

# ***Using speculative methods to challenge the invisibility and inevitability of data in education***

*Joe Noteboom, Centre for Research in Digital Education, University of Edinburgh, UK, [j.noteboom@ed.ac.uk](mailto:j.noteboom@ed.ac.uk)  
Dr Jen Ross, Centre for Research in Digital Education, University of Edinburgh, UK, [jen.ross@ed.ac.uk](mailto:jen.ross@ed.ac.uk)*

## **Abstract**

Speculation is a resource for critical analysis of data-driven postdigital education. In particular, speculative methods help researchers challenge the invisibility of data-driven educational practices, and thereby unsettle the apparent inevitability of data futures. Working against these tendencies towards invisibility and inevitability requires critical imagination, and speculative methods help foster this for researchers and participants. This paper introduces speculative methods and explores their enactment in a research project that examined the social and ethical implications of datafication in higher education. Speculative methods are characterised by their non-representational, complexity-informed and inventive character and their temporal, epistemological and performative qualities. They have a complex relationship with time and temporality, attending to ‘not-yetness’; are epistemologically complex, producing problems and engaging with ambiguity; and act to create futures or realities they represent, in part through engaging publics at different scales and in different contexts. Methods inspired variously by speculative fiction and speculative design approaches have been used by digital education researchers to investigate and intervene in data futures and to challenge predictive, closed forms of data-driven future-making. The methodological value of speculation is explored here through discussion of a research project that involved ethnographic and speculative engagement with students at a research intensive university in Scotland. The research attempted to understand participants’ experiences of and perspectives on emerging data-driven technologies and practices, and what this meant for their relationship with the university. In this paper we analyse the design of and data generated through two particular speculative methods: data walking, and thinking otherwise. We focus on participants’ reflections on the methods used and show how speculation was central to efforts to prompt ethical reflection on data-driven practices. In the case of data walking, this involved sensitising participants to datafication processes, thereby making hidden practices visible to participants. A simple prompt to think otherwise, meanwhile, generated data regarding participants’ experiences and problems in the present while at the same time opening up possibilities of thinking otherwise about data futures. We close by relating these findings to wider considerations for speculative methods, focusing on the role of speculative objects as both instrument and output of research and exploring the significance of discursive closures in participatory research.

## **Keywords**

speculative methods, data walking, data futures, invisibility, critical imagination

## **Introduction**

This paper introduces speculative methods and explores their enactment in research into the social and ethical implications of datafication in higher education. Two key ideas are foregrounded: making data practices visible, and challenging their inevitability through critical imagination. These ideas are explored through a case study from a recent research project that used speculative methods to explore processes of datafication in higher education with university students, highlighting the value of speculation in prompting participants to notice and reflect on data-driven practices in their everyday lives. This speculative engagement was central to efforts to prompt ethical reflection on data-driven practices by making hidden practices visible to participants and opening up possibilities of thinking otherwise about data futures. Key findings include the multifaceted roles of speculative objects in research and what we can learn by attending to the imaginative limits of participant speculation. By illustrating the role of speculative methods in challenging the invisibility and inevitability of data-driven practices in higher education, we argue for the value of speculation in engaging with the complexity and ambiguity of educational data futures.

## Speculation, data and education

Speculative approaches and methodologies in educational research, including research that examines the impacts of technology on education and the imaginaries that inform ideas of the future of data-driven education, are useful for exploring futures because of their congruence with complexity, emergence, indeterminacy, and their potential to help articulate alternatives through seeing, and thinking, otherwise.

Speculative approaches to research are characterised by their non-representational, complexity-informed and inventive qualities. They are aimed at envisioning or crafting futures or conditions which may not yet currently exist, to provoke new ways of thinking and to bring particular ideas or issues into focus. Michael (2012) describes them as “‘inventive problem making” (p.536) that helps reconfigure issues; while Dunne and Raby (2013) value their ability to support critical imagination about the future, and about the present, by making unseen limitations more visible. Ross (2023) describes speculative approaches as “work[ing] with the future as a space of uncertainty, and using that uncertainty creatively in the present” (p.13).

Speculative methodologies are found in a range of disciplines, and are related to speculative design, inventive methods and compositional methods. They also draw on traditions of storytelling and speculative fiction which have emerged from literature, filmmaking and art. Ross (2023) proposes that there are three main qualities of speculative methods that are essential to understanding what they are and what they can do in educational research: their temporal, epistemological and performative qualities.

Speculative methods have a complex relationship with time and temporality. Futures are made in a variety of ways, but are always contingent and contextual. The intersection of hope, expectation, uncertainty and influence produces a state of not-yetness in knowledge claims and explorations of the future. Not-yetness implies multiple overlapping temporalities: including the nature of current preoccupations and invisibilities, as we will see. Duggan (2019) describes futures as social practices made up of assumptions that reflect the present – for example, assumptions about the role of networked technologies. Speculative methods can reveal, generate, critique and otherwise work with versions of past and future in helpful ways. This is relevant in the context of data-driven and digital education, where visions of the future of learning are often presented with apparent certainty.

Speculative approaches are also epistemologically complex, because researchers understand them as producing, rather than ‘answering’, the problems, topics and questions they engage with (Wilkie, Michael and Plummer-Fernandez, 2015). A central and influential argument for speculation in qualitative research has come from a need to try to undo “the logic of procedure and extraction” (Springgay and Truman, 2018, p. 204). Springgay and Truman critique the tendency for methods to be predetermined, rather than to act from within problems. In a similar vein, Lury (2021) writes of “problem space” as a space of methodological potential that is realised through a methodology that composes the problem again and again. Ambiguity is a key epistemological dimension of speculative methods, allowing researchers to respect the tendency of objects and subjects of study to misbehave (Michael, 2012). Benjamin (2016) argues that speculative ambiguity has practical and activist use: it can provide vital experimental space for anticipating and intervening in new formations.

Finally, speculative methods act to create futures or realities they represent, and in part they do this through their focus on engaging publics at different scales and in a variety of contexts, including in formal and informal learning contexts. Researchers in design fields draw particular attention to issues of speculative engagement and performativity. A range of methods is associated with speculative design (Dunne and Raby, 2013; Galloway and Caudwell, 2018), including design fictions, prototyping, and scenario-creation to be used in participatory workshops or other collaborative research or public engagement environments. These methods work speculatively with questions, audiences, and objects-to-think with, producing playful and imaginative encounters while setting up relations of responsibility (Ross, 2023). That responsibility includes attention to how speculation might come to matter to participants – including through what Elsdon et al. (2017) call “Speculative Enactments”: consequential, activity-focused and co-constructive, with a focus on interventions into the mundane or routine. Speculative work with participants and audiences needs to be designed with ethical considerations in mind, precisely because it is designed to matter. Galloway and Caudwell (2018) note that thoughtful engagement on the part of participants is in itself a valuable outcome of speculative research. Also of value is the potential to cut through apathy and a sense of inevitability around topics that can seem to have their futures already mapped out. For instance, Markham (2021) argues that without careful design and planning of engagements, people tend to encounter various kinds of “discursive closures” in speculating about the future of technology. Speculative methods can expose and work with such assumptions in novel ways.

Speculative methods are used to explore a range of educational topics and possibilities (Veletsianos, 2020). In educational research, speculative fiction has been increasingly used as a method to investigate futures (Jandrić and Knox, 2022), work that has been characterised as “fabulation” (Cerratto Pargman, Lindberg and Buch, 2022). Fictions have been used to examine a variety of postdigital objects and temporalities, including textbooks

(Costello, Soverino and Girme, 2022), deschooling (Costello and Girme, 2022) and biotechnology (Jandrić and Hayes, 2023). Researchers have debated the extent to which fictional methods can or should contribute to hopeful or emancipatory futures for education (Houlden and Veletsianos, 2022; Suoranta et al., 2022). In parallel, a growing body of work in education has drawn from speculative design approaches, or “fabrication” (Cerratto Pargman, Lindberg and Buch, 2022). For instance, Krawczak (2022) describes the reception and transmission of sound as a speculative tool for designing postdigital pedagogies of the city. And Goodyear (2022) builds on Costanza-Chock’s framing of speculative design as generating “capacious realities” (p.2) that can push against binaries by proposing new forms of postdigital infrastructure for ‘good’ universities.

The implications of datafication in education have been speculatively explored, challenged and re-imagined in a number of different ways. The production of speculative scenarios or fictions relating to data, algorithms, automation and artificial intelligence cover issues such as feature creep and privatisation, data exploitation, and recentralisation (Hillman, Rensfeldt and Ivarsson, 2020); productivity, individualism and experimentation (Macgilchrist, Allert and Bruch, 2020); human agency in relation to intelligent systems (Cox, 2021) and empowering students as agents of change (Gaskins, 2023). The emphasis of this speculative work differs: for instance, Hillman et al (2020) highlight the risks, the persuasiveness and, eventually, the ubiquity of datafied systems; Selwyn et al (2020) focus on the mundanity of possible futures; and Staunæs and Brøgger (2020) explore the nature of academic life and relations with data. But, in all cases, speculative work is seen as an antidote to predictive, closed forms of data-driven future-making, which can include overly narrow definitions of success – for instance learning analytics platforms that attempt to determine a future where students are always “on track” (Knox, 2017).

A critical response to closures informed the case study of speculative research that follows. This case study draws on data collected as part of Joe’s PhD research project on the social and ethical implications of datafication in higher education.

## **The University of Data: engaging students with datafication**

The *University of Data* project involved ethnographic engagement with students at a research intensive university in Scotland in an attempt to understand their experiences of and perspectives on emerging data-driven technologies and practices, and what this means for their relationship with the university. The case study that follows demonstrates that speculation was central to efforts to prompt ethical reflection on data-driven practices by making hidden practices visible to participants and opening up possibilities of thinking otherwise about data futures.

This work was inspired by critical data studies scholarship that has emphasised the importance of understanding lived experiences of datafication from “the perspectives of the people upon whose data datafication is built” (Kennedy, 2018). This is an underexplored perspective in higher education and offers an important vantage point from which to approach the datafication of the university (Noteboom, 2023). This research thus aimed to address a perceived need for an approach which combines an emphasis on student agency with a careful attention to structural factors, enrolling students as “critical companions” (Ziewitz and Singh, 2021) to understand the ways in which their lives are entangled with data infrastructures and practices.

The research took place at a large research intensive university in Scotland between May 2022 and April 2023. University and place names in the analysis that follows have been changed, and people given pseudonyms, in line with the ethical approval received for the project. Data were primarily generated through a series of workshops where participants collaboratively explored the university as a data-driven institution, along with follow-up semi-structured interviews with participants. Joe conducted five workshops between May 2022 and February 2023, with a total of 22 participants drawn from undergraduate and postgraduate programmes in computer science, sociology, design, education and digital humanities. Of these, 14 participants were subsequently interviewed, with most interviews taking place in person and lasting between 45 and 90 minutes. Taken together, these activities generated a rich body of data about students’ perspectives on datafication, including maps, photographs and notes produced by participants, recordings of discussions and interviews which Joe subsequently transcribed, and notes based on Joe’s observations as workshop facilitator. Two elements of these workshops in particular, a ‘data walkshop’ (Powell, 2018) and an experiment in thinking otherwise, illustrate the value of speculative methods in researching the ethics of datafication in higher education.

### **Data walking as speculative method**

One of the primary goals of the workshops was to sensitise participants to the data infrastructures and practices at work around them in order to prompt ethical reflection. The workshops centred on a ‘data walkshop’ (Powell 2018), with participants exploring the campus on foot to document encounters with data and generate collective

understandings of datafication. Powell (2018, p.18) conceives of the data walkshop as “a radically bottom-up process of exploring and defining data, big data and data politics from the perspectives of groups of citizens, who walk, observe, discuss and record connections between data, processes of datafication, and the places that they live in”. Each participant took a particular role—navigator, photographer, map-maker, note-taker and collector—and worked together to explore an area of campus for around 30 minutes. Following Powell (2018), groups were instructed to notice areas that they thought were ‘data rich’ or ‘data calm’, instances of data being collected, processed or acted upon, and moments when data intersects with the lives of students.

