KU LEUVEN

Faculty of Psychology and Educational Sciences

Methodology of Educational Sciences Research Group

OPEN EDUCATION PLATFORMS
AND THEIR MODES OF DIS/APPEARING
A critical account from science and technology studies

Lanze Vanermen

Doctoral thesis offered to obtain the degree of
Doctor of Educational Sciences (PhD)

Supervisor: Prof. Dr Mathias Decuypere
Co-supervisor: Prof. Dr Joris Vlieghe

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SUMMARY

Open education platforms and their modes of dis/appearing: A critical account from science and technology studies

This dissertation critically investigates the platformisation of open education practices, disentangling its compositions and consequences for education stakeholders. Open education, broadly defined as a collection of practices aiming to increase and widen access to education and knowledge resources, frequently relies on dedicated universities and digital platforms. As more and more digital platforms organise this sort of practice, their ambivalences have also become apparent: platforms are not only opening education but equally closing it in various ways. Drawing on four case studies and theoretical as well as methodological insights from science and technology studies (STS), this dissertation seeks to take open education platforms seriously by scrutinising their operations, meanings, and values in everyday life.

Part 1, *The platformisation of massive open online courses*, investigates how two digital platforms shape different modes of accessing education practices from the user's perspective. Both platforms have close connections to the Open University of the United Kingdom. The first case study, which zooms in on a well-known commercial platform named FutureLearn, addresses how 'access' appears in recent literature, and how it is made possible and impossible in practice. The second case study, focussing on a free, not-for-profit platform called OpenLearn, analyses the phenomenon of flexible learning pathways and shows several ways these pathways also entail inflexibilities.

Part 2, *The platformisation of an open and distance university*, scrutinises the sociotechnical conditions in which digital platforms are situated to organise (access to) higher education. The platforms are tied to a university in the Netherlands that will be referred to with a pseudonym, 'Learniversity'. The third case delves into Learniversity's learning management system and infrastructure, elucidating several modes of operating in open and distance education: the visible and invisible ways humans and non-humans cooperate to exchange data, information, and content for educational purposes. It also sheds light on what it means for data and data-driven technologies to become invisible or self-evident aspects of education. The fourth case scrutinises the production and employment of data visualisations at Learniversity, specifically in the format of dashboards, and shows different modes of learning from the perspectives of designers and users.

The dissertation concludes that besides considering platformised education as 'open' or 'closed', it is worthwhile to consider how it depends on the appearing and disappearing of certain actors simultaneously – *dis/appearing*. In the first mode of dis/appearing, and in a literal sense, digital platforms make some knowledge resources present in education practices, predominantly course materials such as texts and videos, and other resources absent. Specific groups of humans (e.g., family members), animals (e.g., pets) and technologies (e.g., source code) are supposed to stay out of sight and out of the education practice. In the second mode of dis/appearing, and in a figurative sense, digital platforms look like visible surfaces that the user can traverse to access knowledge resources but soon turn seemingly invisible when the user's attention shifts to the course materials. Although it may sometimes look like open education platforms and their auxiliary actors are becoming irrelevant, they can still foster and foreground their own educational resources, theories, organisations, and technologies. Open education platforms, with their different modes of dis/appearing, have real consequences for how education and knowledge resources can or cannot be accessed and, therefore, require the attention of researchers and practitioners alike.

SAMENVATTING

Open onderwijsplatformen en hun on/zichtbaarheden: Een kritisch verslag vanuit wetenschap- en technologiestudies

Dit proefschrift onderzoekt de platformisering van open onderwijspraktijken, waarbij de nadruk ligt op de samenstelling ervan en de gevolgen voor diverse belanghebbenden in het onderwijs. Open onderwijs, breed gedefinieerd als een verzameling praktijken die gericht zijn op het verbeteren van onderwijstoegang, is vaak afhankelijk van gespecialiseerde universiteiten en digitale platformen. Nu steeds meer van zulke platformen dergelijke praktijken organiseren, worden ook hun ambivalente effecten duidelijk: platformen openen niet alleen het onderwijs, ze sluiten het ook op verschillende manieren. Aan de hand van vier gevalstudies alsook theoretische en methodologische inzichten uit wetenschap- en technologiestudies, neemt dit proefschrift open onderwijsplatformen ernstig door hun werking, betekenis en waarden in het dagelijks leven onder de loep te nemen.

Deel 1, *De platformisering van massive open online courses*, onderzoekt vanuit het perspectief van de gebruiker hoe twee digitale platformen op diverse manieren toegang tot open onderwijspraktijken verlenen. Het spitst zich voornamelijk toe op platformen van de Open University in het Verenigd Koninkrijk. De eerste gevalstudie bestudeert een platform genaamd FutureLearn, hoe 'toegankelijkheid' in de recente literatuur verschijnt, en hoe het platform in de praktijk eveneens vormen van ontoegankelijkheid bewerkstelligt. De tweede gevalstudie richt zich op een ander platform, OpenLearn, en analyseert het fenomeen van de zogenaamde flexibele leertrajecten in het open en hoger onderwijs. Het laat verschillende manieren zien waarop deze trajecten ook inflexibiliteit met zich meebrengen en brengt deze verder op begrip.

Deel 2, *De platformisering van een open en afstandsuniversiteit*, onderzoekt de sociale en technische condities waarin digitale platformen zijn ingebed om (de toegang tot) hoger onderwijs te organiseren. Het gaat in het bijzonder om platformen die deel uitmaken van een (gepseudonimiseerde) universiteit in Nederland, Learniversity. De derde gevalstudie gaat dieper in op het Learniversity-platform en de bijbehorende infrastructuur, om zo verschillende soorten van 'operabiliteit' in open en afstandsonderwijs te duiden: de zichtbare en onzichtbare manieren waarop menselijke en niet-menselijke actoren samenwerken om data, informatie en lesinhoud uit te wisselen. Het werpt ook licht op wat het betekent dat data en data-gedreven technologieën onzichtbare of vanzelfsprekende onderdelen van het onderwijs worden. De vierde gevalstudie onderzoekt de productie en het gebruik van datavisualisaties in open en afstandsonderwijs, met name in de vorm van dashboards, en toont verschillende wijzen van leren vanuit het perspectief van zowel ontwerpers als gebruikers.

Het proefschrift concludeert dat het, naast het beschouwen van geplatformiseerd onderwijs als 'open' of 'gesloten', de moeite waard is om te kijken naar hoe onderwijs afhangt van het zichtbaar en onzichtbaar maken van bepaalde actoren – hun *on/zichtbaarheden*. In de eerste vorm van on/zichtbaarheid, en in de letterlijke zin, zorgen digitale platformen ervoor dat sommige kennisbronnen in de onderwijspraktijk verschijnen, voornamelijk cursusmateriaal zoals teksten en video's, en dat andere bronnen verdwijnen. Specifieke groepen mensen (bv. familieleden), dieren (bv. huisdieren) en technologieën (bv. broncode) worden verondersteld uit het zicht en buiten de praktijk te blijven. In de tweede vorm van on/zichtbaarheid, en in figuurlijke zin, ogen digitale platformen als zichtbare oppervlaktes waarover de gebruiker kan bewegen om toegang te krijgen tot kennisbronnen. Ze worden echter ogenschijnlijk onzichtbaar wanneer de aandacht van de gebruiker verschuift naar het cursusmateriaal. Hoewel platformen en hun ondersteunende actoren vaak tot een vanzelfsprekende omgeving beginnen te behoren, geven ze vorm en voorrang aan hun eigen specifieke educatieve bronnen, theorieën, organisaties, en technologieën. Open onderwijsplatformen, met hun verschillende on/zichtbaarheden, hebben reële gevolgen voor de manier waarop onderwijs- en kennisbronnen wel of niet toegankelijk zijn en vereisen daarom de aandacht van zowel academici als practici.

PUBLICATIONS

Published or accepted journal articles, and/or articles submitted for or worthy of publication

- Chapter 1: Curriculum meets platform
  - Authors: Vanermen, L., Vlieghe, J., & Decuypere, M.
  - Original title: Curriculum meets platform: A reconceptualisation of flexible pathways in open and higher education
  - First author: Vanermen, L.
  - Publication status: Published in *Curriculum Inquiry*
  - DOI: https://doi.org/10.1080/03626784.2022.2120347

- Chapter 2: On making in/access together
  - Authors: Vanermen, L., Vlieghe, J., & Decuypere, M.
  - Original title: On making in/access together: A reimagining of 'access' to educational platforms as a socio-material practice
  - First author: Vanermen, L.
  - Publication status: Published in C. Cobo, & A. Rivas (Eds.), *The new digital education policy landscape: From systems to platforms.* Routledge.
  - DOI: https://doi.org/10.4324/9781003373018

- Chapter 3: Educational vanishing points
  - Authors: Vanermen, L., Vlieghe, J., & Decuypere, M.
  - Original title: Educational vanishing points: Or how interoperable platforms turn infrastructural and back in higher education
  - First author: Vanermen, L.
  - Publication status: Published in B. Williamson, J. Komljenovic, & K. Gulson (Eds.), World Yearbook of Education 2024: Digitalisation of education in the era of algorithms, automation, and artificial intelligence. Routledge.
  - DOI: https://doi.org/10.4324/9781003359722

- Chapter 4: Learning to dashboard
    - Authors: Vanermen, L., Vlieghe, J., & Decuypere, M.
    - Original title: Learning to dashboard: Modes of producing and deploying data visualising technologies in higher distance education
    - First author: Vanermen, L.
    - Publication status: Manuscript under review at *Discourse: Studies in the Cultural Politics of Education*
    - DOI: None

Additional forms of publications, or papers with more than two first authors

- None

Relationship between doctoral thesis and master's theses or other papers

- Chapter related to the own master's thesis or paper
    - None
- Chapter related to another master's thesis or paper
    - None

ACKNOWLEDGEMENTS

This dissertation is the outcome of many years spent at the same university, KU Leuven, located in the town where I was born and raised. In its material form, it only offers a glimpse of how residing there has shaped my research and life trajectories.

First, I would like to extend my gratitude to my supervisor, Dr Mathias Decuypere, for providing an abundance of insights and opportunities related to researching and teaching at the Methodology of Educational Sciences Research Group. I would also like to thank my co-supervisor, Dr Joris Vlieghe, for his continued input throughout the project and the countless hours spent discussing (highly philosophical) books during the weekly Education, Culture, and Society reading group. I want to acknowledge my supervisors' academic support – and lots of patience, especially during the first year – alongside the financial support provided by the KU Leuven Internal Funds under Grant C14/18/041, both without which this research would have been impossible.

Second, I would like to thank the members of my evaluation committee, Dr Helene Ratner, Dr Jeremy Knox, and Dr Geert Kelchtermans, for their scholarly contributions and constructive feedback that enriched much of my research trajectory. The same goes for those present in my midterm evaluation committee: Dr Cathy Adams, Dr Elin Sundström Sjödin, and Dr Paolo Landri.

Third, this research trajectory would not have been the same without the participants working and studying at Learniversity where I conducted fieldwork. Given that there was a global pandemic at large, forcing them and myself to stay at home, it was perhaps not the easiest time to participate in and conduct ethnographic fieldwork. Nevertheless, many people agreed to contribute in some way or another without asking for anything in return, for which I'm truly grateful.

Fourth, I cherish my colleagues' care and encouragement over the years. I'm looking particularly at the many (and some, by now, former) doctoral students and professors at 'the hallway' of the Pedagogical Institute, also known as 'de gang van het PI'. Both 'the Boys' and 'the Verticals' deserve honourable mentions for their friendship at the right times and places. I appreciated the chat with Dr Philippe Noens, who gave well-timed advice that helped me steer the research trajectory in a new direction. I'm also grateful for the chats with Dr Ida Cheyenne Martinez Lunde during some of the highs and lows of being a PhD student. I want to give a shout-out to Toon Tierens and printing service De Raaf for helping me print and distribute the dissertation.

Finally, the life trajectory should not be ignored here. Leuven is also where my mother, Frieda, and sisters, Lisa and Ruth, have supported my academic endeavours from the very beginning. It was because of their lives that I set out to investigate the topic of this dissertation, open education. As important as a research trajectory may be from an academic and educational perspective, it is equally the time and place where I met the person who has been enriching my life ever since. (I'm afraid the reading groups may have been important for more reasons than just a love for wisdom!) I'm forever indebted to my wife – perhaps known to you as Dr Qian Liu (刘倩) but Qianqian to me – for her love and support throughout the years. I never imagined that this dissertation would come to a close while spending time in the town *she* was born and raised, Zhongxiang (钟祥).

TABLE OF CONTENTS

GENERAL INTRODUCTION 1

The background: Open education platforms and their issues 1

The foreground: Open education practices 7

The research problem: Open education ambivalences 14

The literature review: The platformisation of open education 18

Why investigate the platformisation of open education? 18

Three perspectives on the platformisation of open education 22

The research approach: STS as a sensitising device 24

STS and some of its sensibilities 24

STS and some of its insensibilities 27

STS and education: Openness as modes of opening and closing 30

STS and platforms: A theoretical framing 32

STS and its cases: A methodological framing 36

The site and participant selection: A tale of universities and platforms 41

About the research ethics and trajectory 45

The research ethics 45

The research trajectory 46

PART 1: THE PLATFORMISATION OF MASSIVE OPEN ONLINE COURSES 50

Chapter 1: On making in/access together 50

Introduction 50

Platform access in open education 52

An STS approach to platform access in education 54

The case of FutureLearn 57

Concluding discussion: From 'access' to 'in/access' 72

Chapter 2: The platform curriculum 75

Introduction 75

Flexibility, curriculum, and technology 77

An STS approach to curriculum in open and higher education 78

The case of OpenLearn 82

Concluding discussion: From a 'flexible pathway' to a 'platform curriculum' 99

PART 2: THE PLATFORMISATION OF AN OPEN AND DISTANCE UNIVERSITY 102
Chapter 3: Educational vanishing points 102
Introduction 102
An STS approach to the operations of platform-infrastructures 104
The case of Learniversity 107
Concluding discussion 115
Chapter 4: Learning to dashboard 117
Introduction 117
Perspectives on educational dashboards 119
An STS approach to the dashboarding of learning 120
Producing dashboards: The case of Learniversity's LAD 123
Deploying dashboards: The case of Learniversity's LMSD 128
Concluding discussion: Learning to dashboard 132
GENERAL CONCLUSION 135
Revisiting the research trajectory and ethics 135
Revisiting the research trajectory 136
Revisiting the research ethics 140
Open education platforms shape access by making actors dis/appear 142
Open education platforms dis/appear when and where they shape access 145
Researching open education platforms, too, makes actors dis/appear 148
Future research trajectories 154
REFERENCES 157
APPENDICES 180
Appendix A: Research protocols of Part 1 180
Appendix B: Research protocols of Part 2 182
Appendix C: List of participants 189
Appendix D: Materials of the workshop about learning analytics 190
Appendix F: Example of the used informed consent forms 195

GENERAL INTRODUCTION

THE BACKGROUND: OPEN EDUCATION PLATFORMS AND THEIR ISSUES

This dissertation critically examines the platformisation of open education practices by disentangling its compositions and consequences for several educational actors today. Researchers use the concept of open education to indicate various things but generally point to the value-oriented act of increasing and widening people's access to education and knowledge through some sort of (increasingly digital) technology (Zawacki-Richter et al., 2020). It is a commonly held view that open education, as a collection of practices, seeks to create access for a larger audience by sharing knowledge at specialised universities and on digital platforms (Ramirez-Montoya, 2020). In recent years, such platforms have been proliferating in education, providing products and services for an ideally extensive user base – think of learners, teachers, and administrators (Amiel, 2023). Some platforms function as a space for online learning and teaching (e.g., EdX), a repository for educational resources (e.g., KlasCement), K-12 curricula (e.g., Curriki), learning management systems (e.g., Moodle), online study rooms (e.g., StudyTogether), and management support systems (e.g., OpenCampus) (Cone et al., 2022; Hamilton, 2016; Kurshan et al., 2010; Lange, 2021; van Dijck et al., 2018). A conventional understanding of education platforms is that they can reproduce information in a digital format and on many different devices simultaneously, making that information accessible for anyone, anytime and anywhere. Once something has been digitalised, be it a book, a course, or a curricular plan, it is considered to be technically "ubiquitous, immediate, [and] portable" for anybody with an electricity and internet connection as well as a working laptop, computer, or smartphone (Rivas, 2021, p. 8). This conventional view on 'the digital' in education makes platforms look like desirable facilitators of learning, teaching, and administrating – who could be opposed to something that makes education(al support) more available with seemingly so little effort?

Recent scholarship, however, argues that digital platforms do more than simply facilitate education services and products in a digital format, such as providing knowledge resources to a wider audience (Decuypere, 2019c; Decuypere et al., 2021; van Dijck et al., 2018). Media scholar José van Dijck and her colleagues contend that platforms have been altering how users experience practices, such as maintaining social relationships on social media platforms or following a course on an open education platform (van Dijck & Poell, 2015). Digital platforms can be understood as

"programmed architectures", infused with interfaces, algorithms, and data, capable of guiding the user's actions, but also as business models and public or commercial values. Users interact with the platform and are simultaneously mediated by it for a variety of intertwined reasons (van Dijck et al., 2018, p. 4). On the one hand, platforms for administration and management purposes analyse behavioural and background data trends, the latter typically going beyond the scope of the individual and pedagogical (Kerssens & van Dijck, 2021). Like platforms outside the education landscape, these programmed architectures thus collect and analyse data to achieve educational, technical, and commercial goals that sometimes may seem unnecessary to contest (Ash et al., 2018; Gorur & Dey, 2021). OpenCampus, for instance, is an education management platform that seeks to "provide access to education for everybody, everywhere" (OpenCampus, 2023). It uses open-source software to digitalise and simplify processes related to student admission, course management, grading, and academic records but also collects data to optimise its own operations (OpenCampus, 2023). On the other hand, platforms for learning, teaching, and assessment create access to relevant knowledge resources but also capture (meta)data about their users' activities (Kerssens & van Dijck, 2021). For example, Khan Academy is a non-profit learning platform that offers free access to a self-paced collection of instructional videos and exercises for "anyone and anywhere", covering subjects from compulsory education to higher and vocational education. It captures data for the technical improvement of its own operations as well as the optimisation of its educational content (Kahn Academy, 2023). More specifically, the platform uses artificial intelligence (AI) and large volumes of user data (e.g., about clicks, downloads, views) to predict and personalise learning pathways (Rivas, 2023). These examples illustrate that platforms do more than merely facilitate education and are rarely neutral; they can alter how people learn, teach, evaluate, and administrate (Decuypere et al., 2021). Perhaps the pertinent question today is not if platformisation is desirable but *how* it occurs: what do platforms do in education practices, what are their underpinning values, and how do they (re)shape the meanings of these practices?

In my investigation, I will use the term '*open education platforms*' to designate those digital architectures and organisations that explicitly *strive* to enhance and expand access to education and knowledge – though that does not imply they are automatically successful (Decuypere, 2019c). These platforms typically play an intermediary role between a user base (e.g., learners) and providers (e.g., educators, educational institutions, and companies), establishing a relatively stable surface to accommodate an assortment of modules. These modules are often regarded as 'products' or 'educational experiences', like following a lecture or taking a course, which are placed on the platform for a potentially large number of users to 'consume'. As a rather recent type of education organisation, platforms produce such modules themselves or in partnership with universities,

colleges, companies, and (non-)governmental organisations, thereby making it possible to also reach the audiences of these respective organisations (de Andrade et al., 2023). Several early and popular open education platforms for massive open online courses or MOOCs were founded around the same time, 2012, which The New York Times named "the year of the MOOC" (Pappano, 2012). Although well-known front-runners were and continue to be based in the United States (US), including platforms such as EdX, Coursera, NovoEd, and Udacity, platforms in other countries soon began emphasising access to affordable higher education. For example, OpenHPI began offering MOOCs in 2012 thanks to members of the Hasso Plattner Institute, an engineering faculty at the University of Potsdam in Germany (OpenHPI, 2021). The XuetangX platform started in 2013 at the initiative of the Chinese Ministry of Education's Research Centre for Online Education and Tsinghua University in Beijing (XuetangX, 2023). These are just some examples of the more than 35 popular MOOC platforms that exist today, aiming to let anyone learn whatever, whenever, and wherever they want (Shah et al., 2023; Suresh & Srinivasan, 2020).

However, the organisational foundations and goals of digital platforms are complex and susceptible to change. Coats (2020) argues that although these platforms barely comprise three percent of the entire higher education sector, business analysts foresee online learning architectures and organisations will generate 67 billion euros in revenue by 2025. Platformised access to education and knowledge requires our attention because it has become big business, and, importantly, it involves big data collection and analysis about education at an unprecedented scale (Coates, 2020). Several open education platforms have adopted commercial business models (e.g., asking a fee in return for course access, a credential, or a degree), thereby installing financial barriers that may hinder participation for those groups of people lacking financial or material means (McCowan, 2017; Wellen, 2013). It has become clear that 'open education' does not necessarily mean 'free' and 'accessible education' given that many learners/parents lack the financial or material means to benefit from online initiatives. This became especially apparent in 2020, referred to as the "second year of the MOOC" by Class Central, and during the Covid-19 pandemic (Shah, 2021d). While there was a surge in online learners looking for emergency distance education (Williamson, Eynon, et al., 2020), many students and households struggled with acquiring, accessing, and using digital technologies (Aristeidou & Cross, 2021; Cone et al., 2022). In that regard, how digital platforms can or *cannot* open up education has proven to be a timely and highly pertinent question.

That pertinence becomes clearer in the face of three contemporary issues regarding the platformisation of (open) education: crowdification, datafication, and visualisation. Firstly, the term *crowdification* has been devised to label the general process in which platforms become digital

infrastructures that support the increased, wide-scale enrolment of learners in various forms of education, including higher and vocational education (de Andrade et al., 2023). Open initiatives have been framed as suitable responses to the growing demand for education, meeting the needs of large and diversified learner groups that, in turn, anticipate the changing labour markets (Zawacki-Richter et al., 2020). Open education platforms, especially those hosting MOOCs, have been framed as possible solutions to overcome the growing cost of higher education for the masses – or crowds – without reducing the quality (Bass, 2014). Between the first and second year of the MOOC, open education platforms from Western nations alone have functioned as education infrastructure for over 220 million learners across more than 19000 courses (Shah, 2021a). These overall numbers indeed suggest that, on a platform level, crowds of learners are accessing online courses. However, it is important to acknowledge that the mere increase in the number of learners, or crowdification, does not automatically result in *widening* educational access. A bigger user base does not necessarily mean a diversified one; despite high enrolment numbers on a global level, open education providers face difficulties providing access to specific groups of students and helping them reach the end of learning pathways successfully (Reich, 2020). The group that benefits most from open online courses is predominantly male, white, and already has a higher education degree. The drop-out rates in courses are often high because of problems with self-directed learning, a mismatch in expectations, and financial barriers (Alemayehu & Chen, 2023). Therefore, a tension emerges between the fact that crowds of learners are moving across an open education platform and the fact that the number of people reaching the end of a platformised course may be few.

The second issue concerning platformisation is *datafication,* the process in which digital technologies render a wide variety of human behaviours into (usually quantitative) data so they can be traced, aggregated, analysed, and reported for current or future strategic purposes (Dencik et al., 2018). For Ben Williamson (2017), the datafication of education entails "the transformation of different aspects of education (such as test scores, school inspection reports, or clickstream data from an online course) into digital data" (p. 5). The datafication of education has been intensifying as digital devices evaluate and inform different practices, such as learning, teaching, grading, managing, and policymaking (Jarke & Breiter, 2019). Here, an important distinction is between relatively stable and changeable data about a targeted population; that is, between demographic data (e.g., race, ethnicity) and traceable interactions with digital technology (e.g., clicking, viewing, downloading) (Whitman, 2020). In open education and online education, the use of data-driven technologies on a large scale has resulted in data repositories for statistical analysis. User data, individual profiling, and adaptive algorithms allow analysts to create personalised learning pathways for open learners to take. The analysis of user data is also believed to help optimise the course

materials, instructions, timetables, and tests and help reduce the high attrition rates that trouble online forms of open education (Prinsloo et al., 2022). Boroowa and Herodotou (2022) argue that the learning platform of the Open University in the United Kingdom (UK), an open education institution that offers limited in-person guidance by instructors and peers, is an example of how data is used to combat unwanted drop-out rates. The university's platform is said to visualise expected and recorded learning pathways, thereby describing students' direction and speed toward completion, but it also predicts completion and success rates. Data about students straying from the expected pathway triggers a warning system, alerting instructors that students are at risk of failing the course and need intervention.

Some forms of datafication in and beyond open education have been criticised for being opaque yet normalised processes, processes in which valuable user data (or metadata) are exchanged for access to and participation on the digital platform (Czerniewicz, 2020; van Dijck, 2014). Prinsloo and colleagues (2019) investigated privacy documents and agreements of Coursera and EdX and critiqued the – sometimes vague and intricate – legal explanations of these platforms' data and surveillance practices. Not only did the researchers identify that much of the data work remains hidden from users, the automated and extensive surveillance performed via platform algorithms also sparked privacy concerns among the authors. Moreover, the data-driven algorithms used on digital platforms have been criticised for co-shaping educational identities and practices (Decuypere, 2019c; R. Edwards, 2015b). For instance, the concealed and automated data gathering and processing performed by Coursera have implications for how people teach and learn: the data help visualise and value some sorts of learning and learners over others. What counts as 'good' learning? And on what basis is someone labelled as a 'successful' learner? Do people modify their actions to meet these ideals? None of these are straightforward questions (J. Knox, 2016a). Though datafication is nothing new (attendance sheets and result tables have been around for decades), digital platforms require a fine-grained understanding because they intensify and proliferate opaque dataflows in education that, in turn, come to shape that education (R. Edwards & Fenwick, 2016).

Thirdly, and related to the two previous issues, *visualisation* involves the turning of the aforementioned data sets into aesthetically-pleasing and intuitive graphical representations about past, current, and future education trends or realities (Mikhaylova & Pettersson, 2024). Data visualisations, in the format of colourised graphs, charts, and diagrams that mainly depict numerical information, have long been used to create actionable insights and tackle practical problems regarding targeted populations and processes (Friendly, 2008; H. Kennedy & Engebretsen, 2020). The visualisation of online learning has been deemed helpful in analysing educational outcomes, the effectiveness of educational platforms, and the prediction of student attrition common in such

learning. Time charts, for instance, have been said to represent and explain (proxies of) learning behaviours over extended periods (G. Zhang et al., 2022). Platform dashboards, too, have been an exemplary format for visualising educational processes – or at least an approximation thereof. Dashboards provide users, such as learners and educators, the knowledge to monitor individual learning pathways (e.g., via learner-faced or educator-faced dashboards). Such pathways tend to be compared to a group average and subject to interventions; as mentioned before, when warning signs indicate the predefined path is completed insufficiently or too slow, the student or educator is expected to intervene (Boroowa & Herodotou, 2022; Kaliisa et al., 2023).

Despite the fact that large data sets may inform their composition, data visualisations are inherently limited in how much of the educational reality they can depict (Burri & Dumit, 2008). Visualisations simplify reality for a particular purpose and direct the viewer's eyes to what is deemed essential, legitimate knowledge about reality (Rose, 2016). Within and beyond the context of open education platforms, data visualisations actively narrow down what counts as important and, therefore, should not be understood as neutral tools (J. Knox, 2016a; Williamson, Bayne, et al., 2020). On the Coursera platform, to stick with the earlier example, a dashboard visualises an analysis of learner behaviours to help course instructors make data-informed decisions regarding their pedagogical approach. The human and algorithmic work behind the visualisations, i.e., the selecting, labelling, categorising, comparing, and computing of data, tends to get obscured, which makes the visualisations look like self-evident, scientific facts (J. Knox, 2016a). Given that data visualisations are customarily endowed with scientific legitimacy (Burri & Dumit, 2008), depictions of education gain persuasive qualities that can – but do not necessarily – inform the viewer's thoughts and actions (Jarke & Macgilchrist, 2021). Some researchers argue that data visualisations (re)shape realities rather than represent them (Decuypere & Landri, 2021; Mikhaylova & Pettersson, 2024). What matters here is that the technological and pedagogical design decisions underpinning the platforms, dashboards, and representations are hardly ever open(ed) for scrutiny or critical reflection. Nevertheless, "pedagogical actions are most significantly mediated through the pedagogical dimensions of learning platform's interfaces – that is, the extracted analytics by which dashboards present data visually for interpretation" (Kerssens, 2023, pp. 244–245). The visualising work done by digital platforms thus establishes seemingly natural but, at the same time, often closed-off processes in open education practices, making visualisation another issue related to platformisation in need of further inquiry.

There are, of course, many other relevant issues that could be named: platformised education is increasingly thought of in terms of learning (learnification) (J. Knox et al., 2020), it comes in the form of modules (modularisation) (B. Y. Chen et al., 2019), and it is characterised by

artificial intelligence (automation) (Williamson et al., 2024). Nevertheless, crowdification, datafication, and visualisation hint at the main concern of this research project: platformisation does more than simply 'open' education practices.

THE FOREGROUND: OPEN EDUCATION PRACTICES

While digital platforms will be present in the background of this dissertation continuously, much like they are present in the background of everyday education, it is the variety of open practices that will be in the foreground. This section introduces several more and less well-known practices that emerged before and after the first 'year of the MOOC' (2012). The purpose is not to give an exhaustive historical overview but to shed some light on the semiotics of 'openness' as well as the intertwinement between socio-democratic values and techno-scientific design choices in these practices, some of which have been around since the 1960s and the start of the first open universities (Shareefa et al., 2023).

O*pen universities* are a collection of practices that align with the basic idea of sharing knowledge openly and using different technologies for that purpose (Paul & Tait, 2019). Open universities began to appear in the second half of the 20th century in numerous countries (e.g., the UK, the Netherlands, Thailand, Ghana, Australia, Pakistan, and South Korea), typically relying on the affordances of the radio, television, computer, cassettes, CDs, and snail mail to send information and assignments to a wider audience of adult students (Harting & Erthal, 2005). The Open University of the UK, established in 1969 and frequently cited as the oldest, most celebrated institution in open education, claims to exemplify the project of democratising higher education for new and larger student populations (Weinbren, 2014). Technology has been propagated as one of the cornerstones of this democratisation because it is believed to help organise access, teaching, and learning at an infrastructural – almost industrial – scale in terms of how many learners can be provided with educational content at the same time (Guri-Rosenblit, 2019). Open university infrastructures (e.g., platforms, offices, assessment centres) are usually complemented with open enrolment policies, such as removing enrolment criteria from bachelor programs, and staffing those programs with extra tutors that can offer additional support to students (Zawacki-Richter et al., 2020). Students who do not have a high school degree or come from a household in a precarious socio-economic situation tend to benefit from such measures, allowing them to enter and even thrive in higher education (DeVries, 2019; Paul & Tait, 2019).

In some literature, open education conflates with correspondence and distance education, and the former builds on the latter's technologies to achieve the pursued social-democratic values (DeVries, 2019). Open universities have been embroidering on older forms of education, such as

correspondence and distance education, which have existed since the 18th and 20th century respectively (Harting & Erthal, 2005). As the name suggests, *correspondence education* involves exchanging letters through postal services, sending emails, or using another stable information delivery system between the educator and student, each working and studying in a different location. In nineteenth-century Europe, for example, a Swedish newspaper called *Lunds Weckblad* published new course content every week to reach the general population (Jung, 2019). In twentieth-century Asia, as early as the 1950s, Chinese open universities started out as 'correspondence colleges' that existed within traditional universities. The colleges turned into separate 'radio universities' and 'television universities' in the 1960s when these new technologies for distance education could be incorporated. These two types of universities merged and became 'radio and television universities' (RTVUs) in the two following decades, under the country's national Reform and Opening-up Policies. RTVUs only became known as 'open universities' officially in the 2010s, typically targeting people from rural areas, ethnic minorities, or people with one or more disabilities (W. Zhang & Li, 2019).

Open and distance education share a history of correspondence aiming to close geographical distances between students and educators. In *distance education* practices, every interaction is mediated by technology, correspondence by mail included, meaning there is no brick-and-mortar campus or classroom where students and teachers interact (Anderson, 2001). Both distance and open education practices can be characterised by an absence of corporeal interaction (e.g., only sending letters, CDs, books), one-way interaction (e.g., via radio, television, streaming services) or multi-way interaction (e.g., via teleconferencing, virtual classrooms), as well as content-to-content interaction (e.g., integrating Wikipedia modules in online courses via the semantic web) (Anderson & Rivera-Vargas, 2020). MOOCs, for instance, are considered a particular kind of open, correspondence *and* distance education, with several sorts of interaction between users, content, and educators, each from their own geographical positions. Since their inception, MOOCs and virtual classrooms have been co-constituting educational spaces, allowing geographically dispersed educational actors to gather and engender new proximities to each other (Bayne et al., 2014; van de Oudeweetering & Decuypere, 2019). These historical cases illustrate the overlap in aims and technologies present in some open initiatives that are still relevant today.

That being said, open and distance education are not the same thing: open education practices often rely on technologies and pedagogies of distance education to organise teaching, learning, and assessment in which learners and educators are temporally and/or spatially separated (Zawacki-Richter et al., 2020). Distance education is supposed to offer a "unique and heightened context of digitalisation" but does not necessarily entail open education's political orientation

towards the democratisation of access (Anderson & Rivera-Vargas, 2020, p. 208). Moreover, not every distance university has an open enrolment policy that lowers admission barriers for students who do not meet admission requirements of traditional universities – which is something open universities and open education platforms do maintain (DeVries, 2019). Open and distance education practices, the conjoint usage of technology to bridge geographical distance (e.g., the internet) and the adoption of specific social values (e.g., freedom to share) exemplify the more recent digitalisation of education.

At the turn of the century 21st century, a wave of *knowledge sharing practices* made it clearer that the realisation of open education's socio-democratic values has come to depend on a constellation of digital technologies. Peer-to-peer collaboration, creation, and dissemination of knowledge, often provided in a material form and through digital means, is meant to be open, i.e., without (financial) boundaries restricting access (Peters, 2008; Ramirez-Montoya, 2020; Toru & Vijay M S, 2008; Zawacki-Richter et al., 2020). The open decade, as Peters and Britez (2008) called the early 2000s, was marked by a belief in and a certain excitement about everything 'open' thanks to the affordances of the internet. Old and new initiatives with an 'open' prefix gained terrain: open-source technologies, open access, open standards, open science, and open education. User-generated content on wikis, fora and blogs appeared as web 2.0 technologies and digital infrastructures started to connect homes, institutions, and organisations. A widely cited article proposed using web 2.0 technologies to create a participatory and collaborative learning culture, a learning 2.0 or open education (J. Brown & Adler, 2008, p. 17). Again, open education was hardly anything new and many open universities had become established institutions, but the broader movement and specific initiatives gained momentum in academic discourse during a time of crisis (Peters & Britez, 2008). The 2008 financial crisis had hit multiple nations and posed socio-economic problems that techno-enthusiastic researchers hoped to solve with cost-effective, digital solutions. These so-called solutions were "placed into a context of wider societal disruption, in the form of large-scale public sector debt and budgetary cuts, climate change, energy security and peak oil" (Hall & Winn, 2010, p. 1). Open practices and technologies for sharing knowledge resources were seen as a great way of providing low-cost teaching and learning to the growing group of people looking for education (R. Edwards, 2015b).

Given the reliance on digital technologies, it is perhaps unsurprising that open education became conflated with ideas from the *free and open-source software* (FOSS) movement, which existed since the 1980s and emphasised creating, sharing, and exploiting knowledge about source code (Berry, 2008). While open-source practices are concerned with increasing technological design and programming transparency, they do not necessarily favour specific social-democratic values or

deem "proprietary and commercial software as undesirable" (Schlagwein et al., 2017, pp. 299–300). *Free* software practices, however, are endorsing and engendering such values as they aim to increase participation and "uphold the view that free software supports computer use and ultimately individual freedom and social progress" (Ibid., pp. 299-300). As we will see, the intent of the people behind open initiatives tends to influence whether something is labelled 'open' or not.

The interdependency between open education technologies and social-democratic values has been particularly clear in the context of *open education resources* (OERs), which researchers describe as accessible materials and tools with specific copyright licenses or placed in the public domain (Wiley et al., 2014). Once more, the idea of open education, here in the form of OERs, did not appear from nowhere. The (free) sharing of knowledge materials has a long history in both compulsory and higher education; books, lesson plans, recordings, and other resources commonly circulate among students and educators to organise learning and teaching (Stracke et al., 2019). Nevertheless, the emergence of the repository and aggregator platform called Merlot (Multimedia Educational Resource for Learning and Online Teaching) in 1997 meant a turn towards sharing higher education materials about various subjects in a digital format. Founded by the California State University and its partners, Merlot began to host and organise free educational resources (e.g., assignments, online courses, textbooks) that users could upload, curate, and download (Barker & Campbell, 2016). A year later, in 1998, a similar repository platform called KlasCement was founded by a Belgian (Flemish) schoolteacher. Like Merlot, KlasCement allows teachers in compulsory education to freely distribute and utilise materials that come to inform classroom practices. Unlike its American counterpart, KlasCement became supported by the government, the Flemish Ministry of Education, and an extensive user base works alongside professional moderators to curate and maintain the materials as well as to assure their quality (Cone et al., 2022). Another example, the OpenCourseWare project, was launched in 2001 and categorised more explicitly as 'open' (Blessinger & Bliss, 2016). It also relied on emerging Internet technologies but gained support from corporations (e.g., from the William and Flora Hewlett Foundation) and the Massachusetts Institute of Technology (MIT). Its interactive website organised access to more than 1000 academic course materials and was deemed especially relevant for students and educators in economically developing countries or regions (MIT OpenCourseWare, 2024).

Debates about the openness of open courseware and educational resources started to gain attention in research and policy (Stracke et al., 2019). In 2002, the United Nations Educational, Scientific and Cultural Organisation (UNESCO) embroidered on the OpenCourseWare project and devised the term 'open educational resources' at the Forum on the Impact of Open Courseware for Higher Education in Developing Countries (Blessinger & Bliss, 2016; Otto & Kerres, 2022). In

collaboration with the William and Flora Hewlett Foundation and the Western Cooperative for Educational Telecommunications, the UNESCO (2002) came to view OERs as "a universal educational resource available for the whole of humanity" (p. 28). The conference working group recommended OERs to be defined as:

> The open provision of educational resources, enabled by information and communication technologies, for consultation, use and adaptation by a community of users for non-commercial purposes. (UNESCO, 2002, p. 24)

The UNESCO definition of OERs thus explicated the relation between social-democratic values (being usable, adaptable, and not-for-profit) and digital technologies that should be present in future open initiatives (e.g., free and open-source software). Access to educational materials should be a human right, and a clear definition would set up a legal basis for future open education initiatives. In the case of education resources, too, institutions of several countries (e.g., Japan, China, Portugal) would copy or contribute to the popular OpenCourseWare project and endorse the dominant definition (Johnstone, 2005). Nowadays, the 5R Model is a basis for a strict, juridical definition of OERs that would exclude some *free* content on certain digital platforms, like YouTube, that does not meet all of the model's criteria (Shareefa et al., 2023). For OERs to be called 'open', some argue that the 5R Model for learning and teaching activities prescribes that anyone should be able to retain, reuse, revise, remix, and redistribute resources (Wiley, 2014; Wiley & Hilton, 2018). Researchers and policymakers initially regarded OERs as just content, a standalone object or material (e.g., digital lecture notes, lesson plans, videos, textbooks) (Deimann & Farrow, 2013; UNESCO, 2002), but these gradually became the basis for a more complex practice: courses.

In terms of technological composition and social values, most, if not all, early examples of massive open online courses were also OERs. However, not all early OERs should be considered MOOCs, since these courses encompassed more aspects than just content (e.g., a course architecture, syllabus, educator) (Stracke et al., 2019). Like OERs, a plethora of researchers has portrayed MOOCs as a radical alternative to traditional higher education because of the way knowledge materials could be delivered anywhere, at any time, and to anyone, thereby addressing the issues related to access and participation that universities and colleges face (e.g., Ebben & Murphy, 2014; Suresh & Srinivasan, 2020). The technological composition of MOOCs, influenced by aforementioned web 2.0 technologies, seemed to offer new opportunities for 'massive' groups of people to participate in the same course simultaneously. Thanks to digital discussion boards and audio or video conferencing software, it became possible for learners, teachers, and online architectures to establish two-way communication in the context of a course (Blessinger & Bliss, 2016). The 2008 Connectivism and Connective Knowledge Course was the first course referred to

as a 'MOOC', an initiative in which the organising team of the University of Manitoba in Canada embroidered on the existing concept of 'e-learning 2.0' (Downes, 2008). The course was driven by a theory of learning that George Siemens (2004) calls connectivism, the idea that people arrive at actionable knowledge – learning – by forging connections with communities and digital technologies. Learning, here, is an activity that can be done not only by individuals, but equally by organisations and databases as long as they connect units of information about a specific topic (Siemens, 2004). The internet and social network platforms at the beginning of the 21st century (e.g., Facebook, Twitter) play a pivotal role in connecting people, technologies, and resources because their networked structure inherently emphasises the connections between such units of information (Blessinger & Bliss, 2016; Spector, 2016). The connectivist-inspired MOOC (cMOOC) embraced these internet technologies and assumed that massive numbers of geographically dispersed people (learners) could acquire knowledge not only in an interconnective but also self-directed, collaborative, and highly motivated manner (J. Knox, 2018).

Since the early 2010s, however, several education platforms and institutions have been *(re)appropriating* (certain aspects of) the early open resources and courses, for instance, by (re)shaping the underlying goal, business model, and/or learning theory (Amiel & do Rozário Diniz, 2023; de Andrade et al., 2023; Naidu, 2020). One example is the small private online course (SPOC) which, as the name suggests, aimed at a smaller rather than larger (i.e., massive) audience; a practice that allows a limited group of university students to engage with subject materials, peers, and instructors in the same online environment. The SPOC incorporates the online accessibility of OERs and automated grading of MOOCs but explicitly seeks to complement rather than replace traditional higher education (Fox, 2013).

Another example, the extended MOOC (xMOOC), has long kept the aim of replacing traditional – supposedly more expensive – higher education alive and promised new learning theories to make it happen. Hosted on some of the previously mentioned education platforms (e.g., EdX), the xMOOC tends to simulate the university experience by interweaving streamed content (e.g., lecture recordings) with peer feedback on online discussion boards and (in)formal evaluations that can be algorithmically automated (Spector, 2016). Besides facilitators of access, xMOOCs were also considered 'experimentation labs' for optimising and trying supposedly new learning approaches. As explained before, online participation allows platforms to capture the learners' activities in the form of digital traces, data which researchers could then employ to analyse and improve educational practices (J. Brown & Adler, 2008). Researchers conduct controlled experiments, such as A/B testing, to determine the (better) outcomes of a design modification or pedagogical intervention on different user groups, all while maintaining a level of constancy in the

overall conditions (Fox, 2013). In xMOOCs, a behaviourist theory of learning is typically important, i.e., the idea that learning occurs through empirically identifiable behaviours (rather than connections) that can be stimulated if they are positively and repeatedly reinforced. Indeed, the novelty of the xMOOC and the difference with the cMOOC should be questioned since behaviourism has a long history in education (J. Knox, 2018). The automated tests embedded in the designs of some open education platforms exemplify a drill-and-practice type of education with behaviourist underpinnings (Decuypere, 2019c).

In recent years, the business models of the xMOOC platforms have helped organisations capitalise on user data as well as access to educational resources and credentials (van Dijck & Poell, 2015). Platforms that originally and explicitly called their online courses 'MOOCs', such as EdX and FutureLearn, have been abandoning the 'open' label (Goglio, 2022). Under these business models, platforms and their partner organisations provide educational content and credentials against a flat fee or monthly subscription and, consequently, are also setting relatively new financial preconditions for accessing education, ushering in a post-MOOC era (Thomas & Nedeva, 2018). Reviewing the past decade of the MOOC illustrates that socio-democratic values and technoscience are intertwined in open education practices as much as how precarious these practices can be when organisations and platforms stop rallying behind the concept of openness for different – often successful – business models (Shah, 2021a).

Finally, open initiatives such as OERs, MOOCs, and open universities have also undergone some conceptual changes. Some open education researchers have been stripping corporate platforms and their resources of the 'open' label or contend they pose another form of openness because these are deemed (too) restrictive for the free circulation of educational resources (e.g., textbooks, courses) (Amiel & do Rozário Diniz, 2023; Czerniewicz et al., 2014; Weller, 2014). Although 'free' and 'not-for-profit' mean different things, normative and legal frameworks are called upon to strictly define what counts as an open education practice (OEP) and undo paid initiatives from the open label – be it open courses, open learning, open teaching, open pedagogy, open technology, or open sharing (Havemann, 2020). Though there is little academic consensus about the term 'open education practice', it provides a perspective on open education that goes beyond the framing of open education as different types of content (e.g., OER versus MOOC) by placing these resources in larger constellations (e.g., of learners, educators, platforms, and so on) (Weller, 2020). According to an editorial by Bozkurt and colleagues (2023), bringing together some of the most prominent names in the field, open education practices have come to encompass a diverse and dynamic collection of technologies and values, including the pursuit of more access,

flexibility, affordability, enlightenment, removing barriers, and empowerment" but also "democratisation, participation, liberty, and respect for diversity" (Ibid., 2023, p. 78).

Though open education practices have been changing over the years, at least one aspect remained stable: open education needs a combination of values, organisations, and digital infrastructures to be successful (Stracke et al., 2019). Again, the examples introduced in this paragraph are not meant as an exhaustive list but demonstrate interdependencies between technoscientific and social aspects that make open education what it is. It is this interdependency that critical researchers have been homing in on to lay bare some of the inconsistencies and unintended effects of open education.

THE RESEARCH PROBLEM: OPEN EDUCATION AMBIVALENCES

In this section, I lay out one key problem that has emerged during open education's relatively long history and will use it as a rationale for further inquiry: ambivalence. Ambivalence, the emergence of two opposing effects that bring an uncertainty into being, is often rendered through user-technology relationships; when and where data-driven technologies enter real-life educational contexts, they do more than what designers and researchers foresee (Hartong et al., 2021). Designers and researchers in favour of open education have long been seeking to eliminate boundaries to education, meaning they intend to open up learning, teaching, and assessment for learners through digital technologies (Iniesto et al., 2016; Lambert & Alony, 2018; Li et al., 2018). As commendable as these efforts may be, the quest for more openness in education has proven to be an uncertain endeavour with unintended consequences and conceptual inconsistencies that need empirical nuance and further theorisation. Ever since the hype about open education platforms during the first 'year of the MOOC', critical researchers have been highlighting that and how open education practices are rife with ambivalence (Bayne et al., 2015; J. Knox, 2016a; Oliver, 2015; Winn, 2012).

From a critical perspective on education technology, platformised open courses and resources are characterised by ambivalences in the sense that they are not limited to just one normative configuration (e.g., education should be flexible) but are susceptible to multiple, sometimes conflicting conceptualisations and consequences (Funes & Mackness, 2018; Hamilton, 2016). Critical scholars argued that open initiatives in the 2010s had been proliferating to such an extent that they "acquired a sheen of naturalised common sense and legitimacy, and formed what seems to be a post-political space of apparent consensus" (Bayne et al., 2015, p. 247). For example, education technology and media researcher Rolin Moe (2015) critiques how a platform and organisation like TED spreads free video content as 'open' education resources despite proprietary

licenses forbidding alternative configurations. His intention is not to dismiss the existence of these online videos, often made in collaboration with well-respected education organisations, but to question their alleged openness. Moe suggests that 'edutainment' or 'educational resources' would be more accurate terms for these free video materials than *open* educational resources.

Critical scholarship has set important steps in the disentangling the ambivalences created in – often platformised – practices and how they are characterised by forms of openness as well as closedness, selectiveness, and opaqueness (Bayne et al., 2020; R. Edwards, 2015b; van de Oudeweetering & Decuypere, 2019). The first ambivalence in the literature is between creating *openness and closedness*, as in the unmaking and (re)making of the barriers to education and knowledge (Brons, 2017; R. Edwards, 2015b; Gallagher & Lamb, 2023; Havemann, 2020; Otto & Kerres, 2022). An example of technical barriers can be found where primary infrastructural conditions for open practices are missing, such as the absence of an electricity net or Wi-Fi connection (R. Edwards, 2015b). The absence of internet providers, subscriptions, hardware or software lay bare some of the boundaries many people need to penetrate, showing that the dependence on digital technologies for education in daily life is anything but natural in many parts of the world (van Deursen & van Dijk, 2019). For instance, in some rural regions on the African continent, MOOC platforms can be meaningful for communities who experience difficulties with travelling to a specific geographical location at a specific time. However, researchers, policymakers, and practitioners often overlook that such platforms also close down education when people do not have the technologies, funds, knowledge, or skills required to participate and benefit from open practices (Maphosa & Maphosa, 2023).

Financial barriers go beyond the availability of basic digital infrastructure and typically entail enrolment fees and credential prices. These fees may look insignificant and, possibly, even attractive on contemporary open education platforms because they tend to be significantly lower than those of elite institutions (van Dijck et al., 2018). While early MOOC platforms propagated they provide education for free, contemporary platforms and their business models now say otherwise and raise (new) financial hurdles. Knowledge in its material form became accessible for a limited time (e.g., freemiums), in exchange for the learner's private information, and sometimes for a flat monthly or annual subscription fee. Access to credentials, a qualification format that evidences a person's knowledge, skills, and attitudes about a particular subject (e.g., degrees, certificates), is rarely free of charge. Valentina Goglio's (2022) extensive mixed-methods research demonstrated that inequalities regarding access to tertiary education tend to be reproduced in certain populations. Learners in a disadvantaged socio-economic situation, an important target group of some initiatives in the open education movement (e.g., open universities), "access these

resources less than their advantaged peers; and when they do so, they are less likely to complete the courses with a certificate" (Goglio, 2022, p. 112). The legitimacy of these credentials is also recognised inconsistently by educational institutions and employers (Hamilton, 2016) and remains a socioeconomic problem (Zawacki-Richter et al., 2020). Digital education platforms may open up knowledge resources and education to many, but not to everybody (Thomas & Nedeva, 2018; J. Zhang et al., 2019).

A second ambivalence in recent scholarship concerns the *freedom and unfreedom* to select course content and trajectories on platforms (Grimaldi & Ball, 2020; Houlden & Veletsianos, 2021; J. Knox, 2016b). As mentioned before, some proponents of open education have seen great merit in using platforms as innovative alternatives for traditional university and college curricula, because they allegedly open up possibilities to freely select resources, courses, modules, and programs (e.g., Guerrero-Quiñonez et al., 2023). Koul and Nayar (2021) advocate for a curriculum where learners can decide what they learn regardless of time and place (an 'open curriculum'), a curriculum that is believed to be better than a traditional one (a 'closed curriculum') because it revolves around personal interests rather than institutional ones. Learners would prefer to choose the platform content they consume and freely select experiences that are deemed relevant to the labour market. Choosing content contrasts with the supposed lack of freedom in a curriculum that introduces students to a comprehensive academic discipline, i.e., a long trajectory of predefined courses that are interesting from an academic perspective. With today's platforms, many learners are believed to "aim for a boundaryless, borderless, flexible, limitless education ecosystem which aligns them with real-world skills" (Koul & Nayar, 2021, p. 101). Freedom is thus regarded as the more desirable value to pursue.

However, Jeremy Knox (2013, 2016a) critiques that open education often fails to recognise openness as more than freely accessing online resources and reminds us that there is equally a certain *unfreedom* involved. Adopting a posthumanist approach, He contends that much of the open education movement conceives humans unreflexively as a kind of subject capable of rationally choosing their learning trajectories in a free, independent manner. For example, the Coursera platform has long offered university education where learners can choose the courses they wish to follow. At the same time, learners are presumed to interact with the same recordings and written materials within the scope of such a course. A platform can "reinstate rigid and often idolised content, where hundreds of thousands of students are expected to consume identical curricula" (J. Knox, 2013, p. 26). Since over 80% of the MOOCs on popular platforms originate from Western universities, some of the trajectories have been – be it unintentionally – maladapted to other contexts. Timetables, for instance, have not always been attuned to the specific cultural

characteristics of large student groups, expecting attendance on religious holidays during which some students are unavailable (Maphosa & Maphosa, 2023). Moreover, the default language of many Western platforms, including much of the content, is American or British English and thus not free to choose (J. Knox, 2016a). In short, the education platforms and their knowledge resources inherently pose restrictions that complicate the idea of freely assembling one's education.

A last ambivalence discussed here entails *visibility and invisibility* in open education practices, especially those with algorithmic operations (R. Edwards, 2015a; R. Edwards & Fenwick, 2017; Otto & Kerres, 2022; van de Oudeweetering & Decuypere, 2019). Platform algorithms are commonly perceived as an opaque, black-boxed collection of rules that process input to generate output for a programmed purpose. For instance, the user enters a word (e.g., 'math') in the platform's search bar, which subsequently triggers an algorithmic process, a search engine invisible to the user's eyes, that generates results corresponding to the keyword (e.g., a collection of math courses). In a technical sense, algorithms work as "sets of instructions that direct the computer to perform a specific task" and are "used to control the flow of actions and future events" (Bucher, 2018, p. 28). Certain types of algorithms allow people to handle large volumes of data, analyse it, and present knowledge to specific stakeholders (Williamson, 2017). In an early book on open education, John Brown envisions that "massive amounts of data" should be gathered much like large internet corporations do for their activities (J. Brown & Adler, 2008, p. xv). For him, the byproduct of learning (i.e., data) is meant to enhance education: "just as Amazon does in their Web site, experiments can be designed and continuously run and the data collected to see what works best for a class of users" (Ibid., 2008, p. xv).

Consequently, digital technologies (e.g., programming languages, algorithms, data) engender so-called invisible operations in open education practices, meaning "the work of software and hardware, and the automated work that goes on 'behind the screen'" to make education and knowledge widely available (R. Edwards, 2015b, p. 257; R. Edwards & Fenwick, 2017, p. 60). As explained before, contemporary open education platforms have incorporated such algorithms into their programmed architecture to handle user data and personalise users' future directions. Beneath the surface, platforms "probe the open learner's interests from the outset, and this in order to offer a personal selection of courses tailored to these interests" (Decuypere, 2019c, p. 449). The invisible operations in open education practices – invisible, at least from the perspective of the learner and educator – have received relatively little attention despite shaping, organising, and disseminating the visible knowledge materials (R. Edwards, 2015a).

While it may be clear by now that platformised initiatives do not simply open up education, it is imperative to understand more in detail how they equally close down, preselect and render

invisible particular aspects of reality (Bayne et al., 2020). According to Benjamin Bratton (2015) the fast proliferation of platform interfaces (e.g., screens) and infrastructures (e.g., cloud services), each with their own ambivalences, has placed researchers in search for suitable words to grasp how practices are (re)shaped for better or worse. For Vlieghe and colleagues (2019), an educational language is needed to grasp the ongoing digitalisation of education because screen technologies – and, by extension, platforms – transform practices in unprecedented ways that do not necessarily mirror the transformations in other domains of life. If current and future platforms fundamentally alter learning, teaching, accessing, and so on, researchers "first need to develop an adequate theoretical language and approach to be able to respond accurately" (Ibid., 2019, p. 1). The ambivalences open education practices produce are a starting point to investigate their ongoing platformisation.

THE LITERATURE REVIEW: THE PLATFORMISATION OF OPEN EDUCATION

In this section, I reflect on existing academic literature by unfolding how researchers have been viewing the platformisation of open education. I do this in order to provide a rationale for my own goals, questions, and views.

Why investigate the platformisation of open education?

The main goal of this dissertation is to make empirical, conceptual, and methodological contributions to the open education research field by scrutinising how digital platforms (re)shape open education practices without taking their ambivalences for granted. I begin by elucidating and motivating the purpose of the research in relation to current tendencies in the field of open education.

Open education research is a mosaic field of inquiry in which researchers have been investigating the platformisation for different reasons and in different ways (Amiel & do Rozário Diniz, 2023; Decuypere, 2019c; Despujol et al., 2022; Zawacki-Richter et al., 2020). First, researchers in open education have predominantly investigated the *platformisation for open education*, meaning that their contributions emphasise the design, development, adoption, and improvement of interconnected platform technologies (e.g., analytical models, algorithms, interfaces, databases, and resources) for the benefit of more accessible and high-quality education (Despujol et al., 2022; Li et al., 2018). Several studies do not focus on platforms as such but on their capacity to capture data, be it on the level of specific courses or the level of the digital architecture more generally, and contribute to the platform's algorithms, statistical models, and connections to the broader infrastructure (Azhar et al., 2019; Clow, 2013; Vogten & Koper, 2018). One important application is to reduce the high student attrition rates in open online courses and improve teaching and

learning (e.g., J. Chen et al., 2022; Figueroa-Cañas & Sancho-Vinuesa, 2021). For instance, the MOOC Analytic Statistical Visual model is meant to scrutinise large data sets about user-platform interactions, predict learners' academic outcomes, and identify possible dropouts. Instructors and developers are then expected to adjust the course design based on the results and improve future outcomes (Mubarak et al., 2023). Platform data are also employed to enhance the digital architecture, investigating which design affords the best user experience (Liapis et al., 2022), or to exchange information with other university applications in a seamless, interoperable manner (Xin et al., 2018).

When open education platforms are addressed explicitly, they are typically expected to facilitate "self-directed and self-paced learning, enabling individuals to acquire knowledge and skills independently" (Bozkurt et al., 2023, p. 99). While this research is done with the best intentions, it risks framing digital platforms as neutral content providers and overlooking the ways these sociotechnical architectures actively (re)shape access to education and knowledge (de Andrade et al., 2023). Platforms are treated as means to an end, beneficial for helping students reach desired educational outcomes, and as apolitical conduits that transfer whatever needs to be taught or learned to the user (Baas et al., 2022). The views of Koul and Nayar (2021) on platforms for educational practices exemplify the belief in a platformisation for access to knowledge and learning rather than a critical attitude regarding *how* and *what kind* of access in provided:

> [Educational] institutes will provide contemporary technology platforms for the learners, which will allow a flexible modern curriculum. Educational institutes will need to infuse technology in their curriculum and education system. (Koul & Nayar, 2021, p. 107)

The first prong of my research goal involves a careful empirical investigation into how digital platforms delineate open education practices, specifically how and what knowledge can or cannot be accessed. Terry Anderson (2001) has long argued in the field of distance education that researchers should scrutinise the unofficial knowledge, the "unstated rules" students learn in technology-intensive settings. For instance, students must "master a particular set of education and communication technologies" or face negative repercussions, such as being excluded from certain online activities (p. 30). Research has yet to fully disentangle how open education platforms prescribe and select what (access to) knowledge is made possible and interrogate how data informs it (Amiel, 2023; R. Edwards, 2015b).

Second, and in contrast to the former, there is research that investigates *open education against platformisation*; that is, some researchers dismiss the use of large corporate and proprietary platforms for educational purposes in favour of open and FOSS alternatives (Amiel & do Rozário Diniz,

2023; Bozkurt et al., 2023). Amiel and do Rosario Diniz (2023) take up the double role of researcher-educator and seek to resist "the ever-growing techno-corporate mammoth in education" (e.g., Google/Alphabet, Facebook/Meta), claiming these platforms have become monetising and data-collecting mediators of educational access (p. 421). These open education researchers tend to cite the works of Srnicek (2017) on platform capitalism and Zuboff (2018) on surveillance capitalism, reproducing the general critique that digital platforms spread an undesirable business model that capitalises on harvested user data (Amiel & do Rozário Diniz, 2023; Cronin, 2020). "Open education", Laura Czerniewicz says in an editorial, entails "practices and processes that exist in opposition to the dominant discourses of big tech, platformisation, [and] surveillance" (Bozkurt et al., 2023, p. 87). Robert Farrow reminisces about the free sharing of online information in the nillies and criticises how the early internet landscape has turned into a "series of walled gardens and increasingly restrictive platformisation" (Ibid., 2023, p. 90). Other researchers frame FOSS platforms (e.g., Moodle, BigBlueButton, Wikiversity) as proper alternatives to the corporate, proprietary ones (Amiel & do Rozário Diniz, 2023) though without empirically investigating how the general critiques about platforms apply to those provided by large but specialised education corporations (e.g., FutureLearn, Udacity). In other words, some researchers view open education as the answer to corporate platformisation that threatens and may hinder education practices (Cronin, 2020). One pitfall of such research against platformisation is that it may dismiss a kind of digital education platform as being intrinsically closed before carefully detailing and conceptualising its actual educational implications. Therefore, my second prong of the research goal is to conceptualise how different platforms make access possible or impossible in open education practices through empirical inquiry.

Third, and different from the previous two research themes, there is a growing body of scholarship investigating the *platformisation of open education*. Here, researchers help fill the gap left by research for and against platformisation by scrutinising how platforms (re)shape open education practices and by acknowledging the social and technical dimensions of this transformation (Decuypere, 2019c; Decuypere et al., 2022; J. Knox, 2016a; van de Oudeweetering & Decuypere, 2019). Some have focussed on the instructional design of MOOCs (Spector, 2016) and how educational institutes, the platform, learners, and pedagogies discursively influence instructors working behind the scenes to shape their instruction in specific ways (Zienkowski & Lambotte, 2023). Others have empirically and theoretically explored some of the ambivalences engendered by open education practices, including but not limited to MOOCs (e.g., Bayne et al., 2020; Hamilton, 2016).

And yet, the theoretical-empirical research on the platformisation of open education is outnumbered by open education research that continues to stress and favour one side of the open-closed binary: education needs to be accessible, flexible, free, and innovative rather than the opposite (R. Edwards, 2015b; Shareefa et al., 2023). A meta-review of over 240 articles indicates this normative aim persists in the field, i.e., the idea that open education "must be accessible to all, supportive, with actions that facilitate the social appropriation of knowledge" (Ramirez-Montoya, 2020, p. 13). While I do not deny the importance of such an aim, binaries (e.g., open versus closed) risk limiting and simplifying more complex realities (Oliver, 2015), thereby constraining the understanding of particular communities of researchers, practitioners, and decision-makers that care about education (Ravitch & Mittenfelner Carl, 2021). The amount of research that has investigated the possibilities of platformisation for open education far exceeds the research about the institutional (e.g., policies, business models, organisational objectives) and educational (e.g., pedagogies, course designs) changes they effectuate (cf. Despujol et al., 2022). Therefore, it is important I add to the field by conceptualising and empirically highlighting how platforms change open education practices (Decuypere et al., 2021; Zawacki-Richter et al., 2020).

Furthermore, on a methodological note, open education research has mostly performed quantitative methods to investigate the impacts of digital platforms on education practices rather than providing a fine-grained analysis of what platforms do in relation to people and knowledge (cf. Despujol et al., 2022). Conducting such a fine-grained analysis of platforms is a *forte* of certain types of qualitative inquiry, José van Dijck (2013) argues, as long as it finds ways to stop taking these programmed architectures for granted as natural aspects of everyday life. This taken-for-grantedness lets the qualitative researcher deal with a difficult task: "[o]nce new technologies and their use have gained a naturalised presence, it is much harder to identify underlying principles and thus question their *raison d'être*" (Ibid., 2013, p. 20). Therefore, it is important to showcase how qualitative researchers may wield (theoretical and) methodological tools to undo some of the self-evident characteristics that digital platforms acquire, for instance, by investigating multiple dimensions: what happens on, with, behind, and beyond the sociotechnical architecture (Decuypere, 2021; van de Oudeweetering & Decuypere, 2021). Additional ways of analysing are needed to deal with the pervasiveness and seeming inscrutability of such digital technologies (R. Edwards, 2015b; Goglio, 2022). Therefore, the third prong of my research goal involves contributing to existing methodological insights by demonstrating how education researchers can scrutinise digital platforms in open education practices without taking them for granted.

Three perspectives on the platformisation of open education

Achieving the research goal contributes to the growing collection of empirical, theoretical, and methodological insights about open education practices and *critical perspectives on education platforms* more generally. More and more researchers investigate how (aspects of) digital platforms shape and are being shaped by different education contexts, drawing on the concepts, theories, and methods from multiple sources to do so (Decuypere et al., 2021; Hartong & Decuypere, 2023; Perrotta et al., 2023). These studies tend to agree that "education is not simply preserved or opened by an innovative technology, rather a new kind of education is shaped, and we are shaped along with it" (J. Knox, 2016a, p. 42). First, researchers adopting a *media perspective* on platforms have been demonstrating how these programmed architectures act as a form of media with performative effects and are embedded in social, technical, and political ecologies (P. T. Nichols et al., 2024; T. P. Nichols & LeBlanc, 2021). Primarily building on the work of José van Dijck (2013), these researchers investigate the ways media such as open education platforms have been altering social and educational practices (e.g., access to knowledge) and how these media practices are co-constituted by a broader ecosystem of political-economic relations (see van Dijck & Poell, 2015). From such a media perspective, education platforms require more attention because of the *extent* that people are informed by the digital media surrounding them.

Second, from a *critical pedagogical perspective*, researchers regard (open) education platforms as artefacts that may help produce access to knowledge and interactions between educators and students but may also hinder participation and, thus, reproduce social inequalities (Amiel, 2023; R. Edwards, 2015a; Farrow, 2017; Hall & Winn, 2010). Typically drawing on the work of Brazilian educator Paolo Freire, this perspective comes with a normative stance to raise consciousness about and resist the (corporate) platformisation of education (e.g., Microsoft, Alphabet, Meta) (e.g., Amiel & do Rozário Diniz, 2023; Öztok, 2020). To give one example, Gallagher and colleagues (2021) investigate data-driven technology and its implicit teachings to raise consciousness among students, teachers, and researchers about its effects and, subsequently, transform social inequalities and power structures. In their case, an LMS platform becomes a self-evident aspect of education, with operations that remain hidden from the users (e.g., capturing data). As users learn from the platform, the platform learns from the users. The technology becomes implicated in the "deliberate or accidental concealment of tacit learning" (Gallagher et al., 2021, p. 437). Here, technologies are problematised, and students are commended for their emancipatory ability to overcome the surveillance that data-driven technologies may impose. For example, some students learn to remain invisible, that is, remain anonymous, on the discussion forum by changing the way they interact online (Gallagher et al., 2021). Critical scholarship suggests further exploring the *hidden and invisible*

mechanisms that potentially contribute to inaccessible education (Amiel, 2023) and, by extension, go beyond any complacency regarding the possible self-evidence or inscrutability of digital education platforms.

Third and finally, more and more researchers disentangle platforms from a *socio-technical perspective,* building on a long tradition in the social sciences that examines the production and use of technologies in social situations (Decuypere, 2019c; R. Edwards, 2015a; Lange, 2021). They focus on how the social *and* technical brings open education platforms, but also algorithms, source code, and so on, to the foreground as possible actors that shape practices in educational settings (R. Edwards, 2015b). In their case on the knowledge that online learning affords, Edwards and Carmichael (2012) put a magnifying glass on semantic technologies in higher education. Official knowledge presented on a screen is given (more) meaning via the semantic web, extending the Internet into another space to create rich and interconnected content (e.g., automatically adding information from an online encyclopaedia to the knowledge resources of a course). The semantic web relies on standards to represent extended, 'unofficial' knowledge and (re)shapes data in a structured, machine-readable way that corresponds with the values of its designers. Digital devices and invisible programming languages shape the extended knowledge resources and make them visible on the user's screen, offering new knowledge-making methods. Education research has not yet fully disentangled how invisible technologies act as the *socio-technical modalities*, i.e., the social and technical conditions that (re)shape open education practices, nor how they precisely (re)shape the interactions between open education platforms and other educational actors, such as learners and educators (R. Edwards, 2015b; R. Edwards & Fenwick, 2017; Zawacki-Richter et al., 2020).

The three different perspectives on the platformisation of (open) education, each with their possibilities and limitations, bring a specific set of questions to the fore. This dissertation has *three main research questions* (RQ) guiding the overall project, though each chapter raises and answers more specific questions that are relevant and tailored to the issues and research fields addressed there. Given the different gaps in open education and (critical) platform literature, we seek to answer the following questions:

- **RQ1:** How do digital platforms shape the ways that learners access knowledge in open education practices?
- **RQ2:** When and where, under which socio-technical modalities, do digital platforms shape access to knowledge in open education practices?
- **RQ3:** How can education researchers scrutinise the ambivalences of digital platforms in open education practices without taking them for granted?

The socio-technical perspective is especially useful and important in answering these questions because open education researchers seek to overcome issues that have both social and technical dimensions (Blessinger & Bliss, 2016; R. Edwards, 2015b). The point of this paragraph was not to give an exhaustive overview of existing perspectives on platforms (that richness in literature cannot be covered in the scope of this dissertation), but rather to introduce insights from and paucities in the literature that will be developed more throughout the upcoming chapters. To add empirical, conceptual, and methodological insights to the existing corpus of research on open education and education platforms, I turn to science and technology studies (STS). As the next paragraph explains, this turn will allow me to imagine the social and technical together and critically analyse how digital platforms powerfully shape open education practices.

THE RESEARCH APPROACH: STS AS A SENSITISING DEVICE

STS and some of its sensibilities

In this paragraph, I introduce the main theoretical and methodological sensibilities of my research approach, meaning the iterative ability to acknowledge and respond to the relations between human and other-than human actors (J. Law & Lin, 2022). Researchers in the interdisciplinary field of science and technology studies, or STS, typically scrutinise how science and technology are connected to everyday practices, meanings, and values in concrete situations. They tend to express concern about the way people often overlook how science and technology operate and are made to operate in everyday life, and how this seemingly natural state of things could be otherwise (Felt et al., 2017; Woolgar & Lezaun, 2013). That is, STS researchers elucidate how technologies are designed and used in social situations by embracing rather than reducing the *heterogeneities* of practices, i.e., their social and material ambivalences or complexities (e.g., present/absent, visible/hidden, open/closed, analogue/digital) (J. Law, 2002). Here, open education is approached as an ongoing "sociotechnical practice", one that has been, and still is, prone to multiple definitions and outcomes, each of which bears different possible consequences for the educational settings in which technological designs are put to use (Hamilton, 2016, p. 15). These researchers typically focus their senses on the relations between humans and technologies, recognising that the latter, too, could become an actor that (re)arranges everyday practices. According to Madeleine Akrich (2023), STS researchers adopt a particular "way of looking at and describing the world", that is, they take on "a kind of a priori agnosticism to the nature and intensity of the forces at work, and an equal attention to humans and non-humans" (Ibid., 2023, p. 169). This way of looking and describing hints at a particular manner of using theoretical and methodological resources in this field: STS acts as a "sensitising device". Such a device permits researchers to focus on "relational

features" or dimensions of educational settings and demonstrate that and how open educational practices operate and are made operable in concrete situations (Decuypere, 2019a, p. 137).

Understanding STS as a sensitising device means researchers commit to analysing the heterogeneous reality by focussing on the *relationality* of social life – the relations, interactions, or doings (J. Law & Lin, 2022). Again, the field of STS is diverse, and the terms used to refer to 'relations' differ across its scholarly works; this makes this line of research both compelling and challenging to follow (Fenwick & Edwards, 2010). One way of understanding the attention to relationality is through the work of Bruno Latour and colleagues (2012), seeking to tackle a long-standing distinction in the analysis of social phenomena, namely the distinction between the individual or micro level on the one hand (e.g., a platform user), and the wider structure or macro level on the other (e.g., the user's country, supranational policies, the economy). For Latour (2005), this micro/macro distinction has been negatively informing researchers' explanations: questions surrounding social behaviours are being answered prematurely by categorising elements as 'contextual' in this or that way, aggregating them *a priori* rather than carefully attending to how something actually comes into existence. Instead of understanding the individual through a predefined context, he adopts a relational ontology, levelling the micro and macro, and begins treating any entity on equal terms. The researcher is urged to analyse every entity, human and otherwise, as populating a single plain of existence (Latour, 2005).

There are two important aspects in this so-called flat ontology: the *actors* (individual elements, entities, actants, agents) and the *networks* (aggregates, entanglements, weaves, webs) in which each co-constitutive part says something about the whole and vice versa (J. Law & Lin, 2022). What thus describes and explains something is the *relations* (e.g., associations, ties, connections, doings) between one thing and something else, the ways actors in the network define and shape one another (J. Law, 2008). In other words, the actors can be regarded as nodes (e.g., users, computers, modems, a platform) and relations as lines (e.g., the actions amongst users, the platform, and so on), together ordering an actor-network (e.g., following an online course). The answer to who or what something or someone is, like an online course or user identity, is always the same:

> *this* network. What was at first a meaningless string of words with no content, a mere dot, now possesses content, an interior, that is, a network summarized by one now fully specified proper name. The set of attributes – the network – may now be grasped as an *envelope* – the actor – that encapsulates its content in one shorthand notation. (Latour et al., 2012, p. 593)

This doctoral research activity does not happen outside the network; the researcher – in varying degree – becomes part of it. Understanding the shaping of socio-technical practices is the result of slowly (learning to) observe, follow, describe, and often visualise the relations between constitutive elements to understand their attributes (J. Law & Lin, 2022). Latour draws on the work of nineteenth-century sociologist Gabriel Tarde and his notion of the monad to clarify, amongst other things, the researcher's positionality within a network of relations: "A monad is not a part of a whole, but a point of view on all the other entities taken severally and not as a totality" (Latour et al., 2012, p. 598). In STS, researchers are thus required to engage in attentive practices of *seeing* how different actors relate to one another and then *visualising* the ever-changing constellation to make it readable and comprehensible. Instead of presupposing how something is ordered based on external or existing factors, STS researchers foreground relations and tend to agree that "nothing has reality or form outside the enactment of those relations" (J. Law, 2008, p. 141). Indeed, there exists a variety of terms to grasp relationality that are often, but not always, used interchangeably: 'entanglements', 'weaves', 'networks', 'webs of practice', and 'modes of ordering' all help make sense of how everything is organised relationally. What matters here is that relations "stage effects"; they order, unorder, and reorder realities in specific ways (J. Law, 2017, p. 42).

This relational take on reality is tightly connected to the principle of *generalised symmetry*, the analytical assumption that one should explain reality by attending to an immanent plane rather than making transcendent categories (e.g., structure versus agency) (Latour, 2005). To put it differently, STS researchers follow the analytical disposition that anyone and anything deserves to be approached on equal grounds, the aforementioned flat ontology. Descriptions and inferences about complex phenomena should be derived from the least amount of ontological assumptions (J. Law, 2004). Early STS scholarship referred to the "principle of generalised symmetry" to avoid making *a priori* categorisations through which researchers make sense of the world they investigate (Callon, 1984, p. 200). The distinction mentioned above between the micro and macro level is exemplary, but so is the sharp distinction between 'the technical' and 'the social'. Not only humans but *non-humans*, too, may matter in how practices are ordered. For example, research on a hospitality curriculum in Scottish compulsory education demonstrated the value of attending to not only people (e.g., students) but also materials (e.g., handbooks) when disentangling how prescribed lesson plans are enacted in practice (R. Edwards, 2011). When the researcher accepts the – perhaps radical – premise of a symmetrical analysis, "nothing has a given form", and the task at hand becomes foregrounding different "modes of ordering" reality (J. Law, 2017, p. 42). A symmetrical analysis may be perceived as radical compared to other social research (e.g., social constructivism)

because it refuses to draw clear-cut boundaries between categories (e.g., human/nonhuman, micro/macro, open/closed) before the empirical investigation.

Symmetry does not mean differences are impossible; the principle does not claim humans and non-humans are the same thing but rather grants an analytical *possibility* that everyone and everything can become relevant in a phenomenon. Non-humans could thus turn into actors making a difference and should be acknowledged as equally agentic in the ordering of sociotechnical practices (Latour, 2005). The rationale for such an analysis is as follows: if "you start off assuming that some knowledge is true and some false, then you never get to analyse how the distinction is constructed and used" (J. Law, 1994, p. 10). For Latour (2005), it is imperative to trace an agent's course of action while investigating if and how it makes a difference as an actor. "Does it make a difference in the course of some other agent's action or not?" he asks (p. 71), wondering if there are ways to pick up on these differences empirically. In sum, treating actors according to the principle of generalised symmetry means the researcher needs to see, describe, and visualise how these order practices *in situ*.

Those familiar with the STS field will know that not all researchers place themselves explicitly under the same banner, that they may express different onto-epistemological positions, and that they allow other fields to adjust and ameliorate their sensibilities (J. Law & Lin, 2022). For example, the 'ANT' banner started to live its own life upon being introduced in the 1980s and was subject to critiques, misunderstanding, and reappraisal (Latour, 2005). Law (2008) who very much following similar sensibilities, proposed the notion of 'material semiotics' to emphasise that relations are both material and semiotic (meaningful) in nature – they are material-semiotic. Suchman (2007) worked with the notion of 'configuration', i.e., the conjoint actions of different entities that make up reality, also highlighting how agency is relationally distributed across different actors (see equally Suchman, 2012). Despite some differences in analysing reality, STS researchers tend to have congruent ideas regarding theory, methods, and empirical inquiry; they "are all part of the same weave and cannot be teased apart" (J. Law, 2017, p. 32). While I will not explicitly position myself as doing ANT, I do aspire an analysis that treats humans and other-than-humans symmetrically and, therefore, conduct research with 'ANT-ish' (in)sensibilities.

STS and some of its insensibilities

In this section, I address two major accusations that have been made against STS and some ways of defending it. STS researchers do not sense and capture everything, meaning they equally have a set of *insensibilities*, that is, an inability or unwillingness to care (sufficiently) about specific aspects of reality. There are always things omitted from a research project, for instance, because of the

theories and methods researchers choose to work with, but researchers outside the STS field have been opposing some (in)sensibilities more than others (J. Law & Lin, 2022).

First, STS and the sociomaterial approaches are sometimes accused of providing merely flat descriptions that do not explain social reality enough, mainly because their (ethnographic) case studies exclude broader social structures from the analyses (Collin, 2014; Mutch, 2013). Some sceptics take issue with the principle of generalised symmetry, the onto-epistemological foundation of many STS endeavours: doing ethnography by following the principle of a flat ontology would result in a flat description rather than an elevated explanation of social phenomena or society at large (Collin, 2014). For example, the principle of generalised symmetry has been criticised by some researchers in the humanities who forefront racism and sexism in investigations of structural power inequalities. Some argue that symmetrical analyses forget to acknowledge pertinent issues in powerful networks (Lave, 2015). When it comes to investigating extensive data systems, to given another example, Mutch (2013) claims several sociomaterial approaches incline "towards a perverse (given the promise of the concept) neglect of the specificity of the systems involved and an inability to deal adequately with the broader context of practice" (p. 28). This accusation is not unimportant for a research project on platforms, which are precisely systems characterised by large volumes of data. Bringing the 'broader context' or 'structures' back into view has been deemed necessary from a critical realist perspective (e.g., the works of Karl Marx and Pierre Bourdieu). Critical realism, as an ontological position, entails that more predefined boundaries should be formulated between agency and structure, subject and object, to assist the researcher in his/her critical analyses (Porpora, 2018). Sceptics voice concerns about symmetrical analyses because of the seemingly blind faith STS researchers need to have in whatever participants say about the sociomaterial practices under investigation and that the powerful, oppressive, unequal material conditions will simply reveal themselves (Mutch, 2013).

STS researchers have not been insensitive to this accusation, the claim that it would be insufficiently explanatory, and have formulated a response to defend themselves: a good description of something *is* a good explanation of that thing. What STS sensibilities bring to the table is a 'good', accurate understanding, i.e., "accounts of how different actors construct their worlds" (Gorur et al., 2019, p. 5). The accusation towards generalised symmetry expresses (too) little faith in participants and researchers alike, as well as the analytical possibility for powerful actors to emerge and become relevant in educational issues. This is precisely the point of wielding STS and doing a fine-grained analysis of what humans and non-humans do (Decuypere, 2020; R. Edwards, 2015b). STS researchers recognise that the world does not start from scratch each day but refrain from assuming a specific, predefined, and unequal structure will be important (J. Law,

2004). For example, retrieving online knowledge materials may be hard without a working infrastructure (e.g., internet cables), but people tend to fabricate surprising, makeshift solutions that are easily overlooked when researchers ignore the sociomaterial dimension (R. Edwards, 2015b; Soliz, 2021). The collapse of the agency/structure divide means STS researchers need to do their job and follow the actors that are close by and far away, even if it means tracing them back to hard-to-reach places.

Second, and related to the former, STS research has been accused of not being *critical* and *politically engaged* enough when analysing social realities and, notably, elucidating and contesting the undesirable values of those realities (Lave, 2015; Mills, 2018). According to Mills (2018), critical sociologists such as those from the Frankfurt School after World War II are, not unlike critical realists, occupied with understanding structures that shape social phenomena. They favour a critical theory that can unveil hidden power relations and can problematise the structures that oppress and disadvantage specific groups of people. The aim of critical sociologists tends to be deeply political and value-driven because of past, current, or (potential) future harms in the world. For Mills (2018), STS has an important insensibility because it:

> overemphasised the fluidity of social structures and too hastily dispensed with 'critique' in favour of a value neutral, descriptive sociology; and that the conceptual vocabulary Latour et al. have developed is ill-suited to social scientific research in an era characterised if not by stable 'structures', then certainly by persistent, and growing, institutionalised inequalities and concentrations of power. (Mills, 2018, p. 287)

Indeed, STS typically does not – at least, not explicitly – engage in negative critique like the critical sociologists, out to expose and counter power structures and discursive formations (Ravitch & Carl, 2016). It usually also does not provide a so-called affirmative critique, i.e., a sort of "critique that focuses on the search for an alternative to the negative reality and requires a capacity to reimagine reality and open new potentials" (Zembylas, 2020, p. 162). Some STS researchers draw on the work of Andrew Feenberg and his critical theory of technology to complement the flat ontology, bringing in a more normative stance vis-á-vis what counts as 'good' technology, for instance, to critique the open education movement and its MOOCS (e.g., Hamilton, 2016).

However, most STS researchers respond to the accusations of being not critical and political in a different manner. Namely, that STS research affords an *inherent critique* and politics because of its capacity to disentangle relations; showing how reality is ordered *already* is a way of intervening and doing critique (Gorur et al., 2019). Providing an accurate description of something already provides a critical account of that something since research is never disinterested.

Researchers choose and are made to choose those realities they can disentangle against the backdrop of an emerging societal – educational – issue in the hope some kind of change may arise (Decuypere & Simons, 2016). The sensibilities of the researcher are informed by whatever issue is at stake (e.g., crowdification, datafication, platformisation), the goals and questions that have been formulated, but not by a predefined explanation (J. Law & Lin, 2022). The change that STS researchers are looking for is a modest one:

> In line with the basic aspirations common to all 'critical' analyses, we hope that our analysis might have some kind of effect, that minimally it might, for example, suggest ways of looking differently at arguments and debates about 'ordinary' objects, that it might bring the critical sensibilities of STS deeper into the seemingly ordered realities of mundane life. (Woolgar & Lezaun, 2013, p. 335)

Because wielding STS as a sensitising device means taking symmetry and relationality to heart, I avoid accepting predominant categories and, alternatively, will put in the work to explore relations and renew what it means for platforms to open and close education practices. Here, and in much contemporary critical scholarship about educational technologies, a critical account has the potential to "destabilise common-sense certainties" from a rather agnostic position instead of a pessimistic one in which faulty and undesirable realities are dismissed (Macgilchrist, 2021, p. 247). I, too, believe that "the playfulness and hope in critical writing underlines the urgency of critical analysis" (Ibid., 2021, p. 247). The critical analysis I will provide here will describe and visualise how the platformisation of open education unfolds to spark a thought or action in the reader which, in turn, could make change possible.

STS and education: Openness as modes of opening and closing

Adopting STS as a sensitising device, which I have introduced to analyse open education practices symmetrically and relationally, is not (meant to be) done uniformly. There are multiple ways of disentangling how the technoscientific plays a role in education, be it learning, teaching, knowledge-making, or any other practice, and elucidating its effects (Gorur et al., 2019). STS researchers do not only describe but also theorise and challenge any self-evident state that people attribute to science and technology – knowingly or otherwise. That is to say, researchers seek to "provoke, highlight and challenge our taken-for-granted assumptions, and to unsettle and disturb our inclination to depend on safe formulae and on comfortable analytic perspectives" (Woolgar, 2006, p. 347). STS researchers in education engage in a two-pronged way of critiquing: first, they show how actors are "ordering society, disciplining actors and promoting ideas and practices" and,

second, they demonstrate the contingencies regarding these ideas and practices to make a re-ordering possible (Gorur et al., 2019, p. 1).

This sort of critical scholarship is not new to education; early work in the 1990s focussed on the university curriculum and how knowledge is not transmitted but made in movement, shaped by relating to social and technical actors (Nespor, 1994). Later work in the 2000s developed the theoretical and methodological foundations for research regarding learning, teaching, and knowledge-making in technology-mediated practices (Fenwick & Edwards, 2010). In recent years, STS has been employed in the emerging field of education platforms studies (Decuypere et al., 2021), for instance, to shed light on how tutoring (Lange, 2021), student monitoring (Martinez Lunde, 2021), and university ranking platforms operate and order their corresponding practices (Decuypere & Landri, 2021). Datafication and visualisation in education (H. F. Ratner, 2024), such as how dashboards presuppose a particular kind of teacher, have been scrutinised with the help of STS sensibilities (H. Ratner et al., 2019).

To analyse open education practices, this sort of critical analysis shows how anyone (e.g., learners and educators) and anything (e.g., digital textbooks) can start to play a role in (re)shaping or (re)ordering relational patterns, temporarily stabilising, destabilising, and restabilising a particular meaning (e.g., the semiotics of accessing knowledge resources) (R. Edwards, 2011, 2015b). I mentioned before that the interest lies in detecting how these patterns come about and the sorts of effects they engender, for instance, how different actors arrive at knowledge, i.e., a particular understanding of the world, as well as norms, i.e., expectations about how to live in that world (Felt et al., 2017). Law (1994) seeks to identify specific *modes,* relational orderings that characterise actors and effects in specific but contingent ways. Human and non-human actors do not just enact one but many modes of learning, teaching, knowledge-making, and so on.

Open education practices, then, are not defined *a priori*, as if these have essential characteristics, but are the result of how people, technologies, and other materialities relate and enact particular modes of opening and closing education (R. Edwards, 2015b; R. Edwards & Fenwick, 2017). In light of the platformisation of open education, STS-inspired research has been fruitful in critically investigating forms of open learning regarding European platforms (see van de Oudeweetering & Decuypere, 2019) and universities (Oliver, 2015). STS research shows how open learning also entails being trained and empowered by the platform according to dominant learning theories, but also subtle processes such as being lured to the platform or being held responsible for one's own education process (Decuypere, 2019c). Taking up STS as a sensitising device means I (should) become able to see, describe, and visualise peoples' modes of opening and closing

education under highly specific modalities, the access to knowledge as an effect of relating to other socio-technical actors, including digital platforms.

STS and platforms: A theoretical framing

STS offers a rich vocabulary to start detailing the role of digital platforms in open education practices, that is, analysing them as and situated in a sociotechnical entanglement with particular effects. The interdisciplinary work of Benjamin Bratton (2015) helps bring into view how platforms are part of a larger whole, an infrastructure he calls 'the Stack', comprising several layers of related elements including the earth, cloud, city, address, interface and user. Platforms, he argues, operate in an inherently difficult-to-grasp whole capable of not only computing social realities but also governing them in multifarious ways. The human and non-human actors that comprise an interconnected and standardised infrastructure (e.g., made of databases and technicians) can be quintessential networks for producing, sharing, and curating knowledge materials for open educational purposes, such as a massive open online course or open educational resource (R. Edwards, 2015b). The two outer layers of the opaque infrastructure, the platform user and interface, will be the most relevant in the scope of this dissertation (Decuypere, 2021).

According to Bratton (2015), the notion of a "*platform*" suggests at least three things: (1) "a plateau or raised surface level", derived from the Middle French word "*platte form*", (2) "a plan of action", indicating the directions given to the user on that surface, and (3) "a stage", the space where the action unfolds in line with or against the plan (p. 80). When someone or something joins the platform and wider infrastructure, they become subject to its rules and directions. As such, platforms constitute particular modes of opening and closing for particular kinds of users; they include and exclude by providing some access to the stage and denying it to others. "The generic universality of platforms", Bratton argues, "makes them formally open to all". As long as a human or non-human actor is "interoperable with the protocols of the platform, then in principle, it can communicate with its systems and its economies" (Ibid., 2015, p. 88). This may be true in principle, but in reality, platforms rarely remain generic because of their specific design and purpose. If platforms are inherently endowed with openings and closings, they fundamentally diverge from the commonly held assumption that free education platforms, such as TED, are open by default (R. Edwards, 2015b; Moe, 2015). *Mutatis mutandis*, proprietary platforms such as FutureLearn and Udacity are equally not closed necessarily. Instead, any sociotechnical architecture can enable and constrain the actions of its user base (Amiel & do Rozário Diniz, 2023). Open education platforms – I retain this notion for platforms *aiming* to open up – provide a space for and are co-constitutive of educational practices by enabling/constraining the actions of their users (Decuypere, 2019c).

I will look at *four focal points* or analytical dimensions concerning digital platforms and how they enable and constrain open education practices: the ecology, design, usage, and interface. This dissertation explicitly builds on the methodological insights developed and demonstrated in the context of open education by Mathias Decuypere and Karmijn van de Oudeweetering. I will analyse (1) the ecology, what happens beyond the platform; (2) the design, what happens behind the platform; (3) the usage, what happens with the platform; and (4) the interface, what happens on the platform (Decuypere, 2021; van de Oudeweetering & Decuypere, 2019, 2021). I zoom in on these platform dimensions, or focal points, as something of analytical interest that meets the gaze of the researcher and possibly informs my findings.

First, I look at how actors contribute to a platform's *ecology*, the broader set of relations in which the sociotechnical architecture is situated, supporting and hindering open education practices (Decuypere, 2021). The prefix in the English terms 'ecology' and 'ecosystem' are derived from the Greek word for 'household,' called *'oikos'*, suggesting an architecture in which a group of entities reside. The word 'system' also has Greek origins (*systēma*) and refers to related entities that compose an organised unit (Audretsch et al., 2019). For decades, the term has been highly prevalent in the disciplines of biology and ecology, pointing to the organisation and stabilisation that occurs when organic and environmental components interact. However, it has also long been used to designate a separated, smaller, yet constitutive part of nature (Tansley, 1935). STS scholarship uses a variety of terms to recognise the complexity of platforms in a relational manner, avoiding the predefined levels that were problematised before. For José van Dijck (2013) that complexity is mainly engendered by an "ecosystem of connective platforms" (p. 18), meaning a dynamic collection of architectures that work together, or interoperate, according to shared standards – house rules, if you will. For her, the ecosystem is characterised by platforms that can create dependencies for and to other actors, locking some in and fencing others out, for instance, through a particular business model that requires users to take long-term subscriptions.

Bratton (2015) refers to an infrastructure, the Stack, to acknowledge that participating in platformised practices is never fully determined and always contingent and situated in an enveloping whole of socio-technical actors. Susan Star (2016), too, turns to the vastness of infrastructures to see the bigger scale of things besides the up-close associations between, for instance, users and objects. Attending to tangible infrastructures, enmeshed with the practices under investigation, allows one to be analytically aware of *possible* issues, such as "questions of scale, of boundary drawing, and of mystifying science and technology, as well as questions of race, sex, and class" (Star, 2016, p. 114). I have already discussed issues concerning the presupposed

neutrality of platforms, as well as the crowdification, datafication, and visualisation that is present in open education nowadays.

Besides being embedded in an infrastructure, platforms are supported by or made possible *because of* infrastructures: electricity and internet cables, data centres, technical standards, and employees work together to make the platform operational. Platforms may also operate *as* an infrastructure on which everyday life depends, upholding, developing, or competing with product or service delivery to a large number of users (Plantin et al., 2018). A learning platform, for example, may act as the substrate of educational practices in which learners can engage in educational activities permitted by the platform's programming. In that sense, "infrastructure is a powerful phenomenon, shifting organisational routine, practice, capacity, and in some cases, the life chances of groups" (P. N. Edwards et al., 2009, p. 371). It is not uncommon for education platforms to turn into almost closed-off areas, fostering only their own proprietary code sets, applications, algorithms, and connections as a business strategy (Kerssens & van Dijck, 2021). All these authors argue that looking at the wider relations, be it under the name of a stack, ecosystem or infrastructure, provides a helpful focal point to see, describe, and visualise how open educational platforms are operating in, as, and because of other sociotechnical actors.

Second, I turn to the *design* or production of platforms, the technoscientific work of designers, programmers, educational scientists, developers, coordinators and various technologies that makes the platform work according to the values they endorse. It is a long-standing idea within STS research that technologies are not neutral objects (Latour, 2005). The values become clear in the design (process), in which highly specific ideas and expectations of the designers about how a device should be handled become part of that device. Values are inscribed into technology before being used or deployed in an actual setting, meaning technologies have a script – as in, a movie script or scenario – that users are supposed to follow (Akrich, 1992). Once again, the terminology within the field of STS differs depending on the author. For Grint and Woolgar (1997), technological design resembles the writing of a text to the extent that human work and values are poured into it, thereby constructing (at least partially) "what it is for and what it can do" (p. 70). Their take on technology creates an analytical opening to read and interpret the technology as text, trying to deconstruct and interpret what it is meant to do and what sort of user the design presupposes. The STS authors regard this process as the *figuration* of the user and, by extension, a practice; the technical design orders a sociotechnical reality in one way over another and, therefore, requires analytical attention. For Lucy Suchman (2012), too, technological design implies (con)figuration, "an action that holds the material and the semiotic together in ways that become naturalised over time, and in turn, requires 'unpacking' to recover its constituent elements" (p. 49).

Because the design of platforms in STS does not occur in a vacuum or without a connection to their usage (Decuypere, 2021), another focal point in our analysis is needed.

Thirdly, production and *usage* are two sides of the same coin, the latter being the relations users (are supposed to) have with the platform architecture when its deployed. The user identity, reminiscent of user ideal types or figures, is being presupposed and enacted in connection to the platform (Decuypere, 2021). While *putative* user identities for Bratton (2015) primarily have to do with the presupposed usage of the platform, co-constituted by the demands of the platform design, they can also point to the enacted identities with actual political implications for users. If technology is written like text, users can be seen as readers, making their way across the story spelled out for them (Grint & Woolgar, 1997). Platforms, like other technologies (such as user manuals), impose certain values, assumptions, and ideas about who the user is supposed to be.

However, *actual* users may resist these putative identities by employing the technology on their own terms, which may not fully align with those of the designers. Users may even ignore or refuse the technology altogether (Suchman, 2012), they can thus follow and deviate from the script that designers write into the technology. What is at stake is the stabilising and destabilising of practices in which the technology is deployed. For instance, the introduction or removal of a feature can change how people use the technology which, in turn, can have positive or negative consequences for users that are not always easily reversed (Akrich, 1992). While an analysis of the *putative* user identity allows the researcher to say something about how designers envision the user's actions, an analysis of the *actual* users says something about the ambivalences that arise when technologies are used in practice. Therefore, taking the usage as a focal point affords an understanding of platforms that goes further than the – sometimes overly confident – claims of producers or owners about their technological inventions. Seeing, describing, and visualising what happens at the intersection of the platform and the user creates a tentative possibility for social change (Oudshoorn & Pinch, 2003).

Lastly, we attend to the *interface* to acknowledge the interconnectedness between the previous parts (ecology, design, usage) and the capacities of open education platforms to order everyday practices (Decuypere, 2021). The concept of the interface originates in the field of chemistry and has been adopted in many technology-related fields (e.g., computer sciences, software studies, platform studies). In its general understanding, the interface separates different entities; it acts as "a surface forming a common boundary of two bodies, spaces", but it also constitutes a point of connection between these different entities (Cramer & Fuller, 2008, p. 149). A platform interface, Bratton (2015) argues, "may open a space for one user [and] also closes it off to another"; it is a connective point between human and other-than-human elements that is capable

of cleaving off and binding users to aspects of life (p. 88). These come in various forms depending on what entities they separate and connect: the graphic user interface (GUI), data dashboard, application programming interface (API), and infrastructural nodes.

The GUI, arguably the most well-known interface in education, functions as the front end of platforms, websites and applications. It provides users with visible handles to operate instead of the internal code it conceals. GUIs typically circumscribe content offered on the screen and enable/constrain the user's navigation on the platform through components such as buttons, sliders, and icons (van Dijck, 2013). Data dashboards, similar to the GUI, are interfacing between a user and platform with clickable/touchable controls but are more inclined to shape a particular relation to data on the screen. Interactive and dynamic time charts, diagrams, and progress bars are examples of data visualisations on such a dashboard that allow the user to complete a particular task. While most dashboards may have some graphical components to navigate the screen, they do not all operate as GUIs (Tkacz, 2022). The API, which van Dijck (2013) also calls the invisible side of the interface, is designed to connect specific applications to the platform. It typically entails "a set of codes that specifies protocolised relations between data, software, and hardware" (p. 31). APIs help people – often programmers – link applications to other software, hardware, or (data) infrastructural nodes, such as data centres. APIs can play a relevant role in the platformisation of education by establishing various dependencies at the back end of the platforms, for instance, by linking a learning analytics dashboard, LMS, and databases (Perrotta, 2021).

Interfaces, according to Suchman (2007), should be understood in relation to their design and user; they are made for specific usage, but their effects result from the conjoint actions between the user and interface. The interface "becomes the name for a category of contingently enacted cuts always occurring within sociomaterial practices, that effect 'person' and 'machines' as distinct entities, and that in turn enable particular forms of subject–object" (Ibid., 2007, p. 268). We turn to interfaces because open education platforms heavily depend on them, creating visible and invisible boundaries that impose technical possibilities and limitations on the user, thereby complicating the hyperbole about simply creating more openness through digital means (van de Oudeweetering & Decuypere, 2019).

STS and its cases: A methodological framing

In terms of methodology, that is, the assemblage of methods that is performed, STS researchers commonly turn to (mostly ethnographic) *case studies* to investigate the role of sciences and technologies in everyday life (J. Law, 2004). Such cases typically come in the form of a written account and are the outcome of the research process as much as the source of inspiration for that

research, allowing researchers to sense the heterogeneities of practices. To put it more blunt: "if you want to cultivate STS sensibilities, then you need to read its cases" (J. Law & Lin, 2022, p. 138). A case study design also suggests that the researcher does not seek to exert control over the research phenomenon and typically looks for an answer to *how* something is done in a bounded setting and its surrounding ecosystem, thereby generating exemplary insights (Creswell & Poth, 2016). The specificity and relevance of the case cannot be straightforwardly generalised from one situation to another. However, the case can contribute to new meanings and has the potential to resonate with and in other situations (Tkacz, 2022), meaning that a degree of transferability is possible (Ravitch & Carl, 2016). Ethnographic case studies within STS magnify daily practices as the unit of analysis, occurring at a bounded area of interest (e.g., a university, a platform) and situated in a broader relational landscape (e.g., partnering institutions). The cases gain relevance when they make empirical and analytical contributions to the research field, especially when they spark new ways of thinking amongst their audiences (Nespor, 1994). Such research is important, Law (2017) argues, because it enables researchers to "…evoke, illustrate, disrupt and instruct, and help STS to craft and recraft its theory" (p. 32). The empirical-analytical work is meant to "generate new conceptual vocabularies and novel forms of engagement" (Gorur et al., 2019, p. 5). Research participants may bring up alternative understandings of open education that contrast given ways of thinking about and relating to the world.

Given that platformisation goes hand in hand with datafication and visualisation and the fact that (data) visualising technologies can be highly persuasive for the viewer, a *visual and ethnographic methodology* is needed to help attune the researchers' sensibilities to the possible social effects of these technologies (Burri & Dumit, 2008; Pink, 2021). In line with what was said about the four focal points, *visual* methods help align the inquiry to the usage of visualising technologies (e.g., pictures, data graphs, dashboards) *in situ*, their materiality and composition (e.g., content, colour, spatial organisation), and the often-invisible production process from which they originate (Rose, 2016). An analysis of visualising technologies means attending to what is included and excluded from their composition, but also "to detect the roles that it makes available, to understand the way in which they are distributed, and to decode the hierarchies and differences that it naturalises" (Fyfe & Law, 1987, p. 1). The visible and invisible aspects of open education platform interfaces, such as GUIs and dashboards (van de Oudeweetering & Decuypere, 2019), require specific methods that acknowledge their complex and persuasive features. Inflecting the STS approach with visual ethnographic methods provides a way of viewing, describing, and visualising open education platforms as potential pedagogic devices, capable of captivating the eyes of the user in a particular direction, for a particular purpose, and presuming a particular viewer (Rose,

2016). Each chapter selects and triangulates slightly different visual and ethnographic methods to address the corresponding research phenomena while ensuring they are practised more accurately in line with the sensibilities of STS (J. Law & Lin, 2022). Platforms function as my "grounding move" when I practice methods across different times and places, meaning I repeatedly (re)visit the sociotechnical architectures under investigation (Tkacz, 2022, p. 25). While starting from this ground base, I adhere to a well-known STS maxim, "follow the actors themselves", a maxim that also informed the protocols I used (see Appendices A and B) during the ethnographic case studies (Latour, 2005, p. 12).

The STS approach I adopt here incorporates *five research methods* (walkthroughs, observations, interviews, document analyses, and visual network analyses) to assist me in seeing, describing, and visualising one or more focal points related to platformised open education practices. According to anthropologist Sarah Pink (2021), adjusting the methods of ethnographic inquiry is increasingly common, as contemporary methodologies "tend to be developed for/with particular projects, they are interwoven with theory, with our own biographies as researchers" as well as the "everyday situations where participants are present" (p. 18).

First, I conduct *technical walkthroughs*, a method developed to understand putative user identities and the sociotechnical design of mobile applications – or platform GUIs, in this case. I focus on what the user is supposed to do when entering, using, and leaving the platform, as well as how all this is situated in a broader ecology. The latter, also called an 'environment of expected use', recognises the historical and socioeconomic contexts in which the platform operates, highlighting the intended user base, partnering or competing organisations, business plans, and so on (Light et al., 2018). The walkthrough method has been a successful way of scrutinising how the design of the GUI configures the user (Decuypere, 2019b). Like others, I navigate what happens on the open education platform as if I am a typical user, thereby elucidating some ways the interface is meant to enable and constrain human actions. However, it does not highlight how users actually engage with it *in situ* (van de Oudeweetering & Decuypere, 2022).

Second, and in light of the limitation, I perform (auto)ethnographic *observations* to get a sense of the *actual* usage, i.e., what happens with the platform in concrete education practices. In an STS understanding of autoethnography, the researcher again takes on the role of the user but fully immerses him or herself in the activities and notes down the everyday experiences (Lange, 2021). The prefix 'auto', derived from the Greek word for 'self', can be misleading as my ethnographic analyses remain focused on practices rather than solely on users (sometimes being the first author of this research) or digital technologies (Adams et al., 2021; Pink, 2021). Whether

in the field of STS or elsewhere, (auto)ethnographic inquiry is challenging because it confronts the researcher with the infamous problem that Mannay (2016) calls *familiarisation*. This familiarity with the practice under investigation emerges during the fieldwork, meaning the researcher and/or participants may start to take for granted their environments and surrounding actors. Mannay argues that:

> [R]esearch aims to investigate the invisibility of everyday life, but when a researcher is working in familiar territory, there is a danger that their findings will be overshadowed by the enclosed, self-contained world of common understanding. (Mannay, 2016, p. 31)

The adopted methods are meant to (re)present research findings and help de-familiarise the setting, that is, to make the familiar strange. I argue that persuasive data representations and slick-looking GUIs necessitate strategies to become attentive (again) to their workings and consequences (Burri & Dumit, 2008). The combined effort of seeing, describing, and visualising is vital, given the non-neutrality of platforms, interfaces, and other related technologies. I will generate textual-visual accounts to counter the self-evidence of visualising technologies across the different chapters in this inquiry.

Third, and complementing the former method, *semi-structured interviews* help elucidate practices that are not immediately visible to the researcher (Ravitch & Mittenfelner Carl, 2021). The main objective of the semi-structured interviews is to obtain a detailed, contextualised understanding of an individual's activities and vocabularies to which the researcher has little to no access. Interviews, semi-structured ones included, are deeply relational in nature and ideally remain symmetrical in terms of how power is distributed; the brief encounters between the interviewer and interviewee are meant to be characterised by a conjoint discussion about specific topics instead of a hierarchical opposition between a knowledgeable 'expert' (the researcher) and a cross-examined 'subject' (the participant). Following interview protocols, a set of approximately 10 open-ended questions (see Appendix B), the interviewer asks participants to describe concretely how they shape practices, i.e., what they are (expected) to do on a daily basis (Ravitch & Mittenfelner Carl, 2021). The interview protocols were adapted to the ecosystem and the role of every selected participant (e.g., students, educators, coordinators) as well as every conversation (e.g., a first encounter, after a study session). The protocols allowed for a "customised replication" (Ravitch & Mittenfelner Carl, 2021, p. 322), the idea that the interviewer may have questions that are repeated in each interview (e.g., "Could you introduce yourself and your role at the university?") and probes or follow-up questions specifically tailored to the interviewee (e.g., "What technologies do you need to fulfil your duties as an employee?"; "You talked about platform A, can you say more about

why you need to use it?). The interviews provided data and partial knowledge about the situation-specific relations that unfold around digital platforms in open education practices.

Fourth, *analysing documents* helps fill some gaps in the wider field of relations in which the platform operates, providing additional historical and organisational information about the actors foregrounded by the other methods (J. Law, 1994). I consult documents (e.g., user manuals, lesson plans, reports) because they reveal the situation, design, and usage of visualising technologies (Rose, 2016), specifically open education platforms, and the effects they engender.

Finally, I conduct *visual network analyses* (VNA) to investigate the socio-technical qualities of open education practices (Decuypere, 2020). This sort of visual analysis employs depictions made by the researchers with digital software (e.g., Gephi, Inkscape) to show the socio-technical relations within a data corpus. This method is meant to help the researchers grasp the complexities of practices and narrate them to their audience (Venturini et al., 2017, 2021). The work of Martinez Lunde and Ottesen (2021) utilises the method as it maps and presents socio-material networks in order to identify the role of digital technologies in Irish and Norwegian education policy texts. After manually coding the dataset, the software visualises digital technologies and other actors as colour-coded nodes and their relations as lines between actors. VNA will be used in a strict and more flexible sense to disentangle the compositions of practices in which an open education platform and its graphical user interface(s) are highly present (see, for example, Figures 1 and 8 in Chapters 1 and 2 respectively).

The case study findings in this dissertation take the form of *descriptive and inferential accounts* that include both visuals (e.g., diagrams, screenshots) and texts (e.g., vignettes) to "show and tell" aspects of everyday life (Tkacz, 2022, p. 7). Like in other STS research, the visuals are not simply collected data that mirror realities 'out there' – they are created by the researcher and performative, meaning they re-present and re-order particular realities in this research (Decuypere, 2020). The researcher visualises, i.e., engages in the creative act of depicting sociotechnical practices (e.g., via images, drawings, diagrams) to help scrutinise relations between humans and non-humans (Coleman, 2021). The visuals are combined with the descriptive texts, where the shapes of practices are put into words and arranged in the format of vignettes, i.e., the brief written excerpts that show local specificities. I will write vignettes because they function as succinct ethnographic texts that show and tell everyday relations between participants, objects, and the researcher, thereby (re)ordering and making visible context-specific relations that can then be conceptualised, all to evoke the reader's thoughts and actions. Vignettes, like the visualisations, are not 'raw' descriptions of realities but are made by the researcher (e.g., using and connecting the interview transcripts,

observation notes, walkthrough descriptions, and document fragments, screenshots). They become accessible presentations of particularities encountered during fieldwork and are refined, i.e., analysed, to have these evocative or performative effects (Bloom-Christen & Grunow, 2022). Together with the visuals, a successful vignette presents the specificities of certain practices and may 'move' the reader by enticing a response (Jenkins et al., 2020). The vignettes and visuals each convey something about the platformisation of open education in an accessible manner, and they lay the foundations for a more conceptualised understanding. Their accessibility lies in keeping the theoretical resources and vocabularies of STS (temporarily) at bay, inviting the reader to see the relations between actors before more analytical inferences are made.

THE SITE AND PARTICIPANT SELECTION: A TALE OF UNIVERSITIES AND PLATFORMS

This section clarifies and motivates the choices made in terms of "site and participant selection", the purposeful sampling strategies that were adopted to foreground specific contexts, places, people, and technologies in higher open and distance education so the research questions could be answered and the phenomenon of interest elucidated (Ravitch & Mittenfelner Carl, 2021, p. 139). The universities and platforms will often function as a research site for conducting an empirical investigation, a "setting or location where the activities in which a researcher is interested take place" (LeCompte & Schensul, 2013, p. 23). In general, digital platforms from two open and distance universities were selected: *the Open University in the UK* with its FutureLearn and OpenLearn platforms and *Learniversity* in the Netherlands with its LMS platform and dashboards. While these universities are only two of the approximately 70 open and distance institutions that exist worldwide (DeVries, 2019), they tell an exemplary tale about the platformisation of open education. Homing in on *higher* education is warranted because it is the sector most affected by digital technologies; platforms and other interconnected, data-driven technologies are reported to be changing educational practices at a more intense pace and larger scale than other sectors (OECD, 2023). Given that open and distance universities rely so much on digital infrastructures and technologies to organise educational access, as was argued before, the selected institutions potentially show the apex of such intensities and scales in contemporary higher open education (Anderson, 2001; Anderson & Rivera-Vargas, 2020).

Neither the universities nor their platforms operate in a vacuum and should be seen as embedded in their respective *national education systems*. The UK's Open University is interesting not just because it was the first open university but also because it is a public institution in a country that faces considerable challenges in terms of "extending access to, and ensuring success in, higher education" for an increasingly large and diverse population (Atherton et al., 2023, p. 7). Like other

universities in the UK, the OU heavily depends on tuition fees and grants to cover its research and teaching. The government may fund both those activities directly through grants from national bodies and indirectly through loans, allowances and scholarships allocated to (specific populations of) students. It should be noted here that England, Wales, Scotland, and Northern Ireland shape their education increasingly in their own regard, which has implications for how open education is done in practice (Atherton et al., 2023). However, these local processes are beyond the scope of this dissertation. Learniversity in the Netherlands offers another suitable setting to investigate the platformisation of open education because it is one of the Dutch public universities listed in the Higher Education and Research Act. The Act legally obligates the university to make its education accessible for individuals, in particular those looking to participate in the so-called knowledge economy and in need of academic or vocational training (Eurydice, 2023). Moreover, its language of operation is Dutch, which contrasts with the dominant status of English at the OU and several open education platforms (see J. Knox, 2016b).

The digital platforms discussed here should equally be seen as (partly) building on and being interwoven with *university infrastructures* that make a range of open and distance education activities possible. The education at the OU relies on a digital infrastructure that includes the Moodle learning management system, a YouTube channel, a collection of Kindle books, an OER design platform for university staff named OpenLearn Create, a for-profit platform called FutureLearn, and a not-for-profit platform named OpenLearn. In turn, the education of Learniversity depends significantly on an LMS platform with the same name but also an open-source infrastructure called Kafka. This open-source infrastructure encompasses a student information system (SIS), an administration platform (AdminTech), a marketing platform (SurveyTech), the LMS dashboard (LMSD), a learning analytics dashboard (LMSD), a virtual classroom (Blackboard Collaborate Ultra), and an online examination system (Proctorio). Regarding the *brick-and-mortar infrastructure*, or where students, educators, and tutors gather, some may study or work from home or an office completely off campus*,* i.e., activities are fully mediated by one or more digital platforms or paper learning materials sent via postal services. Occasionally, activities are organised on campus*,* i.e., in regional centres where people can meet in person (DeVries, 2019). Learniversity has such centres across the Netherlands and Flanders (Belgium). The same goes for *when* they gather: while the MOOCs related to OU platforms have no fixed starting or ending dates, the (supervised) Learniversity courses start on a fixed moment and go on for several weeks (a so-called 'quarter'), and the exam needs to be completed within one academic year. Being 'at' the university is thus not straightforward; it involves a collection of people and objects to be gathered at certain times and places (Bayne et al., 2014).

The *participants* selected here were all affiliated with Learniversity, be it the Coordination Centre or a bachelor program. They were selected because they responded to a general invitation sent via email and an LMS announcement. Learniversity has about 15.000 students across multiple online bachelor, master, and flexible programmes from different faculties. Typical for open institutions, the student populations are often characterised negatively: they are positioned as 'non-traditional' or 'non-conventional' (J. Knox, 2016a), mainly because they consist of adult learners older than the average bachelor and master students in Europe. Open and distance universities tend to share a similar demographic: the median age of new bachelor students is 28, and more than half are between 25 and 44 years old. Less than five percent is older than 65. The minimum age for university entrance is 18, though minors could get access to the UK-based platforms that will be discussed here. While this inquiry did not formulate any criteria regarding the age or role of participants, the age range of those included is between 18 and 65 (DeVries, 2019; The Open University, 2019b). These students also rarely follow the route and pace of students in traditional universities because, amongst many other reasons, there is an academic calendar divided into quarters instead of semesters. Before their enrolment, these students, including some participants, may have faced economic, social, and procedural barriers that excluded them from other higher education institutions. This research included the following Learniversity members as participants: four students, four educators (two being program leaders), one student advisor, three coordinators, one senior developer, and one platform designer (Appendix C). The only exception is to be found in the cases related to the Open University of the UK, where Lanze adopted the double role of researcher *and* participant to give a firsthand account about the platformisation of MOOCs in times of a global pandemic.

This dissertation will provide four cases about the platformisation of open education. The first two cases home in on the role of digital platforms in MOOCs and maintain close ties with the Open University of the UK. The initial case is the *FutureLearn* platform, created in 2012 as a joint venture between the Open University and more than 40 national and international partners. At the start of the doctoral research, the Open University had just entered a joint venture with the SEEK Group (in 2019). It was more recently taken over by Global University Systems (in 2022), a larger entity controlling various for-profit education institutions. It was founded to increase access to topic-specific quality educational resources during the initial hype of MOOCs but has always had a more explicit commercial and vocational orientation (FutureLearn, 2022a). Nowadays, the platform's business model strongly revolves around a freemium and credit system: learners get limited access to about 1400 short courses weekly for free, while all content and certification/credentials become available upon a monthly or annual subscription. Although the

platform targets professionals needing to improve their skills and resumes, it covers courses on various topics for a user base expected to be proficient in English. Underpinning the business is a digital infrastructure that uses data analytics for educational, technical, and commercial purposes and distance learning pedagogy (FutureLearn, 2022b). An investigation into FutureLearn provides an opportunity to explore the role of a so-called post-MOOC platform in creating openings and closures with a new, vocation-oriented curriculum. The case revolves around one of the over 100 newly created vocational curricula labelled 'ExpertTracks': a series of courses about software development. The ExpertTrack exemplifies what is at stake in this dissertation: how access to higher education is (re)shaped through open education platforms (Bowden, 2021).

The second case is the Open University's *OpenLearn* platform, again within the broader context of British higher education, which exemplifies the shaping of access to so-called flexible learning pathways (The Open University, 2022b). Unlike FutureLearn, OpenLearn is framed as a provider of *free* online courses and other open educational resources to democratise access to education for an (inter)national audience. Given that the platform is an intrinsic part of the OU, the business model does not revolve around a pay-to-access or subscription system. Launched in 2006, but with a technological genesis that goes back longer, its educational resources have (at least, at the time of writing) always been available without payment and even without registration of a student account, serving as an initial step towards (more) higher open education (P. Law et al., 2020; P. Law & Perryman, 2017). The focus will be scrutinising one MOOC instead of providing an exhaustive overview. The choice was made to investigate the relatively new phenomenon of 'badged courses' by homing in on the self-paced curriculum of "How to learn a language", which, as the name suggests, provides learners with the basic knowledge, skills, and attitudes to master any language (The Open University, 2022a).

The final cases are all situated in and have strong connections to Learniversity – the organisation and the platform. The third case zooms in on the LMS platform and its positioning in an interoperable infrastructure to shape access to higher open and distance education. It is purposefully selected because it relies on a diverse collection of open-source technologies that were, according to participants, specifically designed for higher distance education. It may offer a perspective on access that differs from the famous (proprietary and British) digital platforms in today's open education landscape (see earlier). The Kafka infrastructure and the Learniversity LMS will become the common threads because they are so heavily involved in arranging lectures, providing course materials, connecting students with educators and advisors, analysing learning behaviour through learning analytics, and monitoring (online) examinations.

The fourth and last case is embedded in the same open and distance university, Learniversity, but focuses on the two dashboards that connect to the LMS: a learning analytics dashboard (LAD) and a learning management system dashboard (LMSD). The LAD was created via a public-private partnership between the university and a company called DataQuest. It identifies and visualises a student's time, place, and engagement with the LMS and its course materials/structures. Like its broader infrastructure, the dashboard tells a story about the sociotechnical modalities of access to higher open and distance education. The fieldwork will show how some technical, juridical, and pedagogical ideas become embedded in the dashboard to (re)arrange the university students' learning. The somewhat older and simpler LMSD helps detail how such (re)arranging of learning practices happens. The LMSD is used to consult course content, syllabi, assignments, announcements, and deadlines. Unlike the LAD, this dashboard is intrinsic to the open-source LMS and completely designed by the university's technical staff.

The emphasis on European universities and platforms does not mean to suggest that other parts of the world do not have – perhaps more pressing – issues regarding the accessibility of higher (open and distance) education. Besides selecting these different contexts based on a sensitising concept (i.e., access) and in relation to the research goal (Ravitch & Mittenfelner Carl, 2021), the selection was methodologically informed. Working with cases from different countries assisted me in adapting and following the ethnographic principle of "making the familiar strange" again (cf. Mannay, 2016, p. 28). That being said, the familiar was not made *too* strange from a practical point of view since I needed to be fully proficient in the official language of the investigated organisations/platforms to understand what was happening.

ABOUT THE RESEARCH ETHICS AND TRAJECTORY

The research ethics

Before setting out on this research trajectory, equipped with the theoretical and methodological sensibilities of STS, it needs to be clear how each of the steps is to be taken in a careful and ethical way, i.e., in a manner of right conduct (J. Law & Lin, 2022). I will commit to two approaches regarding research ethics: procedural and relational. The first approach entails a formal set of actions according to predefined codes of conduct, ethical ones (e.g., ensuring benevolence) and legal ones (e.g., the General Data Protection Regulation), which help protect participants from harm (Ravitch & Mittenfelner Carl, 2021). Concretely, and before contacting any participants, the proposal for this research project first gained clearance from KU Leuven's institutional review board (*Sociaal-Maatschappelijke Ethische Commissie*) under the number G-2020-2830-R2. I also followed its guidelines about drafting and disseminating an informed consent form as well as

keeping personal data secure and confidential (Appendix F). The names of humans and non-humans, apart from multinational corporations and their technologies (e.g., Microsoft, Microsoft Teams) have been given a pseudonym to ensure this confidentiality – though full anonymity is not feasible in this sort of research (Ravitch & Mittenfelner Carl, 2021). Confidentiality was especially important because one of the participating institutions explicitly requested not to disclose its name to the public. It was pseudonymised as 'Learniversity' even before the start of the fieldwork.

The second approach continues my commitment to relationality in the realm of ethics, a caring for the interactions between humans (and non-humans) in which the researcher acknowledges one cannot always know *a priori* what counts as 'right' conduct before, during, and after the research (Ravitch & Mittenfelner Carl, 2021). In what follows, the ethical relations between the actors involved will be situated, intricate, and may have a cascade of political effects, yet I will attempt to review case-by-case how to foster respectful and mutually beneficial ties between myself and the participants. One example of such an ethical matter is (accepting) the discomfort of not knowing how the research process will unfold precisely. In their reflections on a relational and careful research design, Law and Lin (2022) argue that both the STS researcher and participant(s) may have to come to terms with the fact that their sensibilities are yet to be 'educated' in order to arrive at an understanding of the research phenomenon. In this case, the platformisation of open education practices. To educate sensibilities, here, does not (just) mean a straightforward acquisition of academic or professional knowledge, instead it is "learning to see and attend to things in research-productive ways" (p. 128). One does not know exactly what 'good' conduct is nor what the exact outcome of the research will be – it takes time and effort to find out, and this is uncertain and uncomfortable. Before posing this sort of uncertainty and discomfort on others, I will first experience it myself by acting as both the researcher *and* the (only) participant in the first part of the dissertation. After educating my STS sensibilities to a level that the research questions and concerns have become more refined, the next steps in the trajectory are towards the site where other participants reside.

The research trajectory

This brings us to the overview of this upcoming parts and chapters in the dissertation. In Part 1, *The platformisation of massive open online courses*, I act as researcher and participant to investigate how two digital platforms order modes of accessing in open education practices from the perspective of the open learner. Picking two sensitising concepts related to the research goal, 'accessibility' and 'flexibility', two corresponding platforms were selected to help detail the ambivalences of these concepts. The FutureLearn and OpenLearn platforms, and four of their online courses, allow me to zoom in on specific learning pathways that these platforms are said to make accessible and

flexible, respectively. As mentioned before, platforms have been founded in the UK, are tied to the Open University, and have demonstrated global ambitions by spreading English-spoken and -written educational resources to populations beyond national borders (P. Law et al., 2020).

In Chapter 1, *On making in/access together,* I investigate the phenomenon of '*accessing*' in open education, not only how it appears in recent literature but also how it is practiced on and with a concrete platform. Access and participation are not synonymous. While both terms designate a precondition for education, someone joining, a "taking part in something" (e.g., a culture, consumption), the latter emphasises a relevant contribution on top of that, "having a say in decision-making processes" (Weich & Macgilchrist, 2023, p. 5). I take issue with essentialist conceptions of technology, i.e., platforms being framed as being intrinsically accessible, and magnify the FutureLearn platform and its software development course. Drawing on STS and a theory of access (Ribot & Peluso, 2003), I show how the trajectory on, across, and away from the platform is characterised by points of access and in-access. As Jeremy Knox (2013) identified, popular discourse typically understands 'openness' as the learner's unrestricted and unproblematic access to educational resources and courses. But while the 'open' prefix was still prevalent on major open education platforms in the 2010s, this case shows the language of 'accessibility' has turned into a taken-for-granted aspect of higher open and distance education.

In Chapter 2, *The platform curriculum,* I analyse the concept and practice of '*flexibilising*' in open education, so-called flexible pathways. I attend to related literature as well as how flexibilising is done on the OpenLearn platform and one of its MOOCs. The course is devoted to teaching people how to learn a language so a wider audience can participate in the language training courses offered on and beyond the platform. Engaging with theoretical and methodological insights from curriculum studies, and the work of Richard Edwards (2011) specifically, I hold a prevalent understanding of flexible pathways to account by disentangling its complexities and complicating the underpinning instrumentalism found in some contemporary literature. That is to say, I cross-fertilise STS and curriculum studies to approach technologies not as simply natural affairs that help achieve educational goals, but as actively taking part in shaping a highly particular form of curriculum: the platform curriculum.

In Part 2, *The platformisation of an open and distance university*, I scrutinise the platform-infrastructure of Learniversity which, as explained above, organises (access to) higher education in the Netherlands and Flanders. Learniversity was positioned by the participants as the key digital platform in their open education practices, and they used 'open' and distance' education interchangeably. Therefore, the role of distance education becomes much greater in the upcoming chapters compared to the former ones.

In Chapter 3, I delve deeper into how platforms are *interoperating* in open and distance education, that is, how these digital technologies work together in visible and invisible ways to exchange data across geographically distant locations. This chapter sheds a different light on what it means for digital technologies to become natural or invisible parts of education through Hannah Knox's (2017a) concept of 'vanishing points'. The 'vanishing point', a concept borrowed from perspective drawing, assists people (e.g., an artist) in identifying when and where certain entities (e.g., parallel lines, objects) meet and disappear in the distance (e.g., the horizon). In this chapter, too, I inflect STS with insights from another but highly related field, i.e., that of critical infrastructure studies. Through the case of the university's LMS, I demonstrate how data flow across an interconnected platform-infrastructure and turn invisible, visible, and invisible again.

In Chapter 4, I scrutinise open and distance *learning* with data visualisations, specifically the ways Learniversity dashboards enter higher education settings and engender (un)intended effects for designers and users. Again, I cross-fertilise STS with insights from a different field, critical data studies, to get a more complex understanding. The case of the Learniversity dashboards, the LAD and LMSD, show the making of and learning with dashboards. What is disentangled here not only exemplifies a "dashboarding of everyday life" (Tkacz, 2022), the case also demonstrates a 'dashboarding of learning' and 'learning to dashboard'. Dashboards transition into educational practices and entice – with varying success – students to understand and realise their education according to particular technological and pedagogical designs. This resonates with Joris Vlieghe's argument (2014) that what "is happening today is perhaps not so much a transformation *within* education, but *of* education itself" (p. 520).

In the *General conclusion*, I (re)use insights from the four case studies to rethink the platformisation of open education practices: rather than thinking in terms of education being 'open' or 'closed' (R. Edwards, 2015b), it's worthwhile to consider the ways digital platforms depend on certain actors that appear and disappear constantly and simultaneously – they are *dis/appearing*. I will argue that and how, in a literal sense, digital platforms operate by turning specific sets of knowledge resources visible in educational practices and other ones invisible. As we will see, this is not restricted to educational materials alone, a variety of other human and non-human actors will end up being affected by the digital platform or particular entities in the wider ecosystem or infrastructure. The learner's family members, pets, and preferred software applications, too, are meant to stay out of sight and the educational practice to prevent interference. The results across the different cases will demonstrate that and how open education platforms become part of an ancillary field of relations that reinforces the place of one actor over another, making access to *their* education and knowledge resources possible. In a figurative sense, digital platforms may seem

highly noticeable architectures to the user at first, a somewhat unfamiliar surface one needs to traverse to access education and knowledge resources. However, it becomes seemingly invisible when the user's attention is directed toward resources instead of the surrounding architecture and infrastructure. In other words, the usage starts to be taken for granted as the digital architecture turns into the backdrop of educational activities. We will see how open education platforms *themselves* dis/appear and have real consequences for how education and knowledge resources can or cannot be accessed.

Finally, the dissertation revisits the research trajectory and how the researcher, practicing a specific approach to research ethics, theory, and methodology, also made particular (groups of) actors dis/appear from the critical account presented here. Doing research by describing and visualising what happens in open education is equally not a neutral act (Burri & Dumit, 2008; Decuypere, 2020); it makes some actors visible in the results and others invisible. The 'attentive crossing' of platforms and ecosystems is proposed to safeguard a critical yet ethical investigation: one that takes platformised education practices seriously but remains careful about who and what is made to dis/appear.

PART 1:

THE PLATFORMISATION OF MASSIVE OPEN ONLINE COURSES

CHAPTER 1: ON MAKING IN/ACCESS TOGETHER

Open education platforms increasingly host vocational curricula provided and endorsed by companies rather than 'traditional' education organisations. This chapter demonstrates how such a platform, FutureLearn, enables/constrains access to online courses. Drawing on science and technology studies (STS) and the notion of 'configuration', we understand 'access' as the conjoint actions of the user and platform. We performed autoethnography to scrutinise platform access, which, we argue, is situated in an ecology of education organisations, public and otherwise, creating and legitimising educational resources. Three modes of access, namely funnelling, tracking, and diverging, indicate how the user and platform make access together and blur strict distinctions between their roles. Focussing on 'in/access' can help educational actors consider user-platform interplays and rethink restrictive binaries in education.

This chapter is based on: Vanermen, L., Vlieghe, J., & Decuypere, M. (2023). On making in/access together: A reimagining of 'access' to educational platforms as a socio-material practice. In C. Cobo, & A. Rivas (Eds.), *The new digital education policy landscape: From education systems to platforms* (pp. 97-121). Routledge.

Introduction

While student numbers in higher education rise around the globe, access to education – and the lack thereof – continues to engender debates about the preconditions for participation, how to create, maintain, and improve them, as well as how to overcome inequalities between specific student groups (Chien et al., 2017). We referred to the issue of creating platformised access or openness for an increasing amount of people in need of some kind of education as crowdification (see General introduction, de Andrade et al., 2023). Scholarly debates about access often revolve around the question of who can actually benefit and learn from these resources, and under what circumstances (Ribot & Peluso, 2003). These debates are particularly relevant in the context of open education platforms, like Edx and Coursera, which frequently proclaim to increase access for larger audiences in ways that 'traditional' organisations, meaning universities and colleges, could not. For over a decade, western education platforms have been advancing hype and resources to 'open up' education, that is, to remove barriers preventing people from accessing education and educational resources (Blessinger & Bliss, 2016; Goglio, 2022). The OpenLearn platform, for example, provides educational resources (e.g., articles and courses) to "underserved groups" by

hosting them online and under licenses permitting free use (P. Law et al., 2020, p. 51). Massive open online courses (MOOCs) organise distance learning for groups at risk of being excluded from education; think of people living in remote areas, with a dis/ability, or fewer financial means (Iniesto et al., 2016; Stracke et al., 2019).

However, the promises and practices of platforms have been questioned as they partner with universities and colleges to provide a collection of pay-for-access resources with an academic or vocational orientation, ushering in a "post-MOOC" era (Thomas & Nedeva, 2018, p. 1730). Some have argued that the well-known western platforms have exceeded the 'MOOC' label and lost their distinctive open features by reinstating financial boundaries and proprietary licences (Stracke et al., 2019). Professional certificate programs on EdX, online certificate programs on Coursera, nanodegrees on Udacity, and ExpertTracks on FutureLearn, are all commercial resources to "transform access to education" and delivered by supposedly "specialist organisations" (Shah, 2021b). As such, access is increasingly provided through new educational partnerships in which companies, rather than universities or colleges, create content for open education platforms (Ibid., 2021a). Because creating educational access is a long-standing issue in open and higher education, these recent developments necessitate an updated understanding of what 'access' means when mediated by platforms (De Reuver et al., 2018; Ramirez-Montoya, 2020).

Critical scholarship has urged the education field to scrutinise how digital platforms in (open) education act: as programmed architectures that delineate the user's actions, as organisations that intermediate between providers and users, and as data collectors (Decuypere et al., 2021; van Dijck & Poell, 2015). Rather than understanding platforms as natural, passive tools for education, these studies draw on consonant theoretical and methodological ideas from science and technology studies (STS) (H. Ratner et al., 2019), post-humanism (Cone, 2021; J. Knox, 2016a), actor-network theory (Lange, 2021), and socio-technical approaches (Gorur & Dey, 2021) to investigate the ways platforms (re)shape relations, practices, roles, and imaginaries in education. Although such research has argued that open education platforms presuppose a specific sort of learner/subject and make particular forms of openness (Decuypere, 2019c; J. Knox, 2016a; van de Oudeweetering & Decuypere, 2019), less attention has been paid to concrete ways commercial platforms participate in creating (un)equal access or how learners face (in)access (Rivas, 2023).

This chapter aims to investigate and conceptualise how different modes of access are made conjointly – that is, configured – by the platform and user (cf. Suchman, 2012). We cross-fertilise STS and a theory of access to zoom in on the FutureLearn platform as a case of "transforming access to education" (see Ribot & Peluso, 2003). FutureLearn was initially founded by the Open University to deliver MOOCs in collaboration with other universities and has aligned itself with

accessibility policies from the UK government. Since 2019, half of the platform's ownership has been transferred to an Australian company, the Seek Group, in one of the largest EdTech investments of Western Europe and has led to new accessibility and monetisation strategies. The UK-based platform is thus associated with openness, accessibility, and public-private partnerships in education. Its ExpertTracks are of particular interest because they allow learners to enrol in a sequence of two to six courses with practical relevance, provided by specialists or 'experts' from external organisations, in exchange for a subscription fee and registering a user profile (FutureLearn, 2022c).

This chapter is relevant for researchers, practitioners, and policymakers who want to understand the implications of commercial platforms for learners' (un)equal access to education in a time when internet technologies are ubiquitous in many parts of the world and appear as a taken-for-granted digital infrastructure for social inclusion. Researchers have argued, though, that access to internet technology, as well as having the necessary skills, devices, software, and subscriptions to use and benefit from it, is *not* self-evident for many individuals – even in so-called economically advanced countries (van Deursen & van Dijk, 2019). The first section elucidates the notion of 'access' in recent literature, followed by a section on our research approach. In the third section, the main author (Lanze) details his pathway towards, on, and away from a FutureLearn ExpertTrack to demonstrate different modes of access in education (i.e., funnelling, tracking, and diverging). These modes exceed questions about ensuring learners' internet connections, devices, and skills. In the final section, we suggest 'in/access' as a concept to consider accessibility as a sociomaterial and context-specific practice that is enabled and constrained by education platforms.

Platform access in open education

Open education studies have predominantly treated 'access' as a key dimension of openness, an alleged absence of several sorts of boundaries (geographical, financial, temporal, procedural) that limit people's benefits from educational resources. MOOCs, for example, are considered a form of distance education that would overcome the barriers and expenses of on-campus education (Blessinger & Bliss, 2016; Iniesto et al., 2016). Researchers have voiced enthusiasm and optimism about the potential of digital technologies to remove financial limitations that prevent utilising or retaining educational resources for free, and spatiotemporal ones stopping users from learning anytime and anywhere (Suresh & Srinivasan, 2020; e.g., Wiley & Hilton, 2018). These studies tend to regard access to education as a "fundamental human right" and refer to supranational organisations, like UNESCO, to legitimise their normative principles (e.g., Cronin, 2020, p. 10). Therefore, video and text-based courses on commercial platforms are often problematised for being closed as proprietary licences prevent sharing or adapting them (Moe, 2015; Stracke et al.,

2019). However, researchers and practitioners have not always acknowledged the inherent *technical* limitations of digital technologies deployed for boundary removal and how these hinder access (Rienties et al., 2022).

In response, *accessibility studies* have approached 'access' as an optimisable and universal precondition for education, typically focussing on either the technical or human side of access-related problems (Seale et al., 2020). These studies follow "universal design principles" to enhance the "web *accessibility*" of digital architectures by removing technical obstacles for all learners, especially those with one or more cognitive, sensory, or physical dis/abilities, or those with a learning disorder (Kurt, 2018, p. 207). Other improvements concern the user's "*access-ability*": the means, knowledge, and skills required to benefit from digital architectures and instruction (Cradduck, 2020, p. 648; Rogers-Shaw et al., 2018). For instance, MOOC instructors provide video transcripts to ameliorate users' self-directed learning strategies and comprehension of course materials (Zhu, 2021). Accessibility and open education studies thus constitute intersecting fields that discuss pertinent issues and make practical contributions but risk simplifying 'access' to a universal essence that something (accessibility) or someone (access-ability) holds (e.g., Fonseca et al., 2018).

Alternatively, critical studies on open education have repeatedly questioned hyperbole surrounding the claim that digital technologies simply contribute to more access or openness (by removing boundaries) and seek to reimagine related tropes (Bayne et al., 2015; J. Knox, 2013). Whereas open education platforms propagated boundary elimination, critical researchers only started to disentangle how multiple forms of openness are made *through and with* boundaries, including technical ones like the user interface (van de Oudeweetering & Decuypere, 2019). Some have suggested a conceptual move "from openness to permeability" to grasp how openings are made through *relations* between people and objects that can cross the borders of educational settings (Oliver, 2015).

Ribot and Peluso's (2003) *theory of access* suggests that researchers should empirically map the relations that constitute access, laying bare not just rights of individuals but also the "ability to benefit from things – including material objects, persons, institutions and symbols" (p. 153). This critical framing urges us to consider the ways, times, and places that people and material means make access possible, that is, how they configure access in specific circumstances. From this viewpoint, a learner's access to educational resources can be regarded as the result of social and material "relationships that can constrain or enable people to benefit from resources" in specific situations (Ribot & Peluso, 2003, p. 154). We therefore ask the following research questions: How is access configured as a mutual interaction between an open education platform and the user?

What modes of access do the platform and user configure concerning a sequence of online, vocation-oriented courses? And in what organisational situation do these modes of access emerge?

An STS approach to platform access in education

Focussing on the relations between human and other-than-human actors, the broad field of STS offers a theoretical and methodological vantage point to reimagine strict binaries, between the social and technical, the human and non-human, and acknowledge that such sharp divisions may blur in the messiness of reality (Mol & Law, 2002). One of STS's *fortes* lies in recognising how technical artefacts are constantly made, unmade, and remade as complex cultural imaginaries and socio-material practices. 'Configuration,' here, functions as a device to think "about the work of drawing the boundaries that reflexively delineate technological objects, and as a conceptual frame for recovering the heterogeneous relations that technologies fold together" (Suchman, 2012, p. 48). This means we are wielding a part this broad STS field and are using it as a 'sensitising device' (Decuypere, 2019a). The conjoint interactions, or 'configurations', of platforms and users are a suitable unit of analysis for scrutinising how the boundaries between presupposed usage of technology and its actual use blur in a specific situation. This specific inquiry will involve four analytical dimensions (usages, interfaces, knowledges, and ecologies), partly based on the methodological toolbox we covered before (Decuypere, 2021), to help us scrutinise how the user and platform configure access to knowledge resources in particular situations.

Platform usages, interfaces, knowledges, and ecologies

Digital platforms have spread across many domains of life and tend to become taken-for-granted infrastructures, even though they (re)organise interactions between people, institutions, and companies and create value by doing so. From an STS perspective, platforms are not defined *a priori* but are understood as a "set of relations that constantly need to be performed" (van Dijck, 2013, p. 26). The interest here is not just in any sort of platform but in those primarily located in education (hereafter: education platforms). Critical studies refrain from the assumption that platforms act similarly in each domain and, instead, closely examine their data-driven architectural and organisational specificities, their ways of (pre)structuring educational practices such as learning and, as we will argue, access (Decuypere et al., 2021). The goal of critical education platform studies is thus not (only) to articulate what education platforms are but (equally) what they *do* in relation to other actors *in situ*.

Given these general insights, the first analytical dimension concerns the presumed and actual *usage*, referring to the idea that the "user's character, capacity and possible future actions are structured and defined in relation to the machine" or, in this case, platform architecture (Grint &

Woolgar, 1997, p. 97). Research on open education platforms argued the user is *figured* or presumed to act as an 'open learner' and engage with the interface for open learning (e.g., taking quizzes, watching videos) (Decuypere, 2019c). The user can equally be *configured* when using the platform according to the designer's expectations. Research on data visualisations has shown that educators are encouraged to interpret student data using visualisations and, consequently, are configured as 'data users' (H. Ratner et al., 2019). Bringing the (con)figured user into focus permits analysing how the digital education platform and user make access through conjoint interactions, as prescribed by the interface's design and enacted in multiple ways.

The second dimension entails the *user interface*, a "boundary" and "point of conjuncture" between users, programming, designers, resources, and other entities. As part of a platform's sociotechnical architecture, the interface is made of "symbolic handles", orderings of visual and textual elements that enable and constrain the user's access (Cramer & Fuller, 2008, p. 149). Previous research questioned a data platform's hyperbole about creating "more democratic access to information" and showed how interfaces (re)configure relations with users by consolidating rather than transforming access (Gorur & Dey, 2021). Focussing on what happens vis-a-vis an open education platform interface allows analysing how a boundary becomes important in educational practices and making access instead of assuming its removal (van de Oudeweetering & Decuypere, 2019).

The third dimension concerns the forms of *knowledge* people make with representational technologies (i.e., the platform architecture) while moving across an educational setting (R. Edwards, 2015b; Nespor, 1994). Knowledge, here, points to the interested activity of many actors, "constructing and ordering a world in which that knowledge can hold as valid and true", rather than a disinterested individual activity (Gorur et al., 2019, p. 7). Academic knowledge resources can invoke political consequences by giving (some) learners "access to labour opportunities, group or network membership, or privileged physical access to resources" (Ribot & Peluso, 2003, p. 169). Research has criticised how Western universities gain a central position on MOOC platforms and, consequently, advance their ways of knowing over other, "indigenous knowledges" from different settings (Adam, 2019). An analysis of platform access thus benefits from recognising how people and materialities get mobilised for/in knowledge-making, which is rarely a neutral practice.

The final dimension situates platform access in a wider *ecology* of public and private organisations that "engage in complex, opportunistic relationships with one another" and transform because of that engagement (H. Ratner et al., 2019, p. 32). Access to materials and knowledges is configured by a "web of relations" that (dis)allows "actors to gain, control, and maintain" them (Ribot & Peluso, 2003, p. 154). Whereas these four dimensions provide theoretical

foci to investigate the ways access is made through user-platform interactions in a field of relations, we deploy specific methods to take up the user role ourselves and elucidate access in everyday situations.

Methodology

STS also provided methodological inspiration as we concentrated on a bounded case and followed ethnographic principles (Suchman, 2012). Autoethnographers progressively use digital/visual materials (e.g., diagrams) to detail the relationality and socio-materiality of the practices they co-constitute and are part of (Coleman, 2021). We have drawn on earlier autoethnographic explorations of an education platform in which the first author assumed a user role and investigated, from his embedded position, how other actors (too) became important in education practices (Lange, 2021). We performed visual and digital autoethnography to scrutinise access regarding a FutureLearn ExpertTrack, a sequence of three vocation-oriented courses about programming. We attended to the relations between the user and the platform, visualised practices of interest, and analysed them without necessarily prioritising the author's actions over other actors.

The first author performed a six-month autoethnography and practiced multiple methods. *Websites* were analysed to situate platform access in a broader ecology, and a graphic user interface *walkthrough* was performed to map (expected) usage: selecting and enrolling in a track, registering a profile, moving towards content and engaging with it (Decuypere, 2021). Because platforms tend to become natural aspects of the user's day-to-day life, remaining attentive to their workings and values is challenging (van Dijck, 2013). A research protocol helped collect data and pay attention to the relationship between the user/researcher and the platform architecture (Appendix A). Some of the guiding questions for that purpose were: (1) What does the user do with the platform? (2) What does the platform do with the user? (3) What pathway did the user take? Fieldnotes and screenshots were made to capture and reflect on interactions with the platform (e.g., clicking, reading, listening). *Visual methods* helped "make the familiar strange" for the researcher, enriching his understanding of the research setting and contributing to analytical arguments (Mannay, 2016, p. 28). Making diagrams allowed the researcher to engage in an iterative, 'slowed-down' process of familiarising himself with the platform and mapping the composition of practices (cf. J. Law, 2004). The diagrams were also drawn to create a de-familiarising effect that (temporarily) interrupted taken-for-granted situations. Relations were visualised with software called Gephi, meaning diagrams show actors as colour-coded nodes and their interdependencies as lines. Adding background colours helped show that and how divisions between humans and other-than-human actors blur in practice (see Decuypere, 2020). The next section will repeatedly introduce diagrams

and vignettes to present descriptive findings, followed by inferences about an ecology and modes of platform access in education.

The case of FutureLearn

Increasing and transforming access to education has always been an outspoken mission of FutureLearn. The commercial platform was founded back in 2012 by the Open University of the UK, one of the world's most well-known open education organisations, and meant to "bring together a range of free, open, online courses from leading UK universities, in the same place and under the same brand." As mentioned before, providing access was initially associated with a socio-political project of offering free education to a wider (inter)national audience through the affordances of web 2.0 technology. In April 2019, FutureLearn became co-owned by the Seek group, an organisation interested in employment, technology, and learning businesses and co-investor of the Coursera platform. It is in this constellation of several public and commercial actors that FutureLearn progressively provides access to educational resources that no longer bear the 'open' label.

Situating FutureLearn in an access ecology of (new) education organisations

> The joint venture is situated in a particular ecology (see the diagram in Figure 1), an entanglement of education organisations shaping access to a new type of education resource on the platform: ExpertTracks. The collection of partnering organisations, including the Open University, represents the "world's leading universities and companies" and contributes to FutureLearn's resources (see nodes on the diagram). The platform upholds three different subscription plans that set the financial conditions for participation during ExpertTracks: short courses, micro-credentials, and online degrees. Two "free" and "upgrade" plans permit course access for the length of its duration and offer the possibility to get certification. The "Unlimited" plan grants access to approximately 1000 short courses for a whole year, allows learners to retain materials from the course after completing it successfully, and offers certification on top of it. In January 2021, FutureLearn introduced an additional, limited subscription plan that authorises access to one of its new 104 ExpertTracks, self-paced pathways of several months – or between 20-120 hours of learning – during which learners acquire "knowledge and skills for a profession or a hobby." ExpertTracks are promoted as a series of multiple courses meant to let learners "build practical expertise" about a specific subject (see green nodes) and work towards certificates that may interest (future) employers.
>
> ExpertTracks are listed in a catalogue, categorising each track according to a knowledge subject and organisation that creates or endorses access to the product (see the lines between nodes). The "universities and specialist organisations," as FutureLearn calls its partners, typically delegate so-called experts who can acts as instructors. Some organisations contribute to several ExpertTracks across different subjects, such as "Business & Management", and therefore take up a more prominent position in the catalogue than others (see large nodes). Similarly, some subjects and tracks have more or fewer contributing partners. The subject "Politics & Society", for instance, has less creators/endorsers and occupies a rather modest part in the catalogue compared to "IT &

> Computer Science" (see smaller nodes). The Software Development track I enrolled in was created by FutureLearn itself, in collaboration with an American software company (MuleSoft), and endorsed by a British public institution (Coventry University). The track is positioned in the "IT and Computer Science" subject and promoted via a website, social media platforms, and newsletters. Users are presumed to go on an "infinite" and "lifelong" journey with a vocational outlook on learning: improving their work skills, curriculum vitae, or job opportunities. In short, I am supposed to subscribe for work or a hobby and become an expert in whatever subject I choose to pursue.

These descriptive findings show how an ecology of new and more established educational organisations figure access in a standardised manner, leading to 'unlimited' learning that makes users 'experts'. First, education platforms use standardised categories and concepts to establish and maintain specific educational forms: "they make educational practices dividable, intelligible, knowledgeable, and actionable" for the user (Decuypere et al., 2021, p. 7). The somewhat stable architectural core allows commercial platforms to gain importance in the educational field (Lange, 2021) and gather various producers and consumers for a potentially long, diverse sequence of courses. FutureLearn's core is standardised so it can act as an intermediary in a relational landscape of partner organisations (i.e., universities, colleges, companies, NGOs) that provide a variable number of resources or modules (i.e., ExpertTracks) that fit the categories. Second, as others have argued, commercial platforms tend to be explicit about their ideals regarding the creation of more inclusive, accessible education but implicit about the specific forms of learning and teaching they shape (Grimaldi et al., 2023). Knowledge resources are accessible on the condition that learners subscribe, pay, and are willing to be taught by *company* experts. While relations between education platforms, universities and colleges are not new (Thomas & Nedeva, 2018), the case of FutureLearn shows that sharp distinctions between public and private interests conflate amongst rather traditional education organisations *and* those that are relatively new to the education scene.

Whereas other platforms gather organisations and users in an 'information ecology' to share data (H. Ratner et al., 2019), the diagram in Figure 1 shows how organisations and knowledge subjects get entangled and involved *making* access conditional. What is at stake with FutureLearn is that regardless of the different interests that organisations or users in the ecology may have, platform access to knowledge resources is systematically figured through standardised categories and vocational goals of turning learners into so-called experts. The open education platform thus becomes a central part of an *access ecology,* shaping strategic relations between organisations and the modalities under which users can and should enter education.

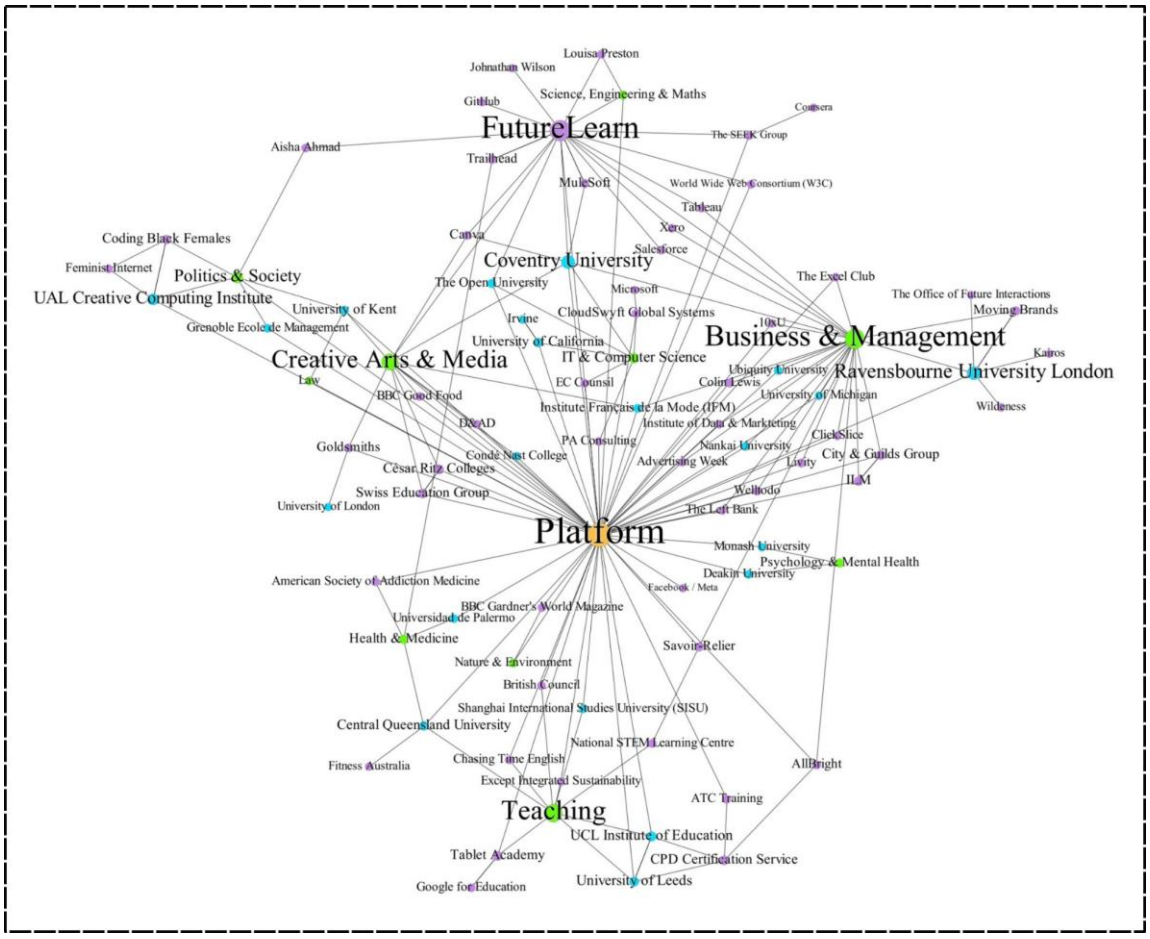

Figure 1. The composition of an ecology of organisations shaping access to ExpertTracks.

Using the Gephi software, universities and colleges are depicted as blue nodes, specialist organisations as purple, and course subjects as green nodes. The relations are visualised as lines and indicate a contribution regarding the (co)creation, endorsement, or accreditation of a track. The nodes vary in size depending on their number of relations.

Converging on the platform: How access becomes a funnelling of the user

> The following vignette shows what the platform does and makes me, Lanze, do upon entrance in the autumn of 2021. My pathway towards the Software Development track is related to personal and professional interests: I am looking for introductory courses on computer programming because I have volunteered to teach a practical session about open-source code at my faculty. According to the platform, I am a "Future learner" who enters an "international community of online learners and experts" while engaging in the social, lifelong, and life-wide activity of "Future learning."
>
> I begin my path on the home interface, a menu and footer circumscribing the top and bottom of most screens, encouraging me to browse courses, subjects, micro-credentials, and ExpertTracks (see diagram on Figure 2). The menu unfolds graphical and hypertextual buttons that urge me to "upskill with a series of specialist courses". At the centre of the screen is a banner with a picture of a single learner, inviting me to "explore ExpertTracks" (see orange node), the "career-changing courses with a flexible monthly subscription and 7-day free trial". Following this option leads me to a catalogue interface with more yet specific selection possibilities (Figure 3). Its grid-like database of over a

hundred items arranges each track's information in a standardised and alphabetised manner: from "Addiction Medicine" to "UX Design Strategy and Application." The ExpertTrack called Software Development is one item in that grid, indicating a creator (FutureLearn), partner (MuleSoft), title, description, number of courses included, expected duration, and level. Whereas the home interface pointed to differing options, the buttons of the catalogue interface entice me to "find out more" about one specific resource (see orange node).

Doing so reveals an information interface with more and specific details about the selected track (Figure 4); the interface displays the Software Development track's topics, learning outcomes, job market, requirements, course structure, certification, didactic team, and user manual. The possible options are further reduced to a colourful button that seemingly follows me as I scroll and urges me to "start my free 7-day trial" (see orange node). Clicking the button leads me to a bare registration interface with even fewer differing possibilities to select (Figure 5). The menu and footer that circumscribed the screens so far have disappeared. There are two options: completing a form with personal details and utilising the "register with Facebook/Google" buttons (see orange node). Selecting the Facebook button pulls my name, age, email address, and password from the social media platform and authenticates the access. Clicking the button confirms that I am over 16 years old and agree with FutureLearn's terms and conditions, privacy policy, and code of conduct. The knowledge materials about software development become visible only after I have entered my credit card details.

The vignette and diagrams detail how the platform architecture and user *configure access* as *funnelling*; that is, how the user pushes seemingly neutral buttons on the graphic user interface to reach educational resources and is simultaneously *being pushed* by them. Originating from marketing theory, 'conversion funnels' on commercial platforms are architectures that nudge potential customers on trajectories that conclude with a purchase (Clow, 2013). The FutureLearn platform transitions users into a funnel with (hyper)textual and visual elements, a carefully ordered sequence of barriers in accordance with the designer's goals. Platforms set meticulously planned "parameters for the users' actions" through which they configure the user in ways that match the expectations of their designers (Grint & Woolgar, 1997, p. 71). From a designer's perspective, funnels typically open with a problem (e.g., the user needs to choose) and end with a solution (e.g., display interesting information to make the user choose). The user is eased into the funnel and meant to pass the barriers with as little friction as possible to complete desirable actions – in the eyes of the designer (Ash et al., 2018). The descriptive findings highlight that the user encounters key points where the navigation is interrupted, and increasingly specific options should be selected (e.g., a particular ExpertTrack). Platform architectures thus pre-select possibilities and encourage users to select them: user data and money are exchanged for being registered as a "Futurelearner" and allowed to converge at specific resources.

As the user moves the cursor or finger over the interface to access resources, *multiple platforms gain access* to the user and a more powerful position. In a technical sense, improving

accessibility involves making interactions with digital architectures "more effective, smooth, and coherent" for an extensive user base (Kurt, 2018, p. 204). The "user-friendly" interface design makes connection points possible to resources, peers, experts, and other platforms (cf. Cramer & Fuller, 2008). The registration procedure in which Facebook functions as authenticator is perhaps exemplary. In line with web accessibility guidelines, the "register with Facebook button" is meant to make user registrations accurate and convenient for anyone. However, as research has argued, platforms are not only "user friendly" but equally are "*making* the user friendly" by encouraging specific actions for specific purposes (Gorur & Dey, 2021). Large platforms, like Facebook, offer so-called "open authorisation identity services" and act as standardised keys to make other platforms more accessible. An existing user profile from the social media platform is instrumentalised to access and extract personal data (e.g., name, age, likes) and automatically complete the education platform's profile registration (De Reuver et al., 2018, p. 130). Clicking the authorisation button means the user can move onto the education platform's architecture and modular content, but the platform equally accesses a repository with user data. The user and education platform hand control over to the social media platform in favour of having a convenient skeleton key to open/close education.

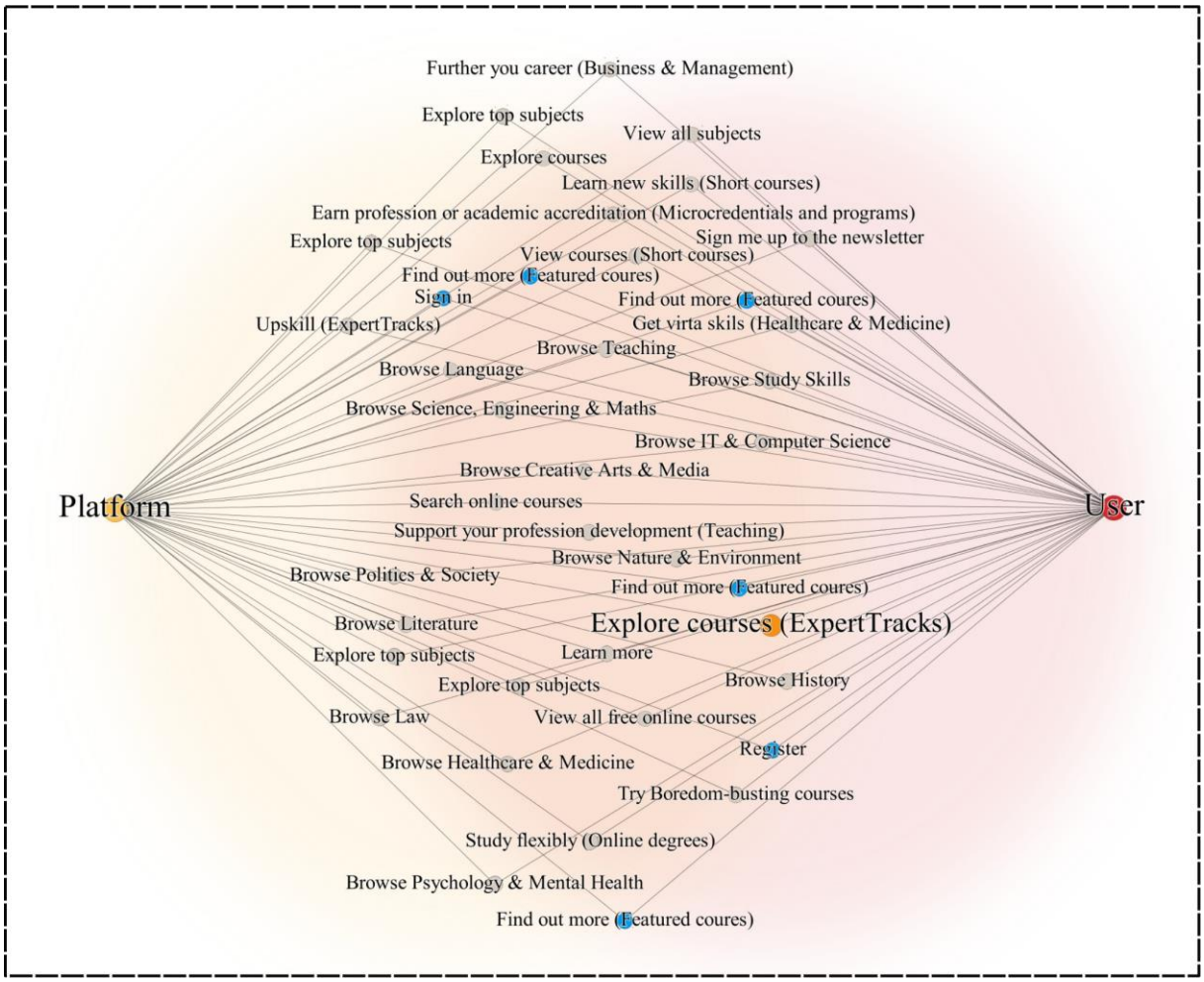

Figure 2. The composition of the home interface when the user browses the platform.

With the help of Gephi software, the user is depicted as a red node, while the platform is marked as an orange one. The grey nodes show interface buttons leading the user to a wider variety of information, the blue nodes refer to a reduced diversity of information, and the orange node indicates the selected trajectory. The colorised backgrounds indicate points of convergence, an interface between the user and the platform.

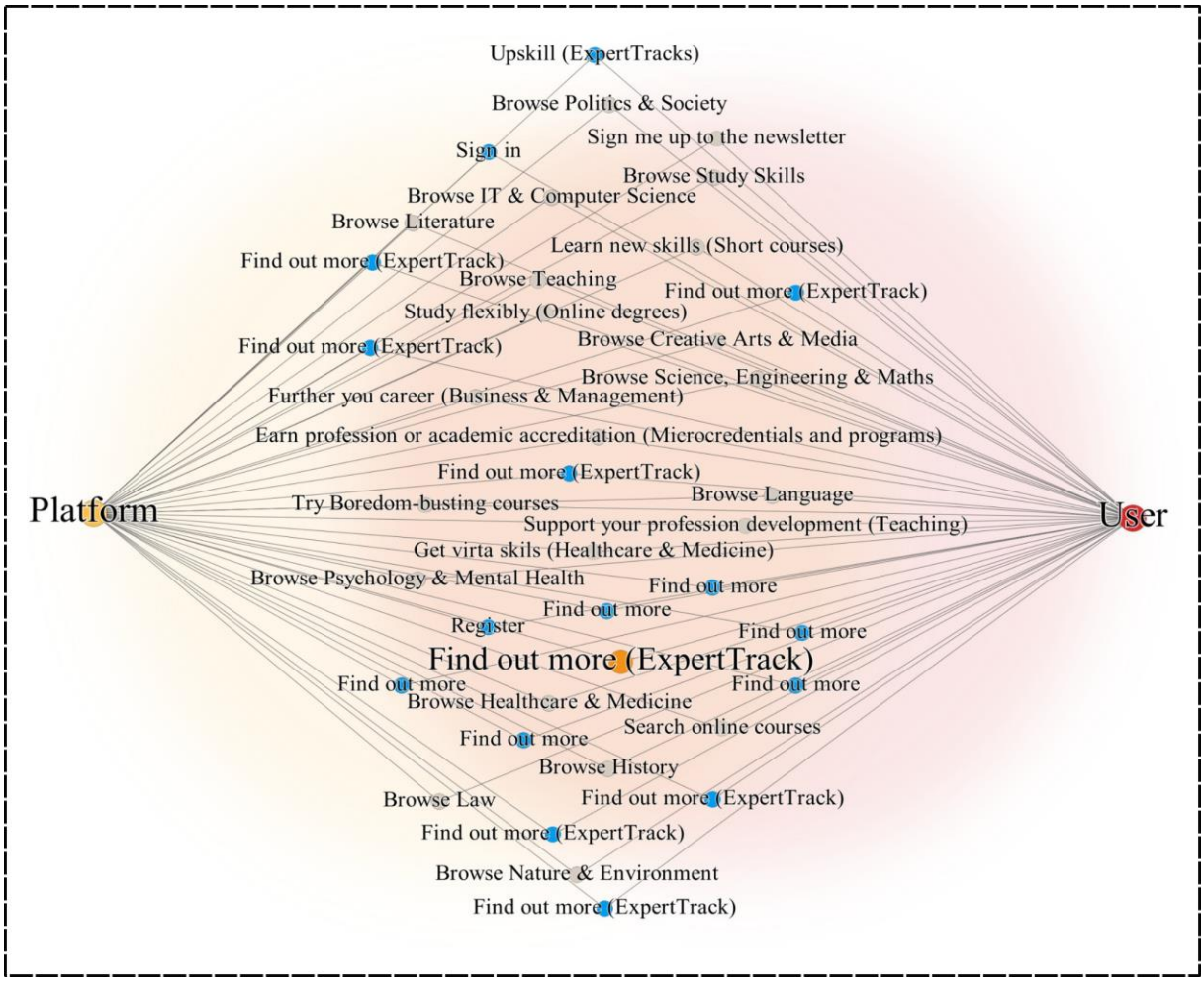

Figure 3. The composition of the catalogue interface when the user explores content on the platform.

Again, and thanks to Gephi software, the user is depicted as a red node and the platform as an orange node. The grey nodes show interface buttons leading the user to a wider variety of information, the blue nodes lead to a reduced variety, and the orange node indicates the user's selected trajectory. Like before, the colorised backgrounds (red, orange, and yellow) mark an interfacing of the user and the platform.

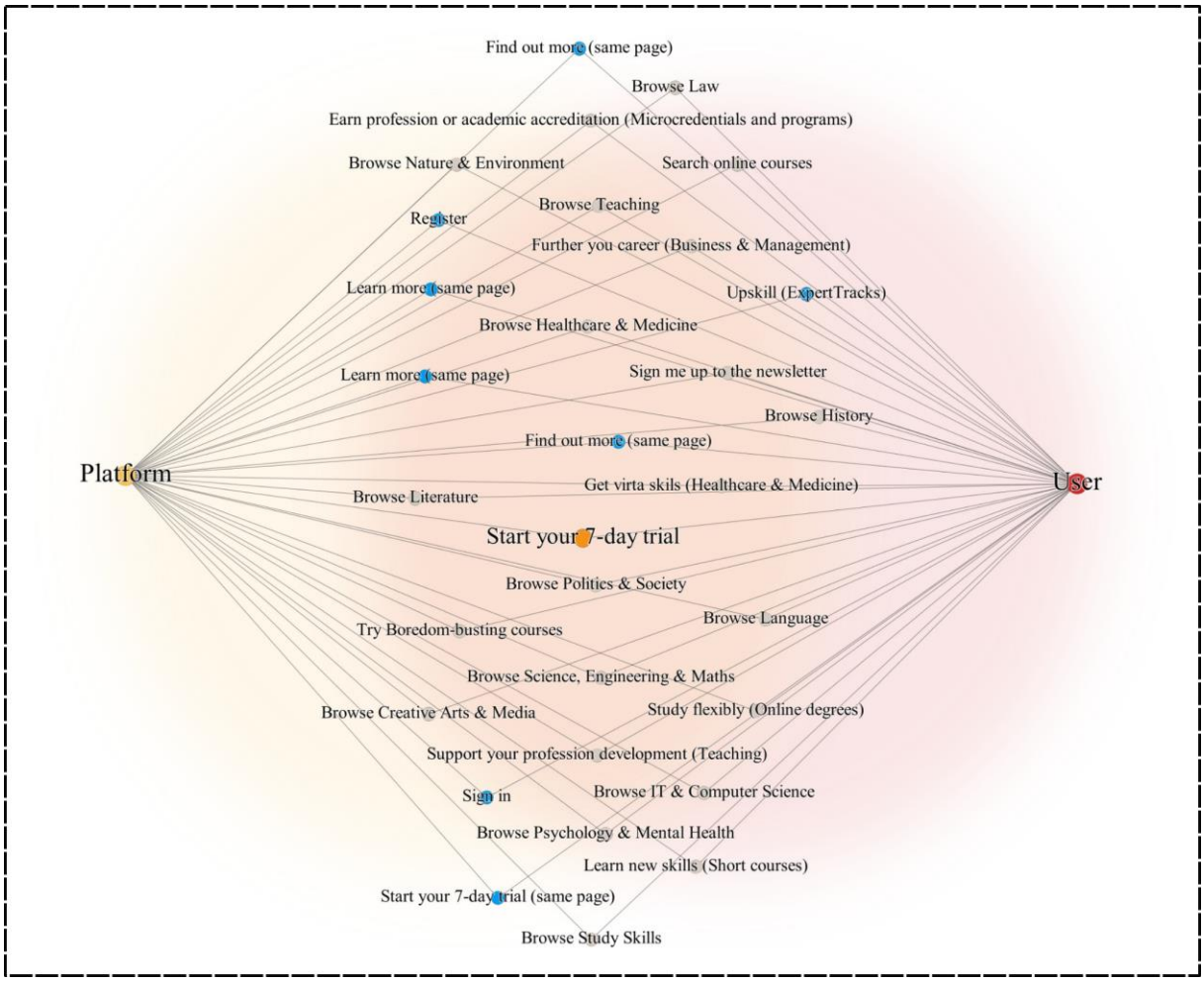

Figure 4. The composition of the track information interface when the user chooses platform resources.

The affordances of the Gephi software permitted us to visualise the user (red node) and platform (orange node). The grey nodes show interface buttons leading the user to a wider variety of information, the blue nodes lead to a reduced variety of information, and the orange node in the centre of the diagram indicates the user's selected trajectory. The background in red, yellow, and orange, suggest a coming together of human and non-human actors.

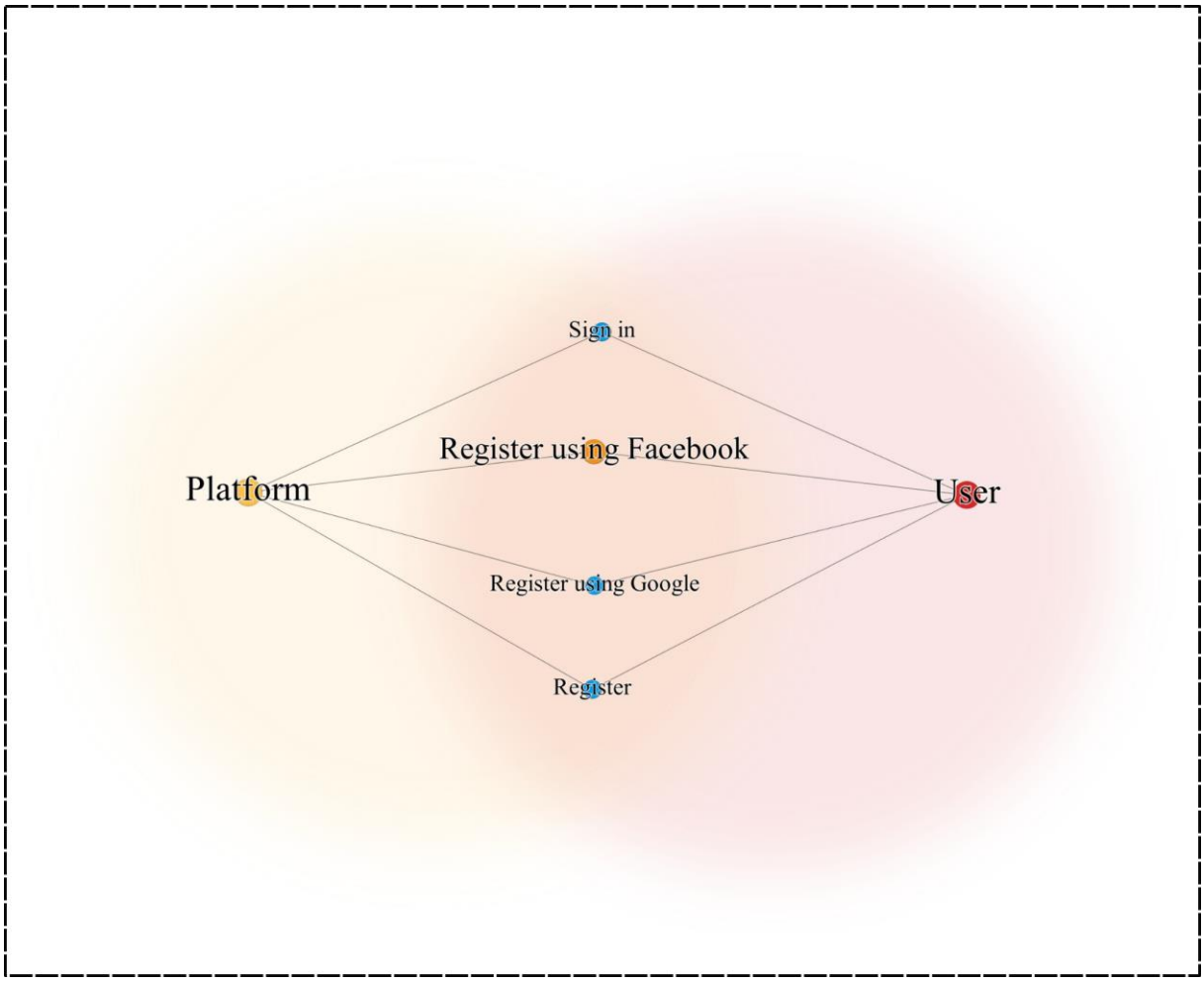

Figure 5. The composition of the registration interface when the user registers to the platform.

Here, too, the diagram presents the user and platform on opposite sides (coloured nodes right and left). The grey nodes show interface buttons leading the user to a wider variety of information, the blue nodes lead to a reduced variety of information, and the orange node in the middle indicates the user's selected trajectory. The background colours yellow, red, and orange characterise the blurry boundary between the user and platform.

Tracking across the platform: Access as monitoring and grouping the user

> The following vignette zooms in on what happens after FutureLearn opens up and lets me view the ExpertTrack on software development. The learning interface announces that I have joined a community of "Futurelearners" and encourages me to complete three courses about software development (Figure 6). The interface connects me to the course program and materials, my to-do list, progress monitor and profile, and other Futurelearners. These learners are expected to engage in social learning, a practice portrayed "as easy and natural as chatting with a group of friends." I am expected to contribute to the social learning of others by asking questions and commenting on messages displayed beneath the course materials. Those materials are divided into weekly modules that culminate in a formal online assessment (a multiple-choice test) and, possibly, certification. Learning involves reading texts, watching videos, making tests, and performing short exercises formulated in course modules (see blue nodes). Linear, oscillating cursor or hand movements characterise interactions with the platform: vertical to scroll up and down or horizontal to press the 'previous' and 'next' buttons. Before moving to another module, I am expected to check boxes and indicate my completion of another "step" on the track (see orange nodes). Every step is converted into a representation of the track's completion rate on the progress monitor.
>
> The Hypertext Markup Language (HTML) course, the first of the software development courses in the ExpertTrack, introduces a standardised type of source code, a language to present information in a web browser or app. Sitting in front of a laptop screen, one of the first modules introduces me to the topic of software architecture and computer programming vocabulary. To get familiar with HTML, I am asked to "right-click on any blank section" on FutureLearn and select "View source." A new window opens. My Firefox browser fills with lines, symbols, characters, and words; the platform's "behind the scenes". As I look up and down the code, the buttons I have been using to navigate the track have turned into HTML, with its typical hyperlinks.
>
> The hyperlinks are also intertwined with a scripting language called 'Ahoy', frequently associated with so-called "tracking cookies" across the platform. FutureLearn explains in its privacy policies that cookies enable the capturing and processing of data about the learner's clicking behaviour for optimisation, marketing, and advertisement. The platform allows users to refuse functional, targeting, and performance cookies via the settings. "Strictly necessary cookies", required to log in or complete forms, do not store personal data but also cannot be refused without completely blocking access to the platform. As my browser's privacy settings have been set to the strictest level, I encounter a picture on the platform showing a dog, a bowl of chocolate chip cookies, and a subscript saying: "You've got a cookie problem. To use FutureLearn, you must have cookies turned on."

The vignette and diagram point to a mode of access that can be understood as *tracking* the user in two ways. Nowadays, 'tracking' is commonly associated with cookies on platforms and websites that allow designers to *monitor* a wider variety of user-interface interactions – with or without the user's consent. Research has mentioned that cookies and analysis software permit capturing, processing, and examining user data. Emblematic is tracking the digital technologies (e.g., browser) used to access a platform, users' geographical point of origin, and the buttons clicked

along the way (Ash et al., 2018; van Dijck, 2013). In education, turning user behaviour on/with a digital architecture into data – typically referred to as datafication – has raised concerns amongst some critical scholars. Indeed, the commercialisation of learning data on open education platforms has led to questions about how users' (initially free) access to online courses results in data being traded with third parties (van Dijck & Poell, 2015). There is an ongoing debate about user privacy when data and digital technologies are deployed for surveillance: the hard-to-notice 'dataveillance' of large user groups has been criticised for the identification and measures that data make possible (Selwyn, 2015). When platforms refer to "educational tracking" as a normal process, "a natural data extraction", they risk obscuring other relevant issues (Yu & Couldry, 2020, p. 127). Access on and to platforms involves a seemingly natural degree of (self) monitoring or tracking of the learner that simultaneously configures them as data users and producers (cf. H. Ratner et al., 2019). Granted that FutureLearn communicates transparently about which cookies are used and for what purposes (e.g., privacy policies, the whimsical picture with chocolate cookies, self-monitoring tool), the monitoring work becomes a normalised, (in)visible part of the programmed architecture.

At the same time, speaking in terms of 'tracks' also resonates with curriculum thinking as the 'track' implies a convergence of specific learner *groups* on the same path, interacting with the same materials and each other while doing the same educational activities (Nespor, 1994). 'Tracking,' as a way of ordering educational activities for learners with specific interests or abilities, has stirred heated debates in compulsory education about how students get in/excluded from vocational or academic curricula according to (sometimes contested) selection processes (Domina et al., 2019). Regarding FutureLearn, the learner relates to a vocation-oriented track and peers who share similar interests and abilities given the courses' introductory level. On the one hand, staying *on track* is valuable for the learner. The platform provides vocation-oriented materials for knowledge-making, which can be recognised as valid because they are delivered by a company in a relevant sector (cf. Gorur et al., 2019). We saw earlier that an IT partner and FutureLearn provide the ExpertTrack. On the other hand, learners are also *made* to stay on track through the platform architecture. The interface installs a "funnel of participation" to keep the learner engaged after registration and avoid the high dropout rates that MOOCs so frequently suffer (Clow, 2013, p. 185). In sum, platform access entails tracking in a double sense: the learner is grouped and is *being grouped* according to particular interests and abilities, and is invited to self-monitor steps and *be monitored* on a predefined pathway.

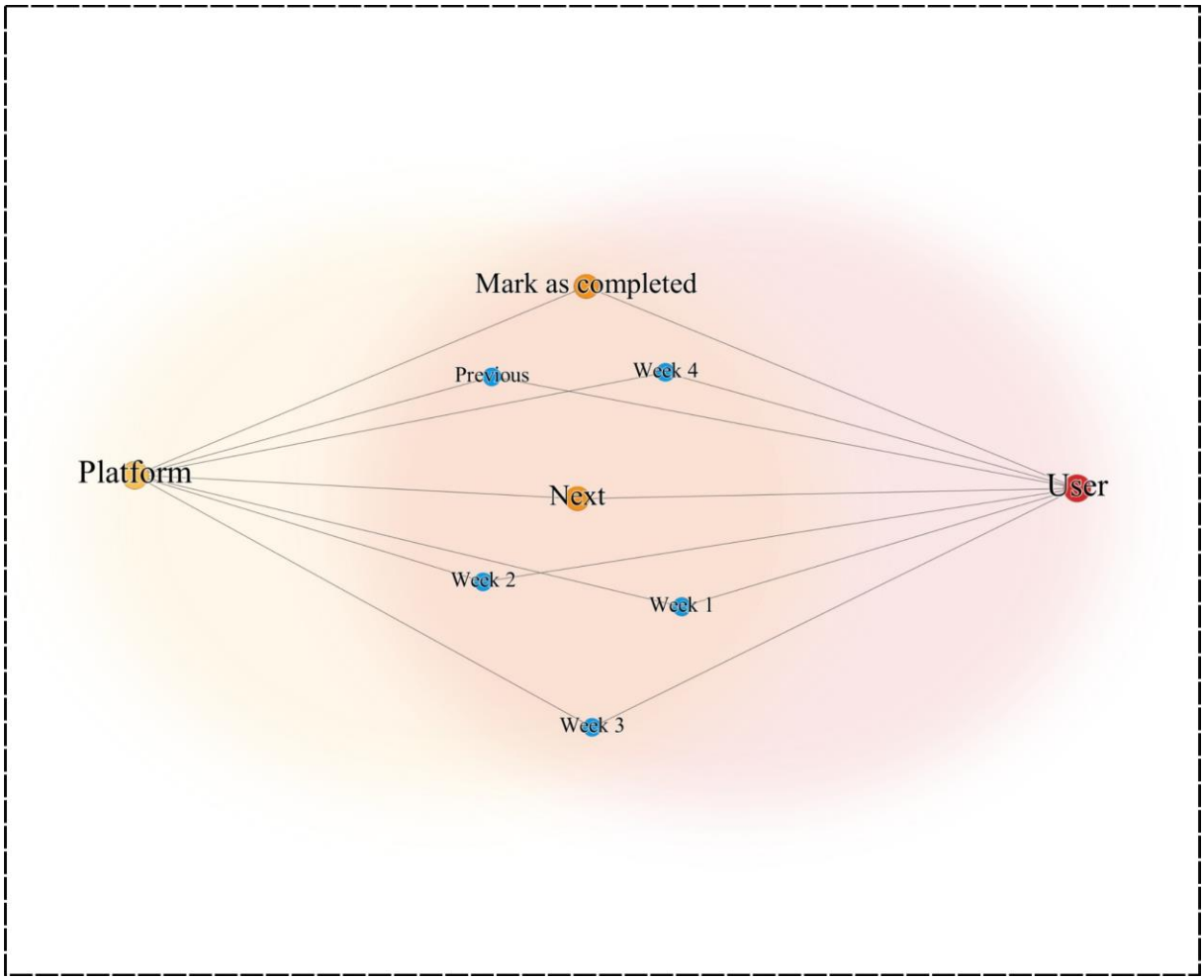

Figure 6. The composition of the learning interface when the user moves on the platform's track.

The diagram was made with Gephi to show the composition of the user-platform relations (coloured as a red and orange node on the opposing sides of the figure). The blue nodes indicate buttons leading to the track's preselected content, and the orange nodes indicate the user's selected trajectory.

Diverging pathways away from the platform: The user's improvised access

> This final vignette focuses more on what happens as I engage with the course materials on the pathway and during the ExpertTrack's project assignment. In each of the three courses on software development, I am invited to create an app using the knowledge, skills, and tools I have gained so far. The general assignment stimulates make-believe, during which I am "leading a team of developers at a small software company." My imaginary manager asks me to create an app prototype for a large organisation, and my team "has suggested creating an online shopping list." I am expected to design and develop the graphic user interface for the app by considering its technical requirements, programming language, architecture, prototype testing, and "assessing the accessibility of the HTML." Web accessibility is a key topic in one of the courses and the platform's policies. For instance, the course text refers to The World Health Organisation and argues that web accessibility is important because many have a "deficiency ranging from visual and auditory deficits to cognitive and motor difficulties." FutureLearn's accessibility policy ensures that people with a disability can access the platform by following an international standard: the Web Content Accessibility Guidelines (WCAG 2.1.) issued by the World Wide Web Consortium (W3C). The W3C has been providing various internet standards for decades and encourages web designers to create more perceivable, operable, understandable, and robust interfaces.
>
> While the platform allows me to engage with materials and peers on the interface, there are also links to resources that fail or must be manually (re)made. As the course project involves memorising and applying knowledge about project management and different kinds of coding language, I am required to access resources on and away from the platform. At times, no (working) hyperlink is embedded on the ExpertTrack, forcing me to search for certain external information and software via a search engine. Software and information that needs to be used every week are not provided on the platform as a ready-at-hand collection of resources. To complete the project, I thus need to make my own "toolbox" by copying essential information to a text file and forging my own interface, with hyperlinks and shortcuts, to (external) resources (Figure 7). FutureLearn's course materials thus get (re)made into a collection for personal use. My project's design (the shopping app) is consequently shaped with technologies found elsewhere: web accessibility guidelines, but also editor software (Notepad++), W3C services and coding manuals, links to an online developers' community (Stack Overflow) and source-code repositories (Github).

This vignette shows that, besides the platform's alleged "web-accessible" design, the user also plays a role in (un/re)configuring modes of access to resources away from the programmed architecture. From a first vantage point, the course materials and the platform's policies on accessibility suggest that the learner's task is to become acquainted with the technical aspects of designing a digital architecture by considering accessibility standards (i.e., WCAG) and using suitable testing software. 'Access' resonates with narratives from accessibility studies arguing that providers and designers are primarily responsible for eliminating technical boundaries that prevent learners with one or more dis/abilities from using technology (cf. Fonseca et al., 2018; Kurt, 2018). While the attributing responsibility to a professional is justified from a legal viewpoint, the user is expected to become a learner and acquire the proper technical knowledge, skills, and competencies

(e.g., coding knowledge). Consequently, the ExpertTrack suggests strictly separating user and designer roles where the latter is believed to have gained the necessary knowledge to make technology "accessible".

Another vantage point in the vignette is the *diverging* or makeshift pathways that emerge in practice and blur some boundaries between 'the user' and 'designer.' STS have drawn attention to how a "divergent infrastructure" begins to take shape, a range of alternative, unexpected or improvised pathways that users make with materials at hand (Soliz, 2021, p. 11). The descriptive findings detail how the user is presumed to "jump" from the platform to other resources, visit external pages, and use software to complete the project assignment. The user needs to improvise interfaces to these external materials because certain hyperlinks failed to work or were not provided (e.g., copying and pasting information in a separate file; creating shortcuts on the desktop). The practice of diverging concerns is not only an act of moving away from the sociotechnical architecture because it creates a mismatch with the user for a particular purpose; it equally concerns *designing* access to a different set of technologies in unexpected ways.

The user is first unconfigured by acting in "violation of the configured relationship users are encouraged to enter into" (Grint & Woolgar, 1997, p. 93). The encounter with scattered content and broken or absent hyperlinks led to a violation of the rules: copying content under a proprietary licence to a personal document and constructing alternative pathways to a set of tools. The learner reconfigures their role and the architecture when finding ways to engage with learning materials. Perhaps that role can be understood as that of a *modder*, someone who makes unexpected modifications to a piece of existing technology in an amateur rather than professional manner (Denham & Guyotte, 2018). The figure of the modder offers a way of thinking about access besides gaining knowledge about (technical) accessibility; it conflates the roles of user/designer or consumer/producer because diverging from the platform involves working on the boundary of what is (un)expected in following and making pathways required for educational activities. 'Access', then, is about remaking financial, geographical or technical barriers but also an improvised way of relating to technology not reserved for one particular group of people.

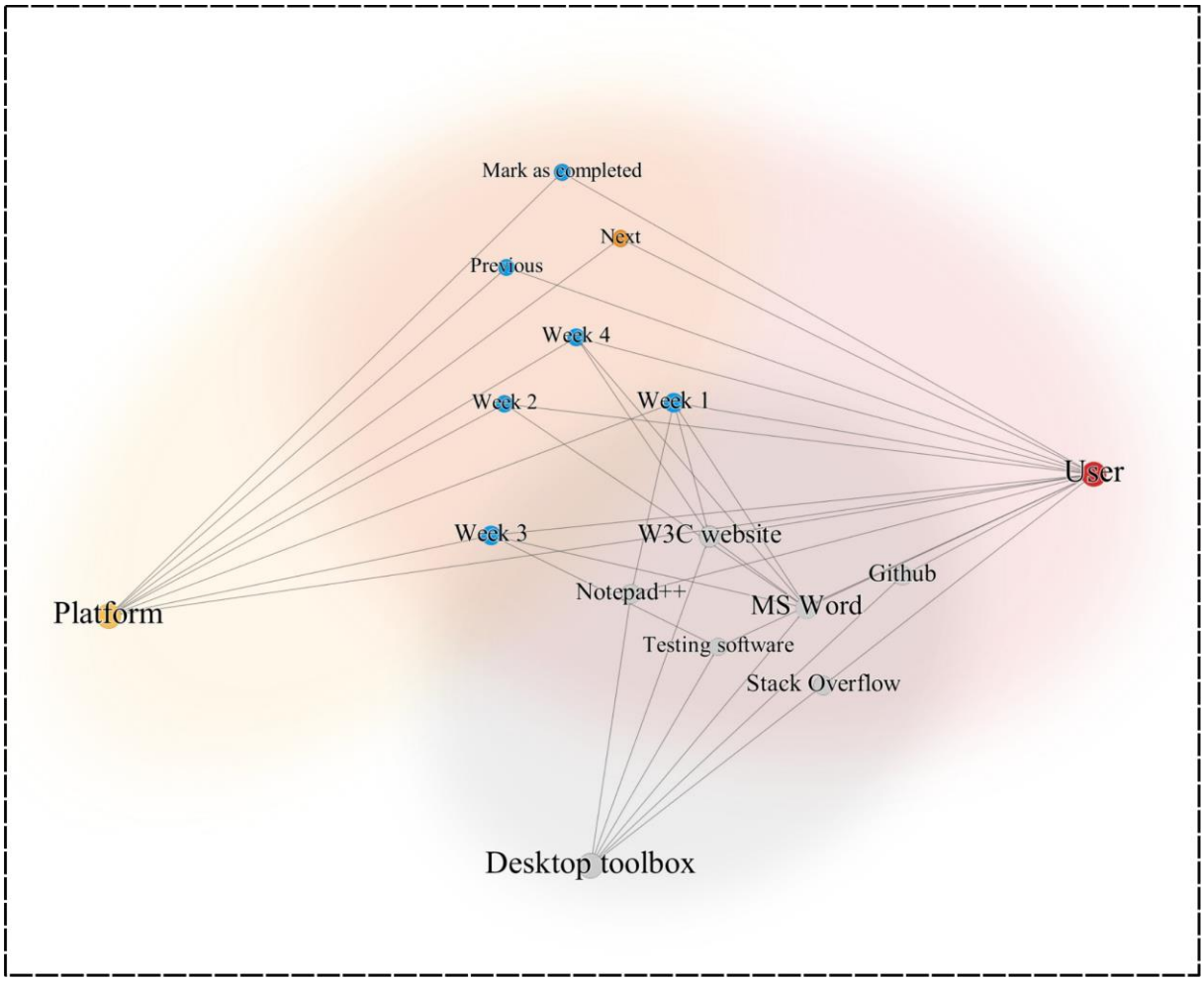

Figure 7. The composition of the improvised interface when the user diverges from the platform.

The diagram is made with Gephi and depicts not only the platform (orange node) and user (red node) but also the improvised toolbox on Lanze's computer desktop (grey node). The blue nodes indicate buttons that lead to the track's preselected content, the grey nodes indicate software (buttons/shortcuts) towards and away from the platform, and the orange nodes indicate the continued course trajectory. The usual background colours (red, yellow, and orange) that indicate the user-platform interface are now mingled with an additional one (grey) to highlight the improvisation.

Concluding discussion: From 'access' to 'in/access'

We started this chapter from the contention that 'access' refers to various debates, imaginaries, and practices regarding who is (un)able to benefit from resources and educational environments, something of particular importance for open education platforms. The chapter thereby connected to an issue identified in the literature called crowdification, the trend that a growing number of people is seeking higher and vocational education, often organised by means of digital education platforms and massive open online courses(de Andrade et al., 2023). The field of open education, both in theory and practice, has been characterised by attention to (and pursuit of) eliminating boundaries that would deny people access to such resources and environments (Blessinger & Bliss, 2016). While the normative goals of creating more openness and accessibility to/with technology may appear self-evident and desirable, critical studies have forcefully shown some ambivalences that might be overlooked when turning to such concepts and practices (Bayne et al., 2015; R. Edwards, 2015b; Oliver, 2015; van de Oudeweetering & Decuypere, 2019). We adopted a relational vantage point, cross-fertilising a theory of access and STS, to consider how various actors enable and constrain access under specific circumstances (Ribot & Peluso, 2003). Using the theoretical and methodological resources of STS as sensitising device (Decuypere, 2019a), we have argued that 'access' can be understood as a mutually constituted practice, being *done* or configured by human and other-than-human interactions in specific situations (Suchman, 2012). The STS approach allowed us to visualise and analyse access by focussing on mundane interactions towards, across, and away from the FutureLearn platform and viewing those as embedded in an ecology of education organisations.

It is becoming increasingly clear how an ecology of public and private actors (re)shapes and (de)stabilises the conditions under which educational professionals perform specific roles regarding, for instance, the use of data in education practices (H. Ratner et al., 2019, p. 32). We argued that the FutureLearn platform and its recent commercial and vocation-oriented course sequences (ExpertTracks) are situated in an entanglement of traditional and newer organisations, which we named an *access ecology,* that (co)creates and legitimises various educational resources on the platform. Our analysis equally highlighted everyday interactions to distinguish durable and contingent modes of access. First, we showed access as *funnelling* the user*,* the user who pushes interface buttons to converge at specific content and is being pushed to perform actions that benefit one or more actors. The second mode of access, *tracking*, demonstrated how users with specific interests and abilities (are) group(ed) to traverse the same prescribed pathway and are monitored simultaneously. Third, access was elucidated as *diverging*, that is, the learner/modder's makeshift pathways that lead away from the platform and complicate strict boundaries between 'users' and 'designers.' While the

identified modes of access regarding the platform (and its resources) are by no means exhaustive or meant to be representative for all users, they present some inherent limitations or in-access effectuated by technologies for education (see R. Edwards, 2015b). Therefore, we propose the concept and practice of '*in/access*' as a focal point when analysing platforms across the field because it may aid researchers and professionals in considering ambivalent, enabled/constrained ways of relating to and benefitting from these socio-technical assemblages.

Researchers can further draw on an (auto)ethnographic STS approach to explore, analyse, and rethink the context-specific socio-material arrangements that characterise in/access to other educational settings. Diagramming the relations between users and platforms allows researchers to familiarise themselves with the opportunities digital technologies and resources afford and de-familiarise the seemingly normal routines with platforms. STS reminds people to imagine technology inscribed with particular values and deployed in concrete situations to see some contingencies in actual usage and possibly begin to reimagine practices (Lange, 2021; cf. Suchman, 2012). Policymakers, in turn, may find the ethnographic findings helpful for understanding post-MOOC platforms in their ambivalent position: propagating and acting on the promise of expanding educational opportunities for learners and, at the same time, delineating those opportunities through new technical, financial, procedural, and pedagogical barriers. Indeed, such platforms may benefit learners to some extent but also generate a range of initiatives and monetisation strategies with universities and colleges that set new preconditions for participation (Goglio, 2022; Thomas & Nedeva, 2018). As the FutureLearn case showed, partnerships include actors *without* a long history in the education sector. This raises questions about the constellation of organisations that can (not) join these alliances, contribute knowledge resources, and negotiate the financial, procedural, and technical modalities for access. We hope the critical analysis presented in his chapter supports policymakers, and other actors, to think beyond the idea that platforms like FutureLearn, EdX or Coursera merely increase access to education. Critical platform studies have shown that digital technologies unavoidably enable and constrain the user's actions for the benefit of the platform and its partners (see Decuypere, 2019c; Grimaldi et al., 2023; van Dijck & Poell, 2015). The identified forms *in/access* call for a joint responsibility from educational actors to think about the more stable organisational/technical core of platforms, its more variable content modules, and who is (in)capable of benefitting from them.

The FutureLearn case reminds us that although various actors contribute to making the education platform and resources in/accessible for the learner, the user's pathway to the digital architecture (and the data it generates) is unilaterally maintained by and beneficial for the commercial platform. Education researchers, practitioners, and policymakers can further look into

what modes of access are made on/with cooperative platforms where users, providers, and designers conjointly partake in a potentially more democratic process of co-owning, negotiating, creating, modifying, and benefiting from access to resources that the digital architecture affords (cf. Sandoval, 2019). Cooperative thinking is not a straightforward response to a complex socio-technical issue but may help to explore more and different ways of creating in/access well together. The key point of this chapter was to scrutinise and conceptualise how accessibility to a digital education platform's vocation-oriented courses becomes tied to value-laden projects, performed in concrete situations, and can be reimagined. 'In/access' can be a point of departure for educational actors to consider how other platforms and users conjointly make, unmake and remake pathways to education resources in everyday situations.

CHAPTER 2: THE PLATFORM CURRICULUM

In open and higher education, digital technologies are increasingly used to enable flexible learning pathways and unbundle programs into separate courses. Whereas technologies have been praised for enhancing the flexibility of curricula, the implications of going digital have yet to be fully explored in curriculum studies. This chapter aims to critically investigate how an open education platform, OpenLearn, describes, prescribes, and enacts a particular form of curriculum. OpenLearn, like FutureLearn in the previous chapter, is part of the Open University of the UK's digital ecosystem. Rather than understanding platforms as passive tools for facilitating education, the chapter draws on theoretical and methodological ideas from science and technology studies (STS) to approach "curriculum" as a collection of socio-technical practices in which platforms play an active role. The findings of our analysis detail how networks of human and other-than-human actors are situated in a wider ecology and enact five curricular practices: prescribing, mobilising, enrolling, evaluating, and rebundling. We propose "platform curriculum" as a sensitising concept to investigate how technologies enable and constrain these practices instead of simply flexibilising them. We also argue for the further adoption of STS in curriculum studies to disentangle the specific ways in which technologies, too, shape education.

This chapter is based on: Vanermen, L., Vlieghe, J., & Decuypere, M. (2022). Curriculum meets platform: A reconceptualisation of flexible pathways in open and higher education. *Curriculum Inquiry*, *52*(4), 443-468.

Introduction

The concept of 'flexibility' has been spreading in policy, research, and practice around the world, typically engendering the idea of a technology-driven strategy for improving educational inclusion, equity, and quality (Shareefa et al., 2023; Veletsianos & Houlden, 2019). The UNESCO (2016), for instance, encourages institutions to deliver "flexible learning pathways" and remove barriers to (in)formal education by using digital means. Flexibility, here, refers to "entry and re-entry points at all ages and educational levels" as well as the "recognition, validation and accreditation of knowledge, skills and competencies" (2016, p. 33). The Organisation for Economic Co-operation and Development (OESO) (2020) proposes that curriculum, or "what students learn," should adapt to personal characteristics and, ultimately, tackle socio-economic challenges that a conventional curriculum cannot (2020, p. 62). Application-oriented research tends to repeat these normative ideas and imagines open and higher education institutions using technology to deliver flexible content and credentials (Michaela & Godonoga, 2020; Orr et al., 2019).

The unbundling of education programs for increased personalisation and employability has been an important yet contested aspect of flexible open and higher education. Research on the political economy of education regards unbundling as a practice through which products/services, initially provided as a whole, are disassembled into smaller constituent modules. Bundles are typically courses from comprehensive programs – consisting of multiple mandatory courses that

culminate in a degree – which get unbundled into more personalised modules for individuals and more marketable modules for institutions. Increased flexibility appears appealing because it enables learners to accumulate quicker and cheaper forms of accreditation but also sparks controversy about its politics and consequences (Cliff et al., 2022; Ivancheva et al., 2020; McCowan, 2017). For example, flexibilisation may become a dominant form of education at the expense of other types of education in which learners engage collectively with the same topics. It has been argued that comprehensive programs with public rather than economic relevance are changed into more flexible alternatives that primarily fulfil personal and economic purposes (van Dijck et al., 2018). The purpose of curriculum thus gets caught in a long-standing tension between "self-actualisation" and "social relevance," between education as providing "satisfying consummatory experiences for each individual learner" and education as helping learners meet societal and labour-market demands (Eisner & Vallance, 1974, pp. 9–11). Although researchers have argued that flexible and unbundled curricula exist and need inquiry, how technology plays a role herein has often been overlooked in curriculum studies (Krause, 2022).

In this chapter, we aim to empirically investigate and conceptualise how a digital education platform, OpenLearn, contributes to making a curriculum flexible in open and higher education. Platforms for massive open online courses (MOOCs), broadcast-centred ones especially, are exemplary organisers of unbundled programs and flexible pathways. During such courses, learners are usually presumed to follow linear trajectories towards predefined goals by engaging with videos, texts, and quizzes (Vansieleghem, 2019). The learner's (in)ability to self-regulate learning activities often makes or breaks the path to course completion (Reich, 2020). In addition to operating as a platform for MOOCs and other educational resources, OpenLearn is an integral part of a self-proclaimed expert in flexible education: The Open University of the UK. In what follows, we will magnify one of OpenLearn's MOOCs, a so-called badged course, because it is interwoven with subjects from a university curriculum and, therefore, a telling case of how technology flexibilises open and higher education (P. Law et al., 2020; P. Law & Perryman, 2017; The Open University, 2022b).

Given our interest in curriculum and technology, we elucidate in the first section of this chapter how open education studies and curriculum studies have approached this topic. The noun 'curriculum', at least in Western education, has been used in numerous ways by educational actors since the 17th century, and often in line with its modern Latin meaning: "a course of study" (Taylor & Richards, 2019, p. 42). Fenwick and Edwards (2010) use the classical Latin verb '*currere*', meaning 'to run' or 'move quickly'. For the authors, *currere* in education points to "running a course, in an active and holistic process bringing together teacher, learner and text in a particular moment to co-

produce themselves, knowledge and culture" (2010, p. 56; see also Pinar & Grumet, 1976). *Currere* has a long history in curriculum studies, especially in the work of scholar William Pinar (1978), which emphasised the (reconstruction of) human experience in and through movement. The concept of curriculum as *currere* urges researchers to understand education by:

> acknowledging that the running of the course occurs socially and subjectively through shared and solitary academic study […] currere emphasises the everyday experience of the individual and our capacity to learn from that experience, e.g. to reconstruct experience through thought and self-reflection in the service of understanding. (Pinar, 2022, p. 2)

We build on a relational understanding of *curriculum as currere*, as social practice (e.g., Priestley & Philippou, 2018) but point to some analytical constraints of assuming only humans have agency (Fenwick & Edwards, 2010). What is at stake here is that curriculum-making technologies (e.g., books, laptops, platforms) may be reduced to inactive tools that merely facilitate education (R. Edwards, 2011). Critical approaches are thus needed to demonstrate how education platforms, operating as digital architectures and organisational forms, actively change curriculum practices (Decuypere et al., 2021). As a response, we introduce the theoretical and methodological ideas from STS in the second section to develop an understanding of 'curriculum' as a collection of socio-technical practices (R. Edwards, 2015a). In the third section, based on our walkthrough of the OpenLearn platform and visual network analysis, we disentangle the relations between human and nonhuman actors that describe, prescribe, and enact curricular practices to reconceptualise so-called flexible pathways. In the last section, we invite curriculum researchers to consider a cross-fertilisation between curriculum studies and STS, both to consider the flexibility and rigidity through which platforms enact a specific (sort of) curriculum, as well as to enrich debates about technology, curriculum, and education more generally.

Flexibility, curriculum, and technology

In *open and distance education* studies, the normative aim of increasing flexibility is often conceptually conflated with a search for more openness (Shareefa et al., 2023). Both concepts, openness and flexibility, point to removing temporal, spatial, and technical barriers preventing the democratisation of education or providing more personalised content (Jonker et al., 2020; Veletsianos & Houlden, 2019). Curriculum designs and digital technologies are considered "tools" to "transform" and "enhance" access, quality, and curriculum in innovative ways. MOOC platforms, for instance, have been designated as the means to make education accessible "anytime and anywhere" (e.g., Lambert & Alony, 2018, p. 73; Li et al., 2018). Discussions about the design

of self-paced courses or modules, in which learners self-direct their pathways with limited to no instructor involvement, often revolve around comparing the benefits and limitations of such education with those of other online formats. Designers often value self-paced courses for their cost-effectiveness and capacity to accommodate larger audiences yet also anticipate possible side effects of flexible learning, like high attrition rates. While application-oriented insights from open and distance education studies can help optimise flexible, self-paced courses, these studies risk instrumentalising technology and curriculum to passive, neutral tools for education (e.g., B. Y. Chen et al., 2019; G. Kennedy et al., 2015).

The field of *curriculum studies* has a history of instrumentalising curriculum as a purposely structured sequence of educational contents and evaluations with predefined goals, meaning 'a course to be run' (e.g., Hirst, 1969). Critical voices have long challenged the idea of "curriculum as technology," a framing in which good educational design is reduced to "finding efficient means to a set of predefined, nonproblematic ends" (Eisner & Vallance, 1974, p. 7). Researchers have therefore reconceptualised the "what" of education (Pinar, 1978) and argued that "curriculum is more than a journey on a map" (Kumar, 2022). Curriculum is increasingly recognised as value-laden and political instead of merely a tool for continuing and optimising practices (Wahlström, 2018). Different approaches are required to reconsider modernist conceptualisations of curriculum that simplify the complexity of educational reality to planned, goal-oriented organisations of educational experiences (Halvorson, 2011). Alternatively, *relational approaches* conceptualise curriculum as a social practice that takes into account how people interact with others and materials to make or enact curriculum (Priestley & Philippou, 2018). Curriculum making in such an approach entails the "multi-layered social practices, including infrastructure, pedagogy and assessment, through which education is structured, enacted and evaluated" (Priestley, 2019). In the following section, we expand on this idea of curriculum as a social practice by acknowledging technologies as potential curriculum-making actors (e.g., Carroll, 2018; R. Edwards, 2011; Fenwick & Edwards, 2010). Our inquiry tries to answer two questions: (1) How does an open education platform contribute to making a curriculum under the conditions of intensifying flexibility in open and higher education? (2) What form of curriculum, flexible or otherwise, is enacted through the relations between the open education platform and learner?

An STS approach to curriculum in open and higher education

We draw on the broad interdisciplinary field of STS as it provides theoretical and methodological sensibilities to investigate practices and how networks of people, materialities, and technologies make, unmake, and remake the world in particular ways (J. Law, 2004). As explained before, we employ STS as a "sensitising device" (Decuypere, 2019a, p. 137) for scrutinising how

entanglements of different actors make a curriculum on, with, and beyond a digital education platform (see also van de Oudeweetering & Decuypere, 2019). Like Fenwick and Edwards (2010), we take the infinitive of curriculum, *currere* as a point of departure to emphasise a composition of social and material relations, what humans and non-humans do, as opposed to the instrumentalist take on curriculum that prioritises people's goal- and content-oriented trajectories. The employment of '*currere*' as a word to think and investigate with has both theoretical and methodological implications (cf. J. Law & Mol, 2020). On the one hand, it helps us frame the complex task of dealing with the discrepancy between the planning and the enactment of an education trajectory, underlining that and how the written plans of policymakers, education designers, and educators seldomly turn out as they envisioned. On the other hand, it suggests a methodology through which the one who is 'running the course' (in this case, the first author) may (re)trace that sociomaterial course of actions to open it up for analysis and discussion.

Curriculum as a collection of socio-technical practices

Some STS-inspired curriculum studies invoke the notion of 'curriculum' as an English synonym for '*currere*' and recognise the multiple ways actors (human and otherwise) prescribe and enact knowledge-making (Fenwick & Edwards, 2010). In an STS vein, a *prescribed curriculum* or planned running of a course is not given *a priori* but made through interactions with materials, "texts which inscribe the standards that students are meant to achieve" (R. Edwards, 2011, p. 40). Written goals, for example, are formulated to safeguard the "alignment and avoid mismatches between learning outcomes, educational activities," and assessment (Gourlay & Oliver, 2018, p. 29). Whereas conventional curriculum approaches typically analyse that and how policymakers articulate these prescriptions (Priestley, 2019), STS opens the analytical possibility that any actor (e.g., instructor, designer, technology) can play this role. However, actors do not simply follow these prescriptions; they also bring an *enacted curriculum* into being with both planned and unplanned consequences (R. Edwards, 2015a; Fenwick & Edwards, 2010). Nespor (1994), for instance, investigated an undergraduate management program and showed how networks of actors enact or 'do' curriculum, that is, how *inter alia* students, textbooks, and professors enrolled in an educational setting forge particular kinds of relations and identities. Overall, STS provides an analytical edge to understand curriculum as a collection of socio-technical practices resulting from human, material, and technological entanglements (R. Edwards, 2015a).

These entanglements or networks are also important for approaching the sociotechnical dimensions of the digital education platforms (Decuypere et al., 2021), the "programmable architecture designed to organise interactions between users" that is embedded in a broader

environment (van Dijck et al., 2018, p. 9). Education platforms should not be understood as natural, inactive tools that merely enable education. On the contrary, through interfaces and algorithms, platforms gain the potential to act and enact (open) education practices in multiple ways and with varying intensities (Decuypere, 2019c; Decuypere et al., 2021). We distinguish four analytical dimensions to help us investigate how digital education platforms become actively involved in a flexible learning pathway or curriculum (the design, algorithms, usage, and ecology). Given the specific interest in flexibility, the dimensions have been infused with insights from curriculum studies and scholarship on algorithms.

First, the *design* is a part of the platform's sociotechnical architecture that both enables and constrains user actions. The graphical user interface (GUI) specifically is a designed, observable, and technical boundary that offers visual and linguistic mediation between the architecture and user; it can "translate human-cultural interest into machine-executable instruction and back again" (Bratton, 2015, p. 120). One important implication of this function is that the GUI delineates a "plan of action," a set of directions for the user regarding the expected usage, which designers inscribed into the platform architecture (Bratton, 2015, p. 80). This idea resonates with the well-established trope in STS that technologies have social consequences and "define a framework of action together with the actors and the space in which they are supposed to act" (Akrich, 1992, p. 208). Taking the interface into account allows us to analyse platforms not as tools that only bring flexibility into a curriculum but as technologies that can equally make sorts of inflexibility.

A second analytical dimension, and equally a part of the platform architecture that this dissertation has not yet touched upon much, is the *algorithms* that demarcate user actions. STS scholars are not so much interested in examining what algorithms are in technical terms (e.g., in terms of their programming) but rather in what they do with(in) sociotechnical practices. So-called "deterministic algorithms" are specific algorithms that execute automatic calculations to process the user's input and display predefined sets of outputs. These outputs, in turn, guide the user's interactions with a digital device (Bucher, 2018, p. 29). Analysing how such algorithms work, and have consequences for learners, allows us to disentangle the ways an often naturalised kind of technology becomes relevant in curriculum making (cf. R. Edwards, 2015a).

A third dimension involves the *usage* of technology, the user that is (expected) to interact with the platform architecture and take part in curriculum making. The architecture presumes and co-shapes a particular "user identity," a figure anticipated by the designer(s) and enacted when working with technology (Bratton, 2015). For example, Decuypere (2019c) argued that regarding open education platforms, the user or "open learner" is "assumed to possess the flexible capacity to learn irrespective of where he or she is positioned in time and space" (p. 448). Focussing on the

presumed and enacted user thus helps us consider how flexible education shapes a particular kind of learner (cf. Houlden & Veletsianos, 2021), but also how a particular curriculum is supposed to be enacted is a result of certain materials and technologies (cf. R. Edwards, 2011).

A final analytical dimension helps us acknowledge how platforms are situated in a wider *ecology,* and constituents in this relational field describe or idealise a curriculum (Decuypere, 2021; R. Edwards, 2011). Curriculum studies tend to make *a priori* distinctions between contexts and levels on which a curriculum is supposed to work (e.g., micro/macro, see Priestley, 2019) or accentuate the actors within a particular locality (Carroll, 2018). As STS researchers have forcefully shown, digital technologies are situated in an "environment of expected use" and do not simply 'work' but are equally 'made to work' through particular actors (e.g., other platforms, institutions, policies). Designers and owners, for example, may describe a specific vision and business model for their platform that specifies how they "expect users to receive and integrate it into their technology usage practices" (Light et al., 2018, p. 889). Thinking of such environments as ecologies allows us to (re)direct the analysis from the highly local curricular practices vis-à-vis the platform to actors beyond the platform architecture (cf. T. P. Nichols & LeBlanc, 2021; van Dijck, 2013).

In sum, inspired by the broader STS field, these four dimensions will guide our empirical analysis of how an open education platform and its user make a specific sort of (in)flexible curriculum in open and higher education.

Methodology

The methodology of this chapter is an assemblage of three methods corresponding to the analytical dimensions mentioned above: a website and document analysis, a platform walkthrough, and a visual network analysis. Through these methods, the first author foregrounded and scrutinised relational practices (see J. Law, 2004). Lanze empirically investigated OpenLearn between June 2020 and March 2021 to conceptualise how the OpenLearn platform described, prescribed, and enacted a flexible curricular form in open and higher education. Firstly, he analysed The Open University's website and documents (open.ac.uk) because they provided an overview of constituent actors in the platform's ecology (cf. T. P. Nichols & LeBlanc, 2021). The analysis of the website and documents helped bring the university's described, idealised outlook on curriculum and user-platform relations to the fore.

Secondly, Lanze performed a platform walkthrough and investigated OpenLearn's sociotechnical architecture (open.edu/openlearn) (see also Decuypere & Landri, 2021; van de Oudeweetering & Decuypere, 2021). He created multiple user profiles and positioned himself as a user/learner in one MOOC called *How to learn a language*. This method allowed him to zoom in on

the relations between the user, GUI, and algorithms and how they enacted a curriculum. A collection of observational fieldnotes, screenshots, and journals assisted him in identifying a network of actors prescribing and enacting educational goals (see R. Edwards, 2011). The protocol was designed to gather relational data and informed by the maxim to "follow the actors themselves" (Latour, 2005, p. 12). Key questions that were formulated in the protocol and guided the walkthrough are: (1) What does the GUI do? (2) What does the GUI make the user do? (3) How does the user depend on written prescriptions (e.g., goals) to complete the course?

Lastly, given the relational take on curriculum and technology, the data analysis involved constructing, presenting, and scrutinising network diagrams. Following the guidelines of visual network analysis (see Decuypere, 2020), we used visualisation software called Gephi to turn the gathered relational data into readable diagrams that accurately account for a network's composition and form. We identified actors and relations composing (unforeseen) curricular practices in the data corpus via coding. The codes preserved emic language or infra-language (Latour, 2005) and were moved from the corpus to a spreadsheet that was later converted, spatialised, and visualised as diagrams via Gephi's ForceAltas2 algorithm. The five diagrams we include act as mappings that present types of actors as nodes (dots) and their relations as edges (lines). The relations point to interactions and dependencies between the user and other actors (e.g., a media player) in overcoming a problem (e.g., achieving prescribed goals). The making of diagrams assisted in slowing down the inquiry and paying attention to actors who are often taken for granted (Jacomy et al., 2014; J. Law, 2004), thereby de-familiarising the role of technologies alongside humans in curriculum making.

In the following section, we start by outlining the ecology in which the OpenLearn platform and curricular practices (prescribing, enrolling, mobilising, evaluating, and rebundling) are situated. We then textually and visually detail the composition of these practices (the network form) and infer the relational effects of these compositions (the network implications) so a particular form of curriculum can be conceptualised.

The case of OpenLearn

An open and higher education ecology, or how a curriculum is made to work

OpenLearn is an integral part of The Open University in the UK (hereafter: OU) and follows its narrative of democratising education for a wider audience, thereby advancing a particular vision and operating model. The university presents itself as "a global leader and pioneer in *flexible learning*," accentuating that its global audience can learn whenever and wherever it wants. Guided by a royal charter, a document that has existed since the university's founding in 1969, the OU aims to provide

affordable public education through strategies that lower spatial, temporal, procedural, and financial barriers to participation. Courses and more comprehensive programs, like postgraduate degrees, are promoted as "flexible" or "open curricula." Consequently, the university's narrated vision reiterates existing normative tropes found in open and distance education literature, namely the idea of removing barriers to participation (Veletsianos & Houlden, 2019), and prioritises flexibility over inflexibility.

The university has a long history of using technology to reduce barriers and provide education. These technologies include the Moodle learning management system, YouTube, Kindle books, a commercial platform called FutureLearn (see Chapter 1), a sister platform named OpenLearn Create, and the OpenLearn platform. When OpenLearn was released in 2010, a collaboration between the OU and the British Broadcasting Corporation (BBC), it embroidered on older initiatives: LearningSpace (established in 2006) and Open2.net (establish in 1999). In line with these organisations' public goals, the OpenLearn platform enabled learning without formal registration or creating a user profile. Students, called "open learners," are permitted to choose from hundreds of free courses, articles, games, and TV programs. OpenLearn's proclaimed flexibility lies in "bite-sized learning experiences designed to fit easily into the daily lives" of millions of people who have used these resources since the launch. The platform describes user experiences as "lifelong" and "informal learning," which are meant to be stepping stones toward the university's formal education and degrees. OpenLearn's educational resources and MOOCs are categorised according to subjects (e.g., languages, science), life spheres (e.g., work, study), and specific types of skill recognition called "statements of participation" and "open badges." Learning pathways are meant to personalise education to the needs and capabilities of learners as well as provide a cost-effective way to improve their employability (McCowan, 2017). OpenLearn and the OU thereby concretise the idea present in policy and research of establishing "multiple entry points" to (in)formal education through digital technology (cf. Michaela & Godonoga, 2020) but disregard the barriers required to make education possible (R. Edwards, 2015b).

Although OpenLearn delivers free, unbundled education that may serve an individual's personal or job-oriented goals, it does not monetise prolonged access or accreditation. Open badge courses are supposed to result in accreditation demonstrating professional development, commitment to a course of study, or simply an interest in a subject. OpenLearn presents such courses as "highly engaging and covering a range of core subjects and professional competencies essential for the modern workplace." They are usually adapted from university courses via standardised templates on OpenLearn Create, the sister platform running on the university's open-source learning management system (Moodle). Templates allow instructors to design modularised

course pathways and include a combination of resources (e.g., books, files, hyperlinks) and activities (e.g., quizzes, blogs, wikis). The university's commercial interests appear in OpenLearn's for-profit counterpart, FutureLearn, which provides more vocation-oriented courses and freemium access. With FutureLearn, the university and another co-owner – SEEK Group – intend to generate "both financial investment and business insight" (The Open University, 2019a, p. 3). OpenLearn, therefore, occupies a particular position as a provider of unbundled public education amongst other, increasingly commercial, open education platforms (see van Dijck et al., 2018). In the following paragraphs, we zoom in on some practices that the platform enables and constrains and how learning in the badged course *How to learn a language* is made (in)flexible.

Prescribing a curriculum for the open learner

> It is worth detailing how OpenLearn prescribes a particular usage for the "open learner" to make sense of who and what makes a badged course's curriculum. After searching and selecting a course from the online catalogue, the user encounters a summary of the course contents, authors, peers, and outcomes (see nodes in Figure 8). The summary typically introduces the general subject to the user and lists the knowledge, skills, and attitudes that should be acquired during the course. In the case of "*How to learn a language*," an opening text first explains that the expected outcome is to familiarise people with "skills and strategies" for language learning (red node). Setting realistic goals, staying motivated, evaluating learning resources, learning to speak and memorise vocabulary, and creating an immersive environment are all expected outcomes. A video (orange node) sets the scene for learning with the university's platform. One of the course instructors (blue node) claims that this "free Open University course explores how to pave the way for successfully learning languages." The video cuts to a woman sitting alone at a desk facing her laptop (grey node). While drinking a beverage and having a pen, paper, and smartphone at hand, she watches peers and instructors who stress the usefulness of the content.
>
> The platform summarises and organises content as modules, sections, and sub-sections that can be extended by clicking buttons with the cursor (Figure 9). From the outset, modules are visually and textually categorised under a particular subject, "languages," and tied to one or more expected outcomes. Information is depicted in the subject's characteristic orange colour and numbers sequence the weekly content as a coherent program (green node). Before enrolling, the user is presented with a clear-cut learning path that should be followed. For example, in "Week 1: Your motivation and goals," the user is expected to "think about reasons and goals for learning a language." When the user enters the course, they encounter a systematic repetition of specific course goals, followed by a numbered series of lesson materials, activities, and quizzes. Whereas the course menu allows the user to pick and choose modules in any order, visual and numeric indicators suggest a linear trajectory from introduction to conclusion.

The descriptions and images show how people and things become entangled and perform a *prescribed curriculum*: a network of human and other-than-human entities that articulates specific standards and directions for the learner (R. Edwards, 2011). The course summary lists written goals learners are meant to achieve as they engage with the course materials, activities, and quizzes. The

video repeats the goals and depicts a private space and specific collection of materials the learner should depend on: one learns from home, at a desk, and with a digital device. The network enacts the trope of a flexible pathway the learner can walk, for personal or vocational reasons, which is also made inflexible by particular forces (Houlden & Veletsianos, 2021). That is to say, the platform architecture plays a considerable role in prescribing what, where, and when learning should take place in the running of this course. The menu on the platform, shown in Figure 9, organises the course into content modules that learners are expected to interact with at a weekly pace. Here, the GUI is not simply a neutral tool for curriculum and learning but entails a "plan of action" that enables and constrains the learner's doings (Bratton, 2015, p. 80; Decuypere & Landri, 2021). The GUI becomes a central actor in making an official programme by guiding the learner through its discernible and hypertextual buttons, lists, and menus. Besides the written goals, it is the platform architecture that contributes to a specific material ordering of educational time and space that delineates a standardised pathway for each learner to follow (cf. Nespor, 1994).

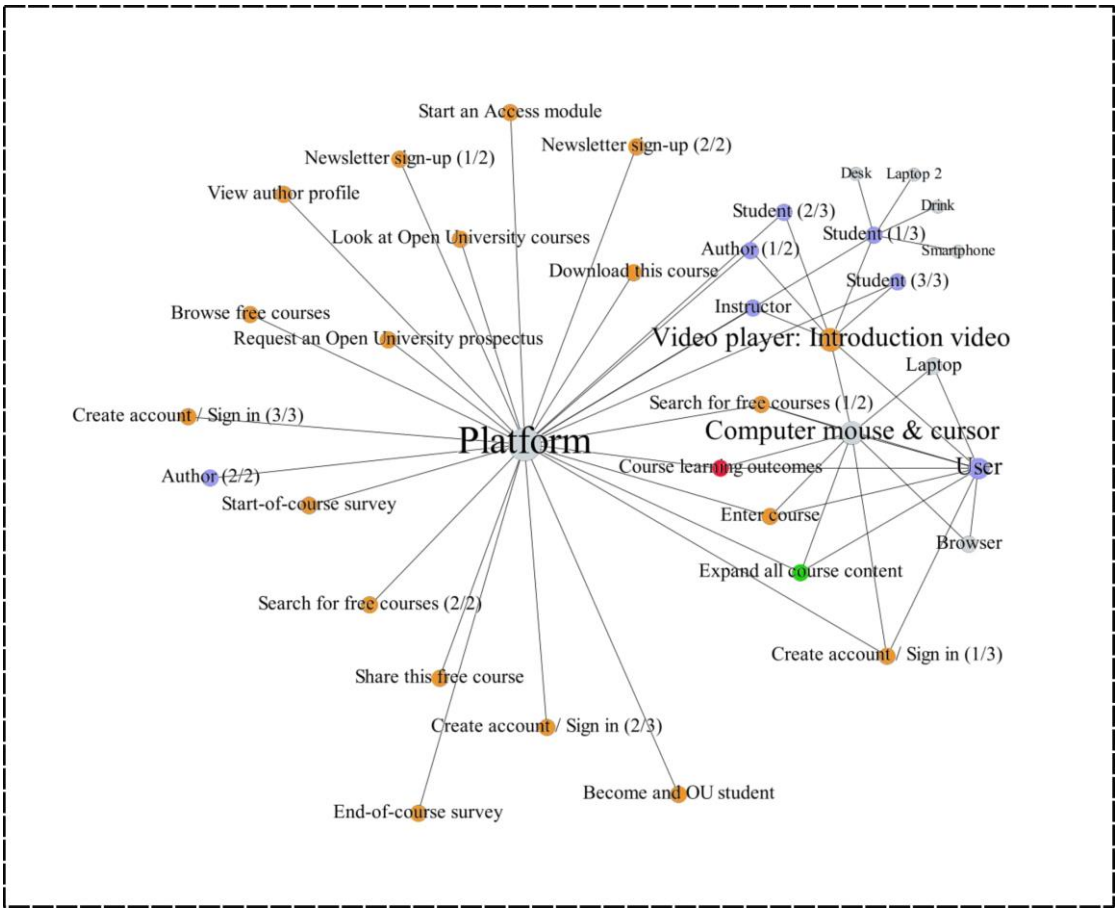

Figure 8. Network diagram of actors and relations prescribing a pathway for the learner.

Nodes (dots) indicate interface components (orange), humans (blue), content modules (green), course goals (red), algorithmic outputs (purple), and other technologies (grey). Edges (lines) show interactions (e.g. reading, clicking, depicting) between someone and something. The Gephi software visualises relating nodes in closer proximity and enlarges nodes with more relations.

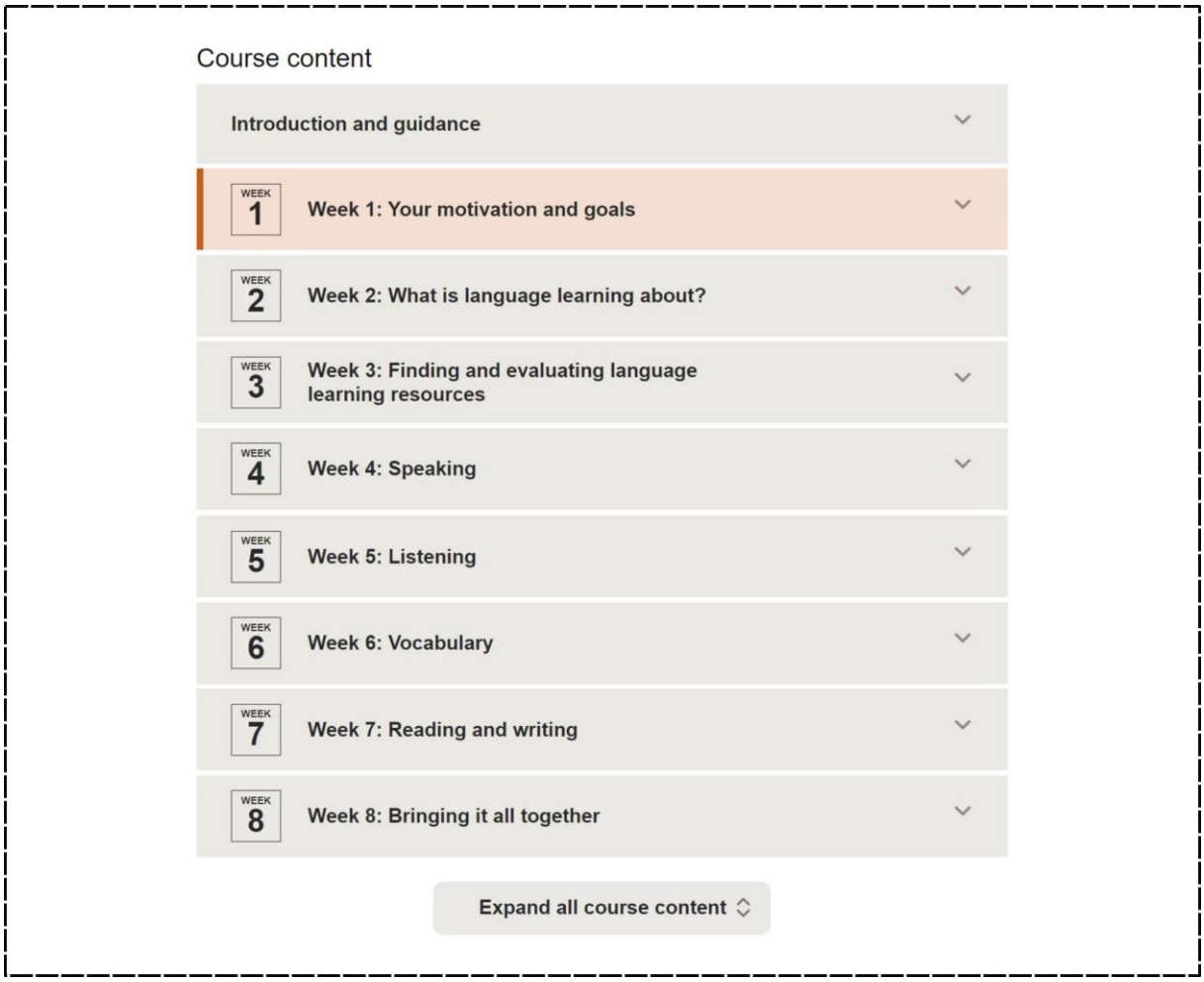

Figure 9. Screenshot of the platform organising content into a menu and modules.

> Although the user can navigate the prescribed pathway of any course without registration, the platform encourages the creation of a profile for formal enrolment. Three interface buttons on the screen allow and entice the user to "create a profile" or "sign in" (see orange nodes in Figure 10). The text adjacent to those buttons urges people to "enrol and complete the course" for a so-called "free statement of participation or digital badge." Enrolment would also enable the user to "access all course activities" (e.g., quizzes) as well as track and save their progress. The buttons redirect the user to The Open University's website (grey node) and a registration form asking for a title, name, date of birth, email address, and password. After filling out the form and accepting the terms and conditions, the user officially becomes an "open learner" at the university and on the platform.
>
> During the introductory course module of "How to learn a language" (green node), the badge system of the university is explained to the learner. OpenLearn states that: "badged courses are a key part of The Open University's mission to promote the educational well-being of the community." Learners should also consider the expected learning outcomes when "moving around the course" and working "towards gaining a digital badge." The digital badge allows the learner's employers, family, or friends to recognise the acquired knowledge and skills. Moreover, it is an invitation to let learners "progress from informal to formal learning," from OpenLearn courses to university ones. The interface delineates the announced course pathway of sections, sub-sections, materials, activities, and quizzes (Figure 11). The learner, in turn, is supposed to forge connections to the content of every module by clicking, scrolling, reading, listening, typing, and watching. The navigation may occur horizontally and vertically across the screen by using the interface's "Next/Previous" buttons (orange nodes) and the scroll wheel of the computer mouse (grey node). Doing so triggers the platform's tracking function, automatically updating the course's dashboard and user profile. The user's clicks are algorithmically captured and visualised as a progress bar and percentage (purple nodes). From the beginning, the platform thus relies on learner data to position them on a pathway.

The descriptions and figures demonstrate how the learner enrols (and is being enrolled) into a network that *enacts* the prescribed curriculum and defines the learner's identity (Fenwick & Edwards, 2010). We saw how the OU website becomes important in authorising access to the complete version of the course. (This stands in contrast with FutureLearn in Chapter 1, where not the OU but Facebook and Google could authorise access.) Some course functionalities only become available if the user agrees to the terms and conditions, provides personal data, and embraces the "open learner" label. Since the university website should not be avoided, it works as an "obligatory passage point" that enables and constrains access while attempting to define the learner's role in the educational setting (Nespor, 1994). Furthermore, the platform makes the course content available to the learner while "the open learner" is equally being made through the content of the introduction module (Decuypere, 2019c). Information about open badges is repeated as the initial subject matter of the course, thus exposing the learner to messages that convey the importance and benefits of aligning with such a type of credentials. In this case, open

and digital badges are positioned as something any learner should relate to and are a built-in part of unbundled programs in open and higher education (Krause, 2022).

The learner is thus presumed to become someone highly mobile and looking for qualifications, only making short-term attachments to particular institutions, platforms, courses, and programs (Simons, 2021). The course introduction shapes a vision of a general curricular outcome for the learner since, in due time, one is expected to change from an informal learner to a formal one and exchange the platform for the university. Moreover, by participating in the course as a registered user, the GUI and dashboard can visualise the steps taken to course completion and university education. A relatively straightforward deterministic algorithm captures the learner's clicks as input and turns them into visual output, representing course progress (Bucher, 2018). As such, algorithmic and textual technologies (content) make a forceful contribution to curriculum making by delineating the pathway learners should follow upon entering the course (cf. R. Edwards, 2015a).

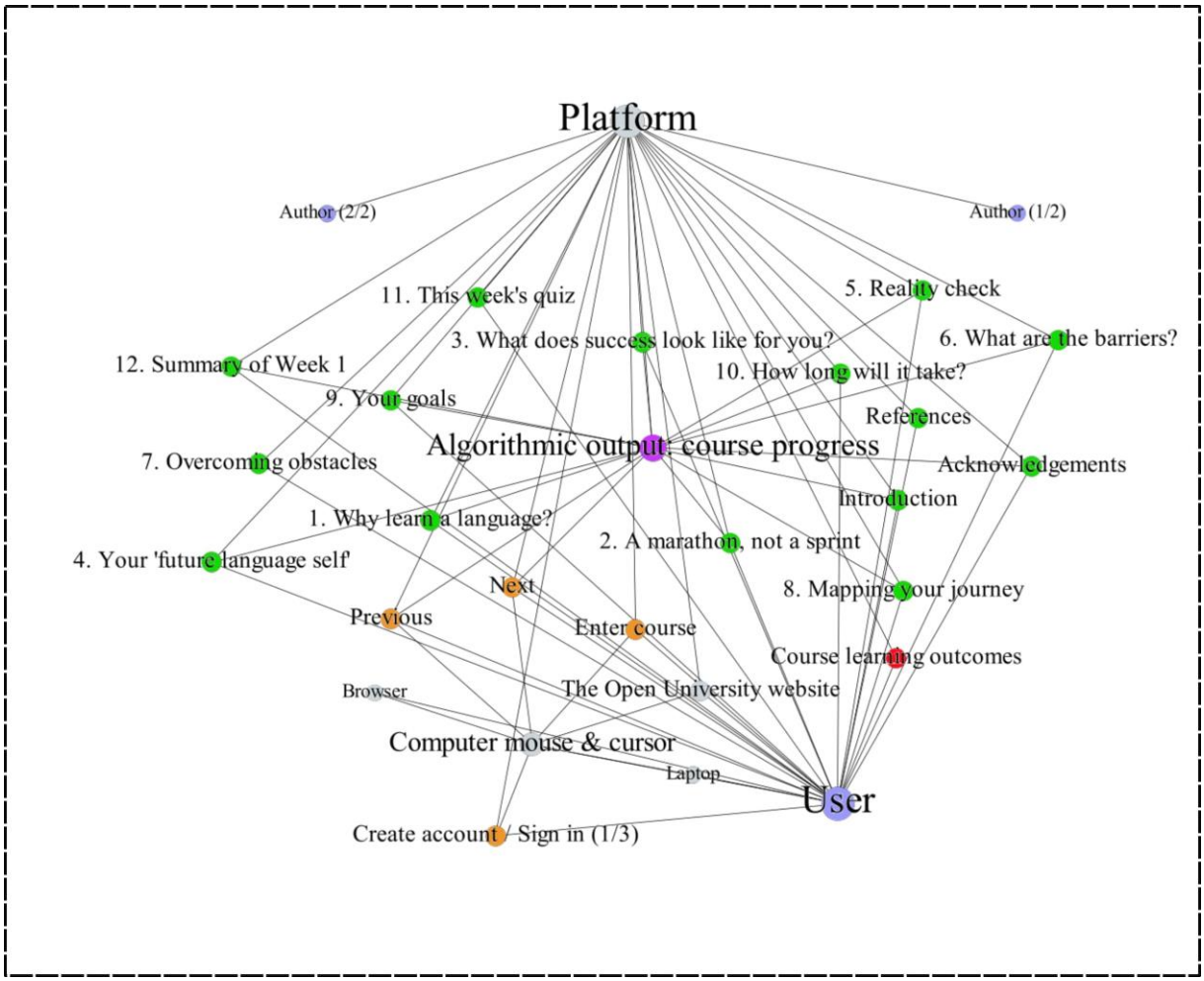

Figure 10. Network diagram of actors and relations enrolling the learner into the course.

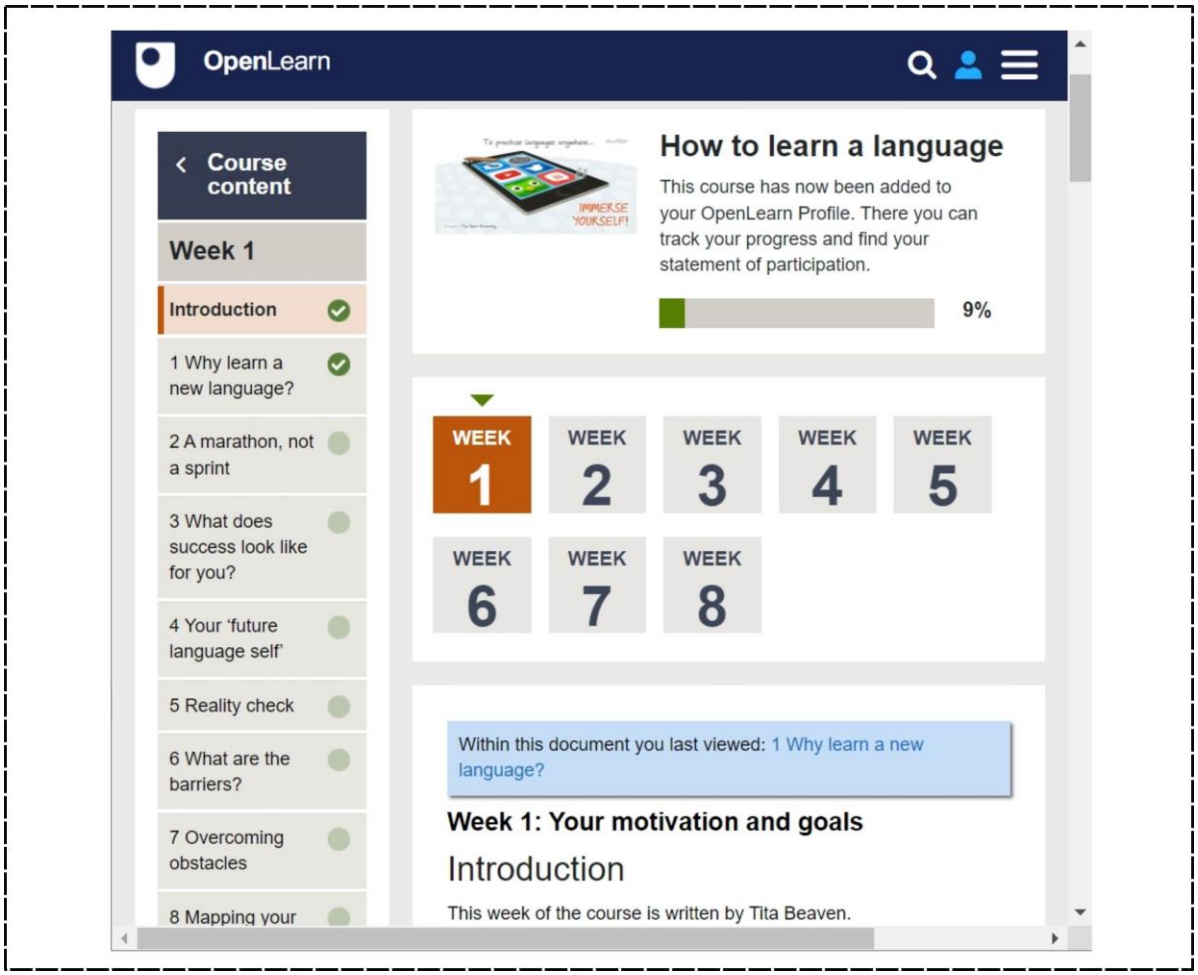

Figure 11. Screenshot of the platform monitoring the learner's pathway.

Mobilising educational resources for the open learner

> As the learner enrols in the course, education resources are mobilised and displayed for learning activities. Written texts, figures, tables, audio and video recordings, but also downloadable and printable documents, are placed on OpenLearn via its sister platform (OpenLearn Create) in service of expected outcomes (see coloured nodes on Figure 12). In the first week of *How to learn a language*, the course's author (blue node) urges the learner to imagine a concrete future self, articulate personal goals, evaluate how realistic those goals are, and anticipate possible barriers that may prevent successful language learning. A diversity of scientific insights from language studies, professional expertise, and real-life examples are brought into the course. These multimodal representations comprise the open education resources (green nodes) the learner is expected to read, watch, and listen to in a predefined order.
>
> For example, one of the modules provides a written introduction to a course activity. The learner (blue node) is asked to engage in a "visualisation exercise" and imagine a "future language self." When clicking the audio player (orange node), the recorded voice of the author asks the learner a series of questions: "Imagine yourself. How old are you? How is your new language useful to you?" Written information (green node) next to the media player refers to the sources of the scientific insights that inform these questions. Additionally, the learner should complete the activity in a "comfortable and quiet place" and within 30 minutes. A student's written testimony stresses the importance of scheduling time for the activity. "I would also suggest you repeat this exercise at regular intervals," she tells the learner, "particularly when you start feeling demotivated."
>
> As activities build on one another, a later module expands on the exercise and aims to help the learner visualise the future according to a standardised language proficiency framework. The module introduces the "Council of Europe Framework of Reference for Languages," CEFR for short, an international standard for organising language skills through different levels. A table is included to differentiate language users as "basic," "independent," and "proficient," with levels that vary from A1 to C2. Once again, the learner is asked to reflect on their "ideal future self" using a Word file and consulting the CEFR levels. The file can be downloaded and printed via the browser and opened with Microsoft Word (grey nodes) to mark a specific level and make notes. Doing so entices the learner to reformulate personal goals as formal ones and maintain a close link to the standardised proficiency levels.

Our analysis of the descriptions demonstrates how different open educational resources (OERs), based on professional, scientific, and international frameworks, are technically mobilised from beyond the platform to make specific times and spaces for educational activities. The learner may follow or betray the written prescriptions that attempt to order educational time-space in smaller fragments (R. Edwards, 2011; Nespor, 1994). On the one hand, the mobilisation of content resonates with the learner-centred format of connectivist courses (cMOOCs) since learning pathways are designed to be flexible, networked, and decided on by the learner (Downes, 2008). The network showed how education is divided into smaller time-space fragments with an articulated purpose. For instance, activities should occur in freely chosen but quiet office spaces and at any moment during the day as long as it is for a fixed duration. The educational resources

and spatio-temporal specificities remind us that open/flexible learning with the platform provides educational access to a broader audience but is made through boundaries that can be closed and rigid (R. Edwards, 2015b; van de Oudeweetering & Decuypere, 2019).

On the other hand, the mobilisation of resources resembles the transmission-based and instructor-centred format of extended courses (xMOOCs) in which the learner takes a more passive role. These MOOCs typically emphasise the broadcasting of curated information by putting instructors (professors) in the spotlight to recreate a university experience (J. Knox, 2016b; Spector, 2016). Consequently, OpenLearn's course activities contrast with constructionist-inspired, open pedagogies where learners engage in collaborative communities that use, share, and create knowledge. In such "learning-by-making" pedagogy, learning would result in OERs that are retained, reused, revised, remixed, and redistributed (Wiley & Hilton, 2018, p. 136). Although OpenLearn's courses are designed as OERs – allowing instructors to reuse and remix them via OpenLearn Create – learners do not make public educational materials themselves. Educational resources are supposed to be consumed in the suggested order rather than constructed. Other "transmission-based" pathways have been criticised because the pedagogy "undermines the relational dimension of teaching and learning" and detaches learners from others (McCowan, 2017, p. 743). By strictly referring to the mobilised resources for achieving expected outcomes, the platform delimits the learner's attachments to an unbundled segment of a disciplinary program.

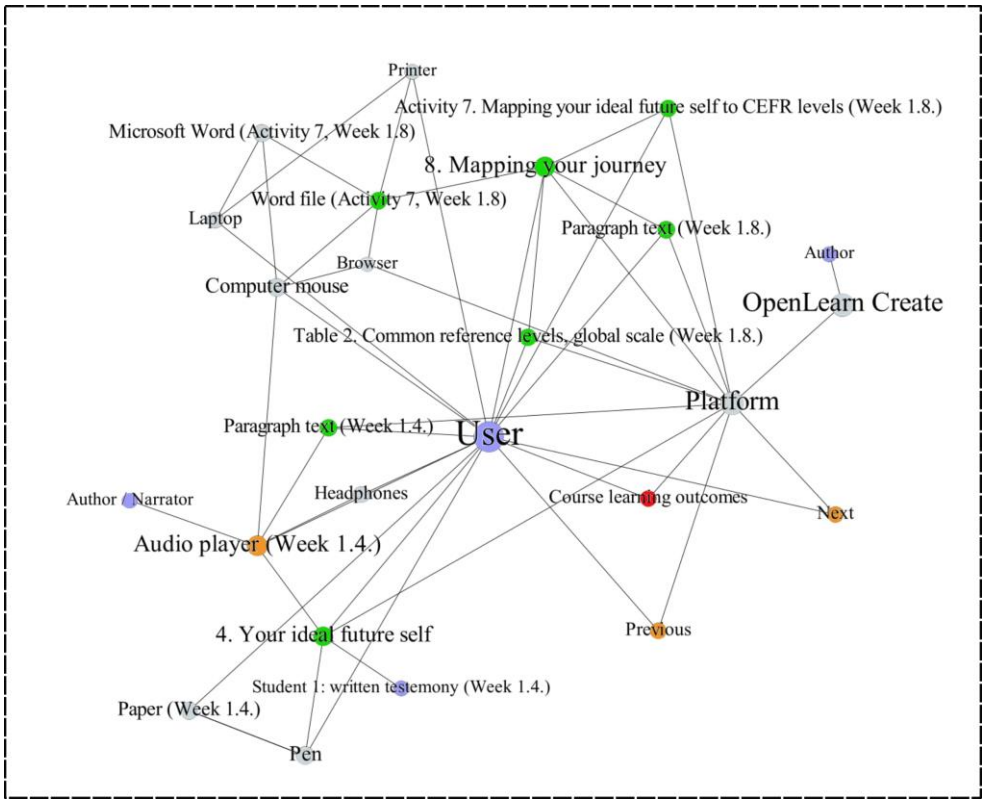

Figure 12. Network diagram of actors and relations mobilising resources for the learner.

Evaluating the open learner's knowledge with algorithms

Whereas content is mostly read and watched, OpenLearn evaluates knowledge through quizzes and tests spread across one or more modules. Short quizzes amongst course materials and activities comprise formative evaluations. In contrast, the more extensive tests at the end of modules and courses tend to perform summative evaluations and verify whether the learner has attained the prescribed outcomes. Both types of evaluation are usually characterised by sets of closed and multiple-choice questions, navigation buttons, input fields, and prestructured answer possibilities (see coloured nodes in Figure 13). Written answers are generated automatically through an algorithm that consistently repeats output when given the same input. Granted that the algorithms' code remains invisible, algorithmic effects and outputs (purple nodes) are observable to the user who interacts with them (see Bucher, 2018). Responding to quiz questions triggers an algorithm that verifies whether answers are correct, incorrect, partially correct, or incomplete.

In *How to learn a language*, quizzes are supposed to take up little time and are regularly deployed to make a summative evaluation of knowledge (Figure 14). In an exemplary activity about identifying barriers to language learning, the learner is asked to take a five-minute quiz with five sets of multiple-choice questions (green nodes of Activity 3 on the diagram). The quiz starts by pointing to some "unsuccessful behaviours that people can exhibit when learning a language," like being "scared of speaking." The learner then needs to answer what kind of barrier the fictional person faces when behaving this way. Clicking one of three predefined answer possibilities and manually checking the answer (orange nodes) reveals a binary right/wrong response. OpenLearn does not provide content adapted to the user, nor do its algorithms learn from the user. Instead, the platform offers rigid algorithmic responses and gives learners control over when to activate them.

The quizzes at the end of modules involve more elaborate, formative evaluations that cover all content seen over a particular period (e.g., weekly quiz). Such evaluations occur on a separate interface and screen for testing, away from the other modules and course contents. The learner interacts with a linear sequence of quiz items, each with a set of questions, answer options, and a button to "check the answer" or "try again." The selected answer is subsequently indicated as (in)correct and accompanied by more detailed comments about the expected answer. The summative tests at particular places in the course – usually at the end – adopt the same structure and organisation as the quizzes just discussed. Differently, though, these lead to accreditation: the "open badges" and "certificates of participation." In *How to learn a language*, the "compulsory badge test" displays 15 questions in an environment separated from the course materials. Completing the questions leads to a digital report containing the achieved score and triggers an algorithm that updates the user profile (orange node). Once the course is completed, the digital badge and certificate become available to the learner in that profile.

The network form shows how evaluations are not simply social practices in curriculum making (see Priestley, 2019) but socio-technical ones. As an entanglement of humans (users) and nonhumans (algorithms) become involved in the formative and summative evaluations of subject knowledge, these practices become characterised by automated feedback and accreditation. The formative evaluations or quizzes in MOOCs resonate with a behaviourist-inspired pedagogy and frequently involve algorithms because they permit upscaling the number of learners. Achieving

curricular objectives then implies depending on particular technologies and pedagogies while accepting that learning within the course becomes predefined and less flexible (Storme et al., 2016).

Although MOOCs usually provide feedback through formative rather than summative evaluations, leaving formal assessment and accreditation to educational institutions (J. Knox, 2016b), the network equally indicates how this distinction becomes blurred in the open badge course. The summative evaluations or tests in unbundled courses increasingly enable learners to attain more flexible forms of accreditation upon completion (e.g., micro-credentials, nanodegrees, or digital badges) instead of the traditional degree that concludes a long trajectory of mandatory courses (Krause, 2022). There is a tendency amongst edtech companies nowadays to draw on behaviourism, machine learning, and adaptive algorithms to personalise and flexibilise learning environments automatically (J. Knox et al., 2020). However, summative and formative evaluations on OpenLearn are organised through a deterministic algorithm that takes one fixed set of inputs as (in)correct answers and evaluates all learners according to the same standard and pathway (cf. Bucher, 2018). Getting an open badge thus also requires a certain *inflexibility* since learners must pass all the MOOC's modules and tests.

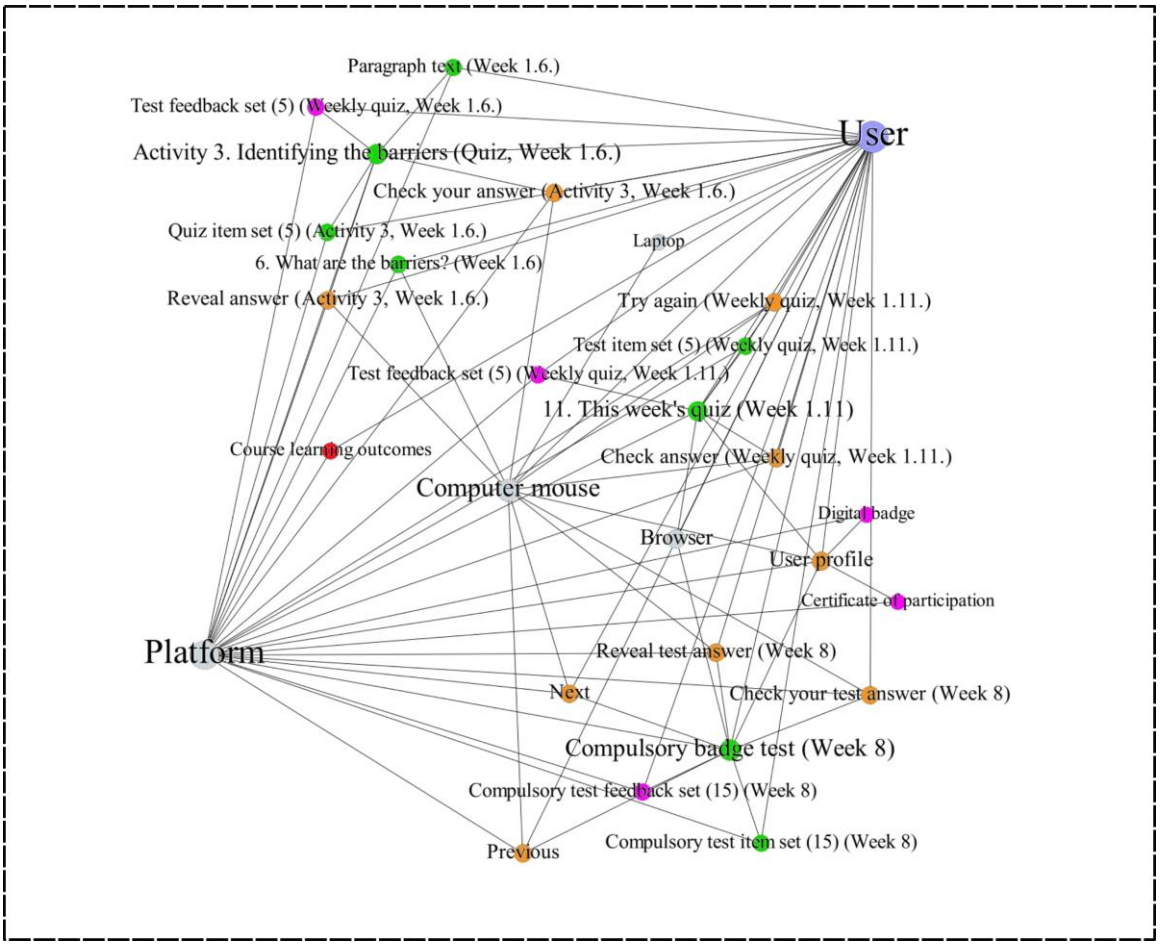

Figure 13. Network diagram of actors and relations evaluating the learner.

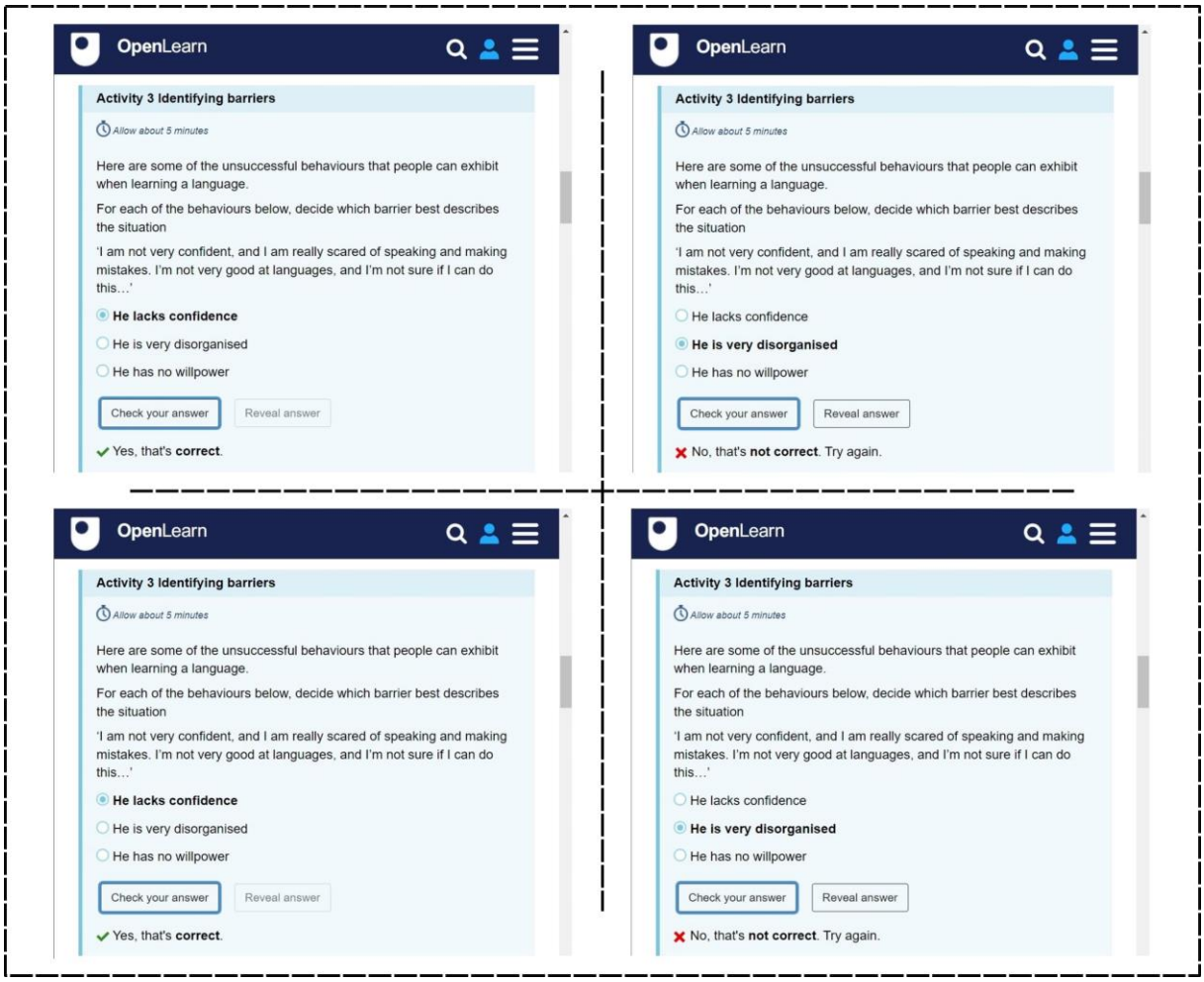

Figure 14. Screenshots of formative evaluations with a deterministic algorithm.

The two images on the top show comments on a user's correct and wrong answers. The bottom images indicate that the algorithm generates identical output when a different user profile is used to provide input.

> Pathways begin and end at the "OpenLearn profile," an assemblage of GUI components and algorithms capturing and displaying data related to the learner's prior and future education. Like the course navigation menu, the profile displays the learning progress as linear, visual, and numeric representations. A detailed activity record can be consulted, showing the date specific modules were completed. The certificate of participation is awarded if a course is completed and the progress bar and record are filled. Course completion is visualised on the profile as an "achievement" that can be made public to other people or kept private. The learner gains control over the profile's privacy settings and can decide what data (e.g., biographical information, pictures, and interests) are made visible to others.
>
> The latter section of the profile allows learners to declare topics and skills that match their self-proclaimed interests. After finishing *How to learn a language,* entering "interests" into the profile becomes the input that generates recommendations on the GUI (see coloured nodes in Figure 15). Keywords such as "languages," "Chinese," or "French" become input data for the recommendation algorithm and provide specific, matching outputs: lists of courses, university degrees, materials, and other learners (purple nodes). For instance, the algorithmic output recommends taking more introductory language courses on OpenLearn, such as "Everyday English 1," and courses that correspond with the learner's provided keywords, such as "Beginner's Chinese." The profile (orange node) also generates a collection of related articles, like "Chinese education" and "Year of the Rat: Chinese New Year." In a way, a learning pathway is altered when learners click and pursue the options the platform recommends (e.g., "Beginner's French" on the bottom of Figure 15).
>
> Furthermore, since OpenLearn is "the home of free learning" from The Open University, the user profile also connects the learner to university courses and degrees on top of platform-based resources (Figure 16). A clickable banner, revealing a university building and logo, continuously advertises the OU on the platform by encouraging every learner to take their "learning further" and "become an OU student." The recommendation section of the user profile is filled with OU courses that echo the keywords the learner provides—in this case, "languages." Consequently, the algorithm and GUI characterising the user profile connect the learner to the old and new educational possibilities on and beyond the OpenLearn platform.

The descriptions and images show how an open education platform bundles, un-bundles and re-bundles educational resources and, therefore, plays an intermediating role in selecting and organising pathways for the learner (cf. Decuypere et al., 2021). Others have argued that a MOOC platform's "core unit of trade is not a *curriculum* but a *course* – a single unit that can be 'unbundled' and 'rebundled' into an online 'product' that is offered outside of a local college" (van Dijck et al., 2018, p. 127). However, OpenLearn's algorithms and GUI contribute in (un/re)making a curriculum by selecting one or more related resources from the platform catalogue, university courses, or full-blown bachelor's and master's degrees from The Open University itself. Hence, OpenLearn does not appear as a neutral, passive tool that only facilitates flexible or unbundled education comprised of separate courses (Orr et al., 2019; Veletsianos & Houlden, 2019). The

platform architecture includes as well as excludes future possibilities by selecting and recommending specific "bundles" of varying size and complexity (e.g., articles, courses, MOOCs, programs). While these recommendations help create new possibilities, they also risk reinforcing past decisions and offering more of the same (R. Edwards & Fenwick, 2017). As algorithms compute the learner's keywords as interests (input) to recommend matching resources (output), they simultaneously take in similar bundles and leave out dissimilar ones. When the platform hides subjects that do not relate to the learner's interests, it forecloses possible pathways and establishes a "filer bubble" that intensifies prior directions (Pariser, 2011).

In sum, even though the open learner chooses from a catalogue with various disaggregated and supposedly flexible educational resources, the learner is also made to choose by the platform architecture and (re)aggregate them differently. As technology, it delineates a particular script or frame in which the user is allowed to act (Akrich, 1992). Selected pathways may be adapted to personal needs and capabilities, tackle spatiotemporal barriers preventing access, or serve economic rather than societal interests (Veletsianos & Houlden, 2019). However, the case of OpenLearn shows some of the complexities and contingencies regarding how a flexible curriculum is described, prescribed, and enacted today. Learners do not simply choose resources to make a flexible curriculum; the platform equally *makes learners choose* and directs their running of one or more courses.

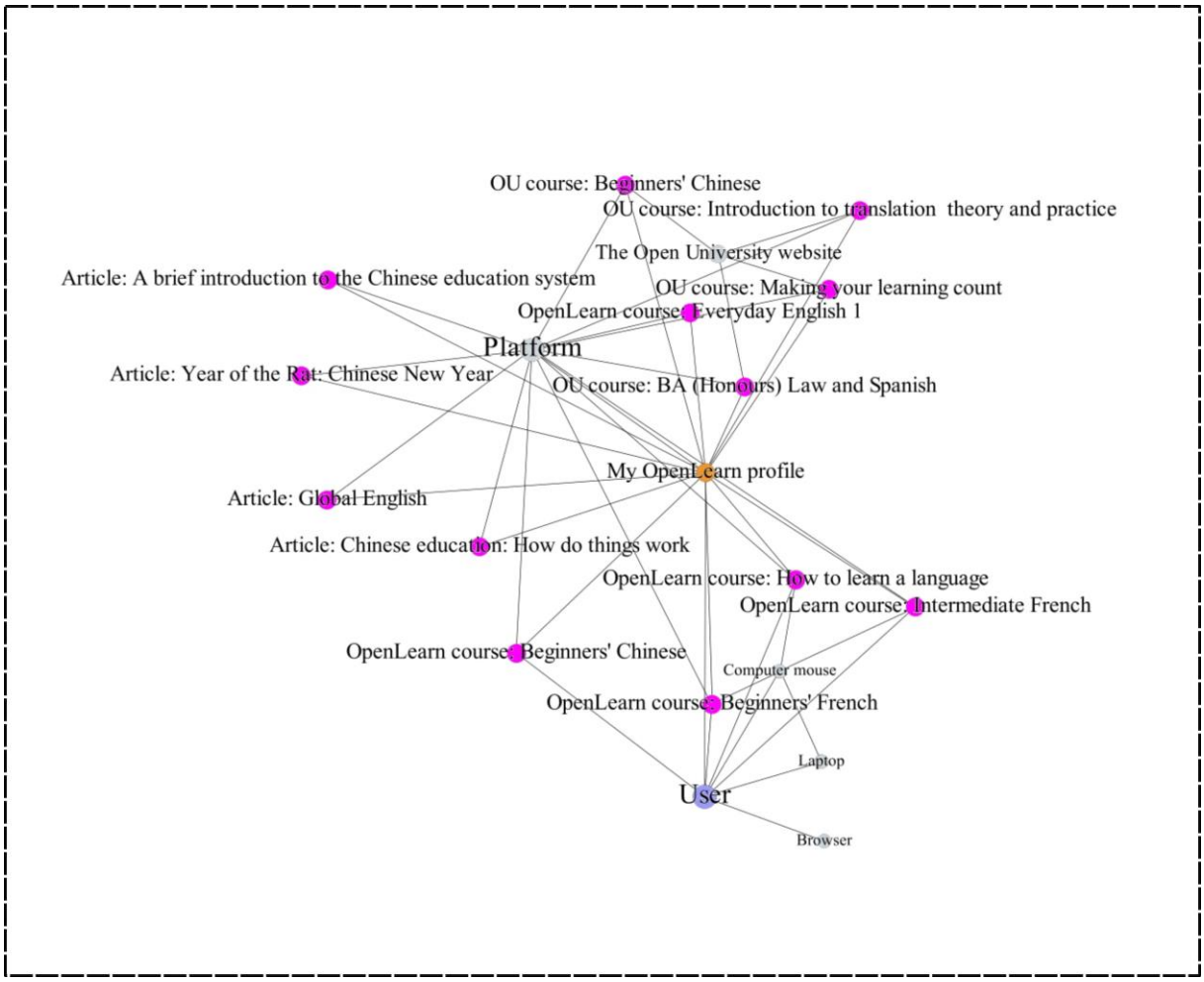

Figure 15. Network diagram of courses, articles, and programs being algorithmically rebundled on the user profile.

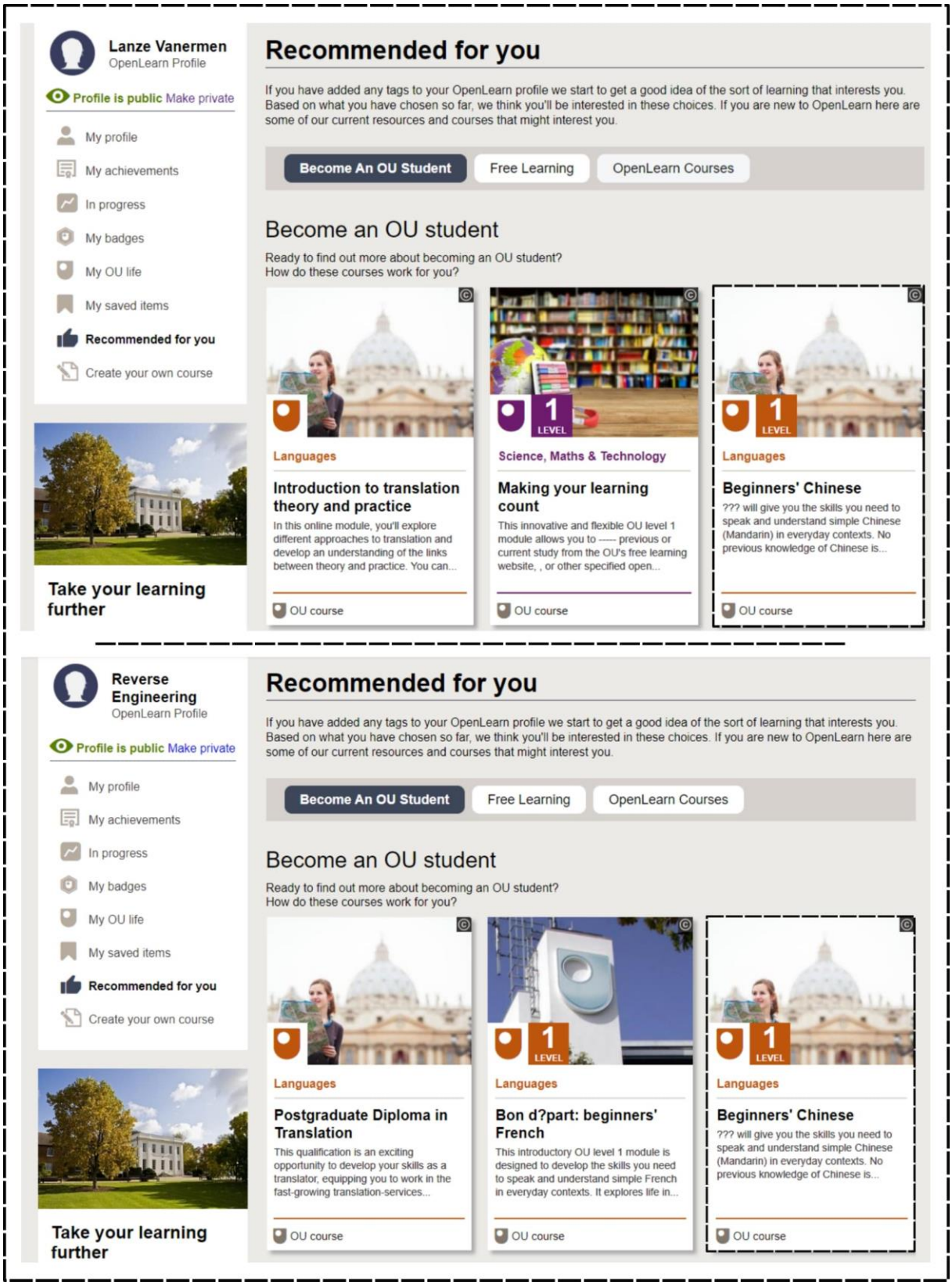

Figure 16. Screenshots of the platform recommending pathways that match the learner's keywords.

The image on the top shows results generated on the user profile. The image on the bottom indicates that the algorithm depicts similar output on a different user profile when given the same input.

Concluding discussion: From a 'flexible pathway' to a 'platform curriculum'

We started this chapter by arguing the trope of 'flexibility' has proliferated in the open and higher education landscape and risks instrumentalising flexible pathways and digital technologies as mere tools for curricular enhancement and facilitation (e.g., Koul & Nayar, 2021; Li et al., 2018). We adopted insights from curriculum studies and STS to empirically analyse and conceptualise how a platform in open education, OpenLearn, idealises, presumes, and performs a specific kind of curriculum (see Fenwick & Edwards, 2010). Whereas curriculum studies scholars have indicated that curricular practices are intertwined with supposedly disruptive technologies and materials (Krause, 2022; Priestley & Philippou, 2018), how technologies make curriculum or *currere* alongside humans remained undervalued (Fenwick & Edwards, 2010). Scholars who consider the distributed agency of technologies in relation to curriculum have done so under the flag of actor-network theory, a sub-section of the STS field (e.g., Carroll, 2018), but have not yet recounted the intricate ways commercial and public platforms today alter (open) educational practices, classrooms, and pedagogies (see Cone, 2021; Decuypere, 2019c; Sefton-Green, 2021; van de Oudeweetering & Decuypere, 2019). Approaching curriculum as a collection of sociotechnical practices helped us to acknowledge established and more recent actors in education. The STS approach allowed us to critically investigate how platform architectures, through algorithms and graphic user interfaces, enable and constrain the user when running a certain course (Bratton, 2015; Bucher, 2018; R. Edwards, 2015a).

The case of OpenLearn demonstrated specific ways an open education platform contributes to curriculum making under the conditions of intensifying flexibility in open and higher education. Findings helped to expand on the trope of curriculum as "multi-layered social practices" (see Priestley, 2019) by showing how entanglements of human and other-than-human actors describe, prescribe, and enact curriculum as a collection of sociotechnical practices (R. Edwards, 2011). Several methods led to textual accounts and visual diagrams for scrutinising and de-familiarising the networks involved (Decuypere, 2020). The diagrams presented five concatenating curricular practices in which the platform is: (1) prescribing an (in)flexible curriculum for the open learner; (2) enrolling the open learner in informal education as a step-up to university education; (3) mobilising educational resources for the open learner; (4) evaluating the open learner through algorithmic means; and (5) rebundling resources into potential pathways on and beyond the platform. Flexibilisation, here, does not only refer to the fact that the learner can assemble an individual pathway of courses revolving around their personal (work)life or serving economic purposes (Houlden & Veletsianos, 2021). What matters here is that the platform enables and constrains the learner and thus contributes to a specific sort of (in)flexibility. Platforms disassemble

– or unbundle – comprehensive programs to individual, linear pathways and can reassemble new, diverging ones by intermediating their and others' educational resources, courses, and programs (cf. Decuypere et al., 2021; McCowan, 2017; van Dijck et al., 2018).

Given these findings, we propose the concept of *platform curriculum* as a specific form of in/flexible curriculum that is the result of humans, materials, and technologies (pre)ordering education in specific but contingent directions (cf. Nespor, 1994). A platform curriculum enables flexible education in the sense that the learner gains access to various courses at convenient yet specific times and spaces for personal or economic purposes (see Veletsianos & Houlden, 2019). At the same time, this form of curriculum limits the learner's engagement with educational materials during courses via prescribed outcomes that should be attained, an interface that presupposes specific usage, and preformatted algorithmic output. We argue that these tensions and the intertwinements between learners, contents, goals, and (digital) technologies call for an adjusted vocabulary that understands 'curriculum' as an effect of sociotechnical practices (Fenwick & Edwards, 2010). Situating this platform curriculum in a wider ecology (see T. P. Nichols & LeBlanc, 2021) helps bring into view the idealising narratives that attempt to set conditions for the running of a course.

The 'platform curriculum' can serve as a sensitising concept for attending to practices when/where digital technologies make a difference in sequencing a course of actions and bundle, unbundle, and rebundle educational programs. Researchers can draw on the trope of 'platform curriculum' to complicate definitions of "curriculum as technology," mere instruments for instructing taken-for-granted educational designs and content. The concept also offers researchers a way to acknowledge the material involvement of digital platforms in education and knowledge-making instead of reducing them to "technologies for curriculum" (cf. Eisner & Vallance, 1974, p. 7). As if platforms only facilitate education. In doing so, we want this written contribution to open up a discussion and avenue for curriculum researchers to investigate how pathways are (un/re)made in relation to platforms. We hope the OpenLearn case encourages researchers to go beyond the idea "that digital platforms suggest an eternal process of school enrolment – a classroom we can never leave, a form of certification to which we all continuously aspire" (Sefton-Green, 2021, p. 11). OpenLearn suggested a variety of resources on and beyond the platform, though these predominantly stayed within the ecosystem of the OU.

Open and higher education research will likely continue to see an unbundling of programs into disaggregated courses and modules as well as the financial and organisational complexities that come with it (Ivancheva et al., 2020). Researchers may equally encounter a rebundling of courses into more market-oriented programs that benefit some universities more than others and can

pressure their public purpose in the future (see Cliff et al., 2022; Swinnerton et al., 2020). Popular education platforms (Coursera, EdX, FutureLearn) progressively create comprehensive programs via partnering universities and companies in response to the labour market's needs while experimenting with monetisation and datafication strategies (Reich, 2020; van Dijck et al., 2018). OpenLearn does not yet provide comprehensive programs and remains free from start to finish because of its connection to The Open University and public purpose. However, such initiatives become the exception rather than the rule as commercial initiatives steadily characterise the open and higher education landscape. Zeroