed, this does not necessarily lead to greater understanding of the needs of learners.

Prioritising openness and accessibility does present challenges to big data or analytical research approaches. For example, in the Bridge to Success initiative introduced in the previous chapter, it was noted that if we aim to create a situation in which anyone can access and use a course or resource in flexible ways, we cannot then put restrictions on them such as requiring them to fill in details about themselves. Neither can we necessarily gain access to institutional data about students in order to use this to contextualise and understand their learning (Pitt et al., 2013). In Bridge to Success, we worked closely with some partner colleges to evaluate the impact of introducing the OER into particular classes in their institutions, but in other scenarios, OER can be adopted and used with very little trace of this activity having occurred, or a sense of its impact on learners.

Equally, supporting the flexibility required for disabled learners can also challenge analytics approaches. For example, if a learner requires their learning materials in an alternative format, they may not produce data through their interactions with a Virtual Learning Environment (VLE) in the same way that other learners would. If a research method uses data on VLE interactions, such as measurements of student logins or page views, are students using alternative means of access and engagement represented in the data? These issues need attention for the benefit of both the students who engage through these means to ensure they are not excluded, but also for the validity of the research, which might otherwise inaccurately suggest a lack of engagement with the learning materials where actually these are being delivered by alternative means.

While these problems need to be considered, data-driven approaches, which are explored in Chapter 7, can also be used to understand the accessibility of courses, and to identify where potential problems might exist. Cooper et al. (2016) conducted an analysis using a large data set spanning five years of module-level data on student retention. By analysing the proportions of students with declared disabilities who completed each particular course or module, they could identify discrepancies where disabled students were performing more poorly than could be expected, using odds ratios of the likelihood of completing a module when compared with students who had not declared a disability.

Cooper et al. (2016) note that this approach only identifies modules where there may be accessibility problems. It does not tell us what the causes of these lower completion rates in these modules are. Therefore, they also explore the use of student feedback to augment the approach. Feedback is commonly collected from students on all modules through end of module surveys. If this contains free text responses, and if the responses within this data that relate to access issues can be isolated, this feedback offers a means to create improvements which follows the notion that accessibility should be considered as a process (Coughlan et al., 2017). For Cooper et al. (2016), their analysis of student survey feedback highlighted a different set of courses that may contain accessibility issues to the ones they identified through the comparison of completion rates. This suggests that multiple approaches to evaluating course accessibility are complementary rather than providing similar results.

A focus on one particular variable, such as whether or not a student has declared a disability, offers potential for insights such as those found for course accessibility by Cooper et al. (2016). However, students and the challenges they face are not one-dimensional. The concept of intersectionality – that multiple aspects of discrimination co-exist and interact – should also be considered in analytical strategies. By analysing multiple intersecting data points about a student (for example, gender, disability, socio-economic status and race), we can harness data to identify and explore the combined effects (Borden & Coates, 2017). Encouraging research and evaluation with an intersectional approach is now an explicit focus for the Office for Students, the body responsible for Higher education provision in the UK (Office for Students, 2019).

Noting that most prior research had focused only on one or two demographic variables, Rizvi et al. (2019) set out to analyse the relative effects of six demographic variables on the attainment (distinction, pass or fail) of students who had completed one of four OU courses. These variables comprised geographical region; socio-economic status via the Index of Multiple Deprivation (IMD) for the student’s postcode; highest level of previous education; age, gender and disability. Using a Decision Tree analysis approach, they identify that the geographic and socio-economic factors had the largest impact of all these factors for these students. Analysis such as this is important to ensure a broad understanding of factors impacting on attainment.

End-of-module surveys and data collected through student behaviour and assessment are the current materials available for learning analytics, but there could be better methods for students to self-report their experiences in ways that provide further insights. Prompted by the desire to support disabled students to represent the challenges they faced and the impacts of these on their studies, the Our Journey tool (<https://ourjourney.ac.uk/>) has been developed with the participation of students and other stakeholders to provide a structured approach to capture the diverse journeys our students take (Coughlan et al., 2019a). By creating a series of ‘cards’ that represent important events for the student and their emotions at the time, combined with free text to further contextualise the event, we can create a different means of representing the student experience.

The representation of a journey taken over time helps to unpack the ways in which series of events and the development of the person combine in both the challenges and achievements of study, and the impacts other areas of life may have on study. Our Journey aims to capture the experience of each student, but we are exploring how this can be combined with other forms of analytics data and events. In this way, adding additional context and narrative that

Tim Coughlan, tell us about your journey

What happened?
Select a word or an event connected to your journey

Assessment

How did you feel?
Select a word or emoji which describes how you felt.

anxious

Describe the event (optional)

My first exam!

186 characters remaining

When did it happen? (optional)

Autumn 2019

Add any word or date format you like.
For example: 5 November 2019 | November 2019 | Autumn 2019 | 2019 | 2018

POST

Figure 5.2: Our Journey card creation interface.



Figure 5.3: A student journey representation created in the Our Journey tool.

is structured by the student rather than the institution. Furthermore, unlike a survey, Our Journey is designed to be engaging and enjoyable for the student, with the potential to underpin reflective learning activities around study skills. Finally, options are being explored to integrate the tool, with prompts for guidance and support. We continue to iteratively refine the design, and to trial the tool in a variety of ways, in order to develop an evidence base and improvements.

Our Journey is being developed with continual input from students and staff, and was informed by our prior research around the challenges that disabled students face and the impacts of these (Coughlan & Lister, 2018). One particular area that was highlighted in this process was the importance of the emotional effects of events in the student journey. For example, that having to complete arduous administrative processes is a cause of stress and potential exacerbation of mental health challenges. As such, the application of Our Journey to understand student mental health and wellbeing is an important direction in our work. Because students report an emotion in relation to each event, and the patterns in this over time can be studied, the tool has the potential to uncover patterns and types of events around emotional wellbeing.

More broadly, there has been a wave of activity around student wellbeing and mental health in recent years. This has been prompted by data showing

increased disclosure of mental health conditions, and high-profile cases of student suicide. As well as providing new understanding at scale of student mental health, analytics and other technologies could underpin preventative approaches that respond to students with relevant guidance and prompts to support (Jisc, 2019). However, the complexity of practically measuring or engaging with student mental health requires qualitative, co-produced approaches to the design of strategies (Piper & Emmanuel, 2018; Piper & Byrom, 2017).

Future advances in our capacity to understand our students and the challenges they face as they access education may depend on our ability to combine analytics drawn from university systems with the participation of students and other stakeholders to give context.

Innovation for inclusion benefits everyone

Rather than inhibiting innovation, a focus on inclusion is key to directing innovation towards human-centred outcomes that are useful for all people. By embedding accessibility from the start of the process, and by working in the open, we create greater opportunities for people to use and build on our work.

The ‘Our Journey’ tool described above provides a reminder of this. The project developed because we recognised a need for disabled students to be able to communicate the challenges they face, as well as a difficulty for educators, researchers and support staff to understand these challenges.

However, we now see that Our Journey could be useful for all students, and that the underlying concept has potential for a wide range of scenarios. This is because most students face some challenges and could benefit from representing and reflecting on these, as well as their successes. Equally, institutions lack rich understanding of their students in general, so could benefit by understanding the journeys of all their students. There is wider interest in applying the Our Journey concept even further from this starting point, by using the activity of creating a journey as a way to capture and learn from personal experiences in a range of different domains. The tool and graphics are openly licenced, which can simplify and enable adaptations of the tool to different types of activities and contexts.

This doesn’t mean that the project has become detached from the original purpose – we maintain the involvement of disabled students and will still use the tool to create greater understanding of their experiences. But rather than suggesting that accessibility and inclusion constrain innovation, projects like Our Journey identify needs or goals by working with a particular population, and direct innovation towards it (Coughlan et al. 2019a). In doing so, it is often the case that the goal which is particularly apparent to this population is actually more widely applicable. By aiming for a mainstream audience, a tool that is inclusive by design is no longer a specialised solution. Instead we have empowered the underserved audience such that they are directing innovation in the mainstream.

It is argued in the Beyond Prototypes framework that “TEL involves complex systems of technologies and practices” (Scanlon et al., 2013, pg. 7). Because inclusive innovation projects are grounded in tackling real problems, they are usually open minded towards combinations of technological and practice-based solutions. For example, the ‘Returning to STEM’ Badged Open Course (BOC) was based on research that explored the challenges for women returning to STEM careers after an extended break (e.g. because of child care). The project identified strategies that had been successful for women returning to their careers. BOCs are a model for free courses designed to support independent study (Law, 2015). The ‘Returning to STEM’ BOC was created by drawing on the project research and through a partnership with Equate Scotland - an organisation that works towards the advancement of women in STEM careers. However, a key lesson learned was around the effectiveness of a blended learning approach, which combined the BOC with face-to-face workshops and individual meetings (Herman et al., 2019). While there is a tendency to focus on the online experience of OER, it can be at their most useful when combined with face-to-face teaching and support. As Cannell and Macintyre (2017) argue, partnerships that provide for physical, face-to-face activities to introduce learners to OER and build confidence are important because there is a danger that if we only make online learning opportunities, we are likely to reinforce digital and educational divides.

Where technological advances are developed to improve inclusion, these often go on to underpin mainstream advances. Captions and transcripts for online videos provide a useful example. Back when online learning was still relatively new, Colwell et al. (2005) described the development and evaluation of a video player to identify requirements for deaf students. This supported existing transcripts to be displayed alongside the relevant video, and for software-generated transcripts to be produced where there was no transcript available. We now find that many students benefit from such transcripts in situations where they cannot easily listen to audio or prefer to read (e.g. reported in Coughlan et al. 2013). More broadly, the technologies that developed for speech to text (speech recognition), and text to speech (screen readers) as an essential component of assistive technologies now find both in pervasive use in mainstream technologies from smart speakers such as Amazon Echo, smartphone-based assistants such as Apple’s Siri, and in automated telephone answering services.

The value of innovation also flows in the opposite direction, with mainstream technologies having the potential for specialist assistive uses. If properly harnessed, virtual assistants, smart home devices, and other Internet of Things technologies can be beneficial for inclusion. Technology companies, such as Microsoft, now recognise that Artificial Intelligence (AI), combined with pervasive mobile computing, has many potential applications to accessibility (Microsoft, 2019). An example of this is the ‘Seeing AI’ app, which provides visual recognition of objects and reading of text in the environment using a smartphone camera (Microsoft, 2018). By focusing on the development of an innovation that supports blind or low vision people, they provide a grounded and important challenge for the

underlying technology to be applied to. There is, however, a perennial concern that if these new technologies are not designed with consideration of accessibility, they may instead exclude by design. The development of standards through global networks is again important here (Abou-Zahra et al., 2017).

While some AI innovations will be specialist assistive technologies, the integration of accessibility with mainstream technologies means that people are not segregated or left out of activities. Live automated captioning of lectures or other presentations is being integrated into mainstream presentation software such as Microsoft Powerpoint. It seems likely that more teachers will use this technology than if a specialist tool needed to be purchased and installed. The Android Live Transcribe app offers immediate speech to text conversion as a means for deaf or hard of hearing learners to communicate as equals with peers in collaborative activities, just using a standard smartphone (Android, 2019).

Taking this idea further, AI is being applied to overcome communication barriers of all kinds for all people, automatically translating audio and text between any language that is spoken, including sign languages (Ahmed et al., 2018; Wolfe et al., 2016). We are at the point where it is possible to translate, for example, British Sign Language into written Spanish and vice versa. To achieve this, sensors to convert gesture into data, text to speech, translation services, speech to text, and virtual reality technologies to enact a signing avatar would be used in concert. As these various technologies mature, the potential to create online learning that is more global and inclusive of all groups becomes a realistic and exciting prospect.

Some people may expect innovation to work best when unconstrained by the hassle of having to produce results that work for everyone. But meaningful innovation should identify and work to tackle real issues. In our current research, we are working with Microsoft to explore how an AI-based assistant could support people through the processes of communicating about their disabilities and getting effective support in study and everyday life. Research grounded in the participation of students identified these issues (Coughlan & Lister, 2018), and now provides an inspiration for us as we explore how to harness and innovate with these technologies.

Having argued that the results of inclusive innovation projects are likely to be useful to wider audiences, we want these to be adaptable and easily available to others to use. This leads us back to importance of an open approach. The tool and graphics are openly licenced, and our discussions about adapting the tool to different types of activities and contexts are made easier because of this.

Taking advantage of opportunities: bricolage and guerrilla research

In the previous chapter, we described persistent strands of research in the areas of virtual laboratories and remote access to fieldwork. These pushed the

possibilities of technology at the time, and there was value in conducting these experiments to produce a close approximation of what would become more achievable in time. Taking available opportunities to use cutting edge technologies in new ways allowed for the investigation of pedagogical possibilities, in advance of these becoming a mainstream reality. We use what is available now to create and learn things that should be important later.

Taking these opportunities as they arise is important to the bricolage approach. As Scanlon et al. (2013) put it, bricolage ‘involves bringing together and adapting technologies and pedagogies, experimentation to generate further insights, and a willingness to engage with local communities and practices.’ (pg. 7). Key features of the approach are that a project may start by reviewing what tools and resources are available and how they could be innovatively used; and that the use of theory to underpin research is balanced with engaging communities and grounding innovation in practice. Attention is paid to the constraints of a situation and how these can be overcome or compensated for.

Bricolage can be particularly pertinent to work around inclusion because of the pressing need to address and have an impact on real problems faced by people. Also, exclusion often occurs through restrictions and constraints within particular situations, so attending to these is often an effective starting point and continued interest for any project.

We also see the value of bricolage in the more recent IncSTEM project (Embedding and Sustaining Inclusive Practices in STEM). This built on and scaled up existing examples of inclusive practice in STEM at a range of levels, including teaching activities, institution-wide systems and policy and sector-wide accrediting bodies (Pearson et al, 2019). In order to do this, IncSTEM has sought the voices and involvement of staff and student stakeholders from across the university and the sector, adopting a diverse range of methodologies and a collaborative approach (McPherson et al, 2019). The aim here is to systematically take opportunities to review, refine, and spread innovations for which there is evidence that they could make a difference to inclusion.

The potential of open approaches to support and help to spread innovations widely in education is commonly alluded to, but as noted in the Beyond Prototypes framework, such processes need to be viewed longitudinally, which is problematic when projects are only funded for short periods. In a retrospective analysis of Bridge to Success, which returned to interview stakeholders in the three years following the completion of the project (Coughlan et al. 2019b). Through this we found instances where the introduction of the OER to new audiences led to wider change, such as embracing the idea of providing free and openly licenced materials for all students studying with the institution, rather than expensive proprietary texts. Equally, enthusiasm for OER by individuals could be tempered over time by a lack of organisational buy-in, and the withdrawal of the support that the project funding could enable. We must conclude that sustainability is an essential focus that can be hampered by the project and

innovation focused world of TEL research. Once again a persistent intent in an area means that successive projects build on each other.

The concept of bricolage can also help us to understand how an open resource can become a basis for innovation. In the case of Bridge to Success, the original course materials, such as ‘Starting with Maths’, were designed to support learners new to higher education with support from a tutor. Years after their original production, these course materials were openly-licenced and remixed for self-directed use, predominantly for a US audience. This created ‘Succeed with Math’. Additional elements such as quizzes were added which supported independent use of the materials, and further revisions of these resulted in ‘Succeed with Maths’ Parts 1 and 2. These were some of the first set of Badged Open Courses (BOCs) referred to earlier. This potential for reuse and remixing of tried and tested educational content in new contexts helped to make innovation a reality (Coughlan et al. 2019b).

If we consider what openness offers as part of an approach to bricolage, there is also a sense of supporting opportunities to arise and taking advantage of the increasing resources that are freely available to use. Valuable research projects can be constructed using open data, open source tools, platforms and people who can engage, or openly-licenced materials.

Arguing for the value of harnessing this, Weller (2014) describes the notion of ‘guerrilla research’, as an alternative to the common template of an academic research project. The key notion is that in many situations where we identify a research question, there are open resources that provide opportunities to do interesting research right away, for ourselves, and without extensive costs and planning. Guerrilla research can have the following characteristics:

- It can be done by one or two researchers and does not require a team.
- It relies on existing open data, information and tools.
- It is fairly quick to realise.
- It is often disseminated via blogs and social media.
- It doesn’t require permission.

These characteristics can be seen in initiatives to harness open data as a means to social change. A nice example of this has been the School of Data initiative, which has created structures to enable small and large projects around the world that develop data literacy among journalists and NGOs, and lead to practical results by exploring and creating publicly available data (School of Data, 2019).

While longer term plans and funding are important for many research projects, these may become barriers that prevent progress being made in the development of knowledge. One of the great things highlighted by this approach is the way in which it promotes the notion that anyone can conduct research at any time, we just need an idea or question that matters to get us started.

Conclusions

Continual change in technology and in education mean that inclusion requires constant re-evaluation and discussion. In this chapter we have explored some of the practices and trends that are important to the present and future of our work in accessibility, openness and inclusion.

We have highlighted how global networks can support sharing of research and practice and work towards shared goals. In the modern age these networks are always likely to have a digital foundation, and these networks can embody and exemplify how open practices enable wider participation and inclusivity. However, these networks should still be designed to account for individual and local matters. Networks based around principles of openness and inclusion have created global standards, but they also help localised activities gain traction, and provide individual researchers with homes and communities that benefit their research and enhance the impact of it.

From the early foundations, data analysis has been used to identify gaps in participation, completion and attainment for particular groups. More recently, the trajectory of innovation in data gathering and analysis has been to embrace complexity by looking at wider ranges of variables and intersections between these, and to develop means to capture and analyse events in the student journey and their impacts over time. These analyses often lead to more questions, and there is still much that we do not know about the mechanisms of exclusion. But we are embracing new opportunities, including more data captured from learners interacting with online learning environments, data at scale from new platforms for open education, and new learning analytics tools and techniques.

We are also finding that our work to address audiences with particular needs leads to wider impact. There is increasing recognition that harnessing technologies such as AI to address problems identified by working with a minority group is an important means to create mainstream innovations. Rather than considering these outcomes as incidental, we can argue that inclusive research and innovation should be the norm. This is achieved by opening up our projects to participation at all stages, and making sure that the outputs of these are available to others to innovate with through their own bricolage and guerrilla research.

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