We see data walking as an inherently speculative method that encourages participants to notice and ask questions about the taken-for-granted data practices around them. Es and Lange (2020) locate the value of data walking in the artistic-philosophical tradition of walking as ‘embodied, situated and generative’ practice, which they argue can help address the challenges posed to critical data scholars by data infrastructural invisibility, decontextualisation and accessibility. The speculative quality of data walking is particularly valuable in confronting this invisibility. Many of the participants described the data walk prompting them to take note of ubiquitous data collection to which they hadn’t given much thought before. This prompted some to consider how data might be used, and raised normative questions around privacy, surveillance and the benefits of data practices. As one participant reflected:

I didn’t realise how many security cameras, or how secure the library is? ... that’s a lot of surveillance for just a library ... I on one hand think it’s a bit over the top, on the other hand understand why it’s there, and appreciate the practicalities of like, oh, I can go on the library website and see how crowded it is. That’s helpful. (Sidney – PG digital humanities)

Along with ethical reflection, the data walk led some participants to consider ways that datafication might be resisted or appropriated. For example, Asha, a postgraduate sociology student, was inspired by the idea of ‘data calm’ spaces suggested by the data walk. She told me that, before the workshop, she had accepted ubiquitous data collection as an inescapable fact of life, and that from this perspective the idea of ‘data calm’ spaces was quietly radical and generative. The idea later informed her actions as a student representative on her programme when students raised concerns about the potential for surveillance in classrooms, leading her to arrange to meet students in a park and to request that students be provided with a ‘data safe’ space in which they might discuss sensitive topics.

As these examples illustrate, data walking is valuable as a method for prompting speculation on the part of participants. This speculation is geared towards sensitising participants to the invisible and taken-for-granted data practices in their everyday lives, and can stimulate ethical reflection on the part of participants and generate useful data about students’ experiences, feelings and opinions about datafication in higher education. In the context of the workshops, this was complemented by another speculative approach that encouraged participants to build on the ideas generated by the data walk to consider how things might be different, to which we now turn.

### **Thinking otherwise and ethical reflection**

Each workshop closed with a short activity in which participants were asked what they would change about the university if they had three wishes. By asking students what they would change about the university, Joe hoped to understand what they perceived as the biggest problems facing them in the present. At the same time, this simple speculative exercise in ‘thinking otherwise’ also sought to open up new possibilities and generate alternative data futures.

This kind of speculation can help shed light on data-driven practices in the present. Participants’ wishes for greater transparency about how data is used, making data ‘magically unhackable’ and having the ability to delete one’s digital footprint forever reflect common concerns over data privacy and security. Wishes for greater consistency in the use of online platforms and for the university to stop using private, third party platforms, such as a proprietary learning management system, reflect tensions in the political economy of digital higher education between public and private value (Komljenovic, 2020). Other wishes, such as a desire for better timetabling or a model to predict which study spaces are going to be busy, point to ways in which the university might improve its digital infrastructure and make better use of the data it collects.

Participants did not always find it easy to think otherwise about datafication. The prompt was frequently met with long pauses and sighs, with participants reporting that they were not often asked to think in such speculative terms. But for some students, the simple question of what they would do differently proved generative. As Stuart, an undergraduate computer science student, recounted in his interview, the three wishes activity “planted a seed in an unintended way”, providing inspiration for an essay he was writing about unintentional harms in drone systems.

The speculative activity thus helped Stuart generate new understandings of data-driven technologies in other contexts.

For others, the ‘three wishes’ activity served as inspiration to think beyond the harms associated with data to consider what good data practices would look like. As Seth, a postgraduate sociology student from China, remarked, while certain parts of the university infrastructure, such as the library, seemed to be well connected and relatively datafied, other parts of campus were less joined up. He told a story of going from door to door trying to find an open building one evening, bemused that “they collected a whole bunch of my data, yet I’m not being able to find a toilet”. Reflecting on the workshop and interview, he continued:

we mainly talk about the potential of harming, of harming me... [of] being harmed by the misused data. But now I think, there could be better, there could be better uses. (Seth – PG sociology)

As both the data walk and ‘three wishes’ exercise demonstrate, speculative methods can be valuable for prompting participants to notice and reflect on taken-for-granted data-driven practices around them and to think otherwise.

## Discussion and conclusions

In addition to sensitising participants to often-invisible data infrastructures, data walking demonstrates the importance of ‘objects-to-think-with’ in speculative research and the range of forms these can take. In Ross’ terms (2023, p.172) the method of data walking involves both researcher- and participant-produced objects-to-think-with: providing a ‘way in’ for participants to explore datafication in their everyday lives by performing the walk, taking notes and photographs, collecting artefacts and generating a map telling the story of their walk. These served as important reference points for discussion in the workshops and interviews with participants and also constituted valuable data for analysis by the researcher, illustrating the dual role of objects-to-think-with “as both an instrument and an output of the research” (Ross 2023, p.176).

The experiment in thinking otherwise, whereby participants were asked what they would change about the university given three wishes, points to the significance of “discursive closures” (Markham, 2021) for speculative research on data-driven practices. Markham argues that participatory futures work is challenged by the difficulty people have imagining futures outside of dominant discursive frames. Discursive closures can clearly be seen in the ‘wishes’ of the participants outlined above, which tend to be concerned with questions of transparency, security, convenience and usability within the confines of current data-driven imaginaries. However, rather than being seen as barriers that must be overcome, discursive closures might just as well be seen as valuable data for understanding the discursive terrain in which participants live and work. A better understanding of the “limits of the imaginary” (Markham 2021) constitutes an important part of an account of what datafication means for students, their relationship with the university, and the specific present in which they are generating futures. In this sense, the significance of discursive closures for speculative research, whether as design considerations or as data in their own right, depends on the research aims.

In working with students as active creators and interpreters of some present-day experiences of datafication in the university, we see how values are communicated through existing practices, and begin to better understand the sorts of futures that are either foregrounded or concealed by the practices uncovered. We can also better grasp the possibilities for unsettling the apparent inevitability of certain apparent facts about data in education, for instance surveillance cultures (Beetham et al., 2022), by inviting students to look speculatively at their surroundings and activate, sometimes partially or in unexpected ways, possible alternatives. For researchers, this way of working does not deliver straightforward answers to questions about data futures: that is not the purpose of speculative approaches. Instead, they work to generate possibilities and attend to ambiguities within complex problem spaces, including problem spaces of data futures for education.

## References

- Beetham, H. et al. (2022) ‘Surveillance practices, risks and responses in the post pandemic university’, *Digital Culture & Education*, 14(1). Available at: <https://www.digitalcultureandeducation.com/volume-14-1>.
- Benjamin, R. (2016) ‘Racial Fictions, Biological Facts: Expanding the Sociological Imagination through Speculative Methods’, *Catalyst: Feminism, Theory, Technoscience*, 2(2), pp. 1–28.
- Cerratto Pargman, T., Lindberg, Y. and Buch, A. (2022) ‘Automation Is Coming! Exploring Future(s)-Oriented Methods in Education’, *Postdigital Science and Education* [Preprint].
- Costello, E. and Girme, P. (2022) ‘Edge School: A Speculative Design Fiction’, *Postdigital Science and Education* [Preprint].

- Costello, E., Soverino, T. and Girme, P. (2022) 'Books (Are Not Like People): A Postdigital Fable', *Postdigital Science and Education*, 4(2), pp. 519–539.
- Cox, A.M. (2021) 'Exploring the impact of Artificial Intelligence and robots on higher education through literature-based design fictions', *International Journal of Educational Technology in Higher Education*, 18(3), pp. 1–19.
- Dixon-Román, E. (2016) 'Algo-Ritmo: More-Than-Human Performative Acts and the Racializing Assemblages of Algorithmic Architectures', *Cultural Studies ↔ Critical Methodologies*, 16(5), pp. 482–490.
- Duggan, S.B. (2019) 'Thinking with the Future', in S.B. Duggan (ed.) *Education Policy, Digital Disruption and the Future of Work: Framing Young People's Futures in the Present*. Cham: Springer International Publishing, pp. 21–40.
- Dunne, A. and Raby, F. (2013) *Speculative everything: design, fiction, and social dreaming*. Cambridge, Massachusetts ; The MIT Press.
- Galloway, A. and Caudwell, C. (2018) 'Speculative design as research method', in G. Coombs, A. McNamara, and G. Sade (eds) *Undesign*. 1st edn. Routledge, pp. 85–96.
- Gaskins, N. (2023) 'Interrogating Algorithmic Bias: From Speculative Fiction to Liberatory Design', *TechTrends*, 67(3), pp. 417–425.
- Goodyear, P. (2022) 'Realising the Good University: Social Innovation, Care, Design Justice and Educational Infrastructure', *Postdigital Science and Education*, 4(1), pp. 33–56.
- Hillman, T., Rensfeldt, A.B. and Ivarsson, J. (2020) 'Brave new platforms: a possible platform future for highly decentralised schooling', *Learning, Media and Technology*, 45(1), pp. 7–16.
- Houlden, S. and Veletsianos, G. (2022) 'Impossible Dreaming: On Speculative Education Fiction and Hopeful Learning Futures', *Postdigital Science and Education* [Preprint].
- Jandrić, P., & Hayes, S. (2023). Postdigital education in a biotech future. *Policy Futures in Education*, 21(5), 503–513.
- Jandrić, P. and Knox, J. (2022) 'The postdigital turn: Philosophy, education, research', *Policy Futures in Education*, 20(7), pp. 780–795.
- Jasanoff, S. (2016) 'Future Imperfect: Science, Technology, and the Imaginations of Modernity', in S. Jasanoff and S.-H. Kim (eds) *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. University of Chicago Press.
- Kennedy, H. (2018) 'Living with Data: Aligning Data Studies and Data Activism Through a Focus on Everyday Experiences of Datafication', *Krisis : Journal for Contemporary Philosophy*, 2018(1), pp. 18–30.
- Knox, J. (2017) 'Data Power in Education: Exploring Critical Awareness with the "Learning Analytics Report Card"', *Television & New Media*, 18(8), pp. 734–752.
- Komljenovic, J. (2020) 'The future of value in digitalised higher education: why data privacy should not be our biggest concern', *Higher Education* [Preprint].
- Krawczak, M. (2022) 'Counter-Mapping with Sounds in the Practices of Postdigital Pedagogy', *Postdigital Science and Education* [Preprint].
- Lury, C. (2021) *Problem Spaces: How and Why Methodology Matters*. Newark, UNITED KINGDOM: Polity Press.
- Macgilchrist, F., Allert, H. and Bruch, A. (2020) 'Students and society in the 2020s. Three future "histories" of education and technology', *Learning, Media and Technology*, 45(1), pp. 76–89.
- Markham, A. (2021) 'The limits of the imaginary: Challenges to intervening in future speculations of memory, data, and algorithms', *New Media & Society*, 23(2), pp. 382–405.
- Michael, M. (2012) "'What Are We Busy Doing?": Engaging the Idiot', *Science, Technology, & Human Values*, 37(5), pp. 528–554.
- Noteboom, J. (2023) 'Exploring University Students' Lived Experiences of Datafication, Data Literacies and the Potential for Collective Data Governance in UK Higher Education', in *Collective Experiences in the Datafied Society*, Cardiff University: Data Justice Lab.
- Powell, A. (2018) 'The data walkshop and radical bottom-up data knowledge', in *Ethnography for a data-saturated world*. Manchester University Press.
- Ross, J. (2023) *Digital Futures for Learning: Speculative Methods and Pedagogies*. Routledge.
- Selwyn, N. et al. (2020) 'What might the school of 2030 be like? An exercise in social science fiction', *Learning, Media and Technology*, 45(1), pp. 90–106.
- Springgay, S. and Truman, S.E. (2018) 'On the Need for Methods Beyond Proceduralism: Speculative Middles, (In)Tensions, and Response-Ability in Research', *Qualitative Inquiry*, 24(3), pp. 203–214.
- Staunæs, D. and Brøgger, K. (2020) 'In the mood of data and measurements: experiments as affirmative critique, or how to curate academic value with care', *Feminist Theory*, 21(4), pp. 429–445.

- Suoranta, J. et al. (2022) 'Speculative Social Science Fiction of Digitalization in Higher Education: From What Is to What Could Be', *Postdigital Science and Education*, 4(2), pp. 224–236.
- Van Es, K. and De Lange, M. (2020) 'Data with its boots on the ground: Datawalking as research method', *European Journal of Communication*, 35(3), pp. 278–289.
- Veletsianos, G. (2020) 'How should we respond to the life-altering crises that education is facing?', *Distance Education*, 41(4), pp. 604–607.
- Wilkie, A., Michael, M. and Plummer-Fernandez, M. (2015) 'Speculative method and Twitter: Bots, energy and three conceptual characters', *The Sociological Review*, 63(1), pp. 79–101.
- Ziewitz, M. and Singh, R. (2021) 'Critical companionship: Some sensibilities for studying the lived experience of data subjects', *Big Data & Society*, 8(2), pp.1-13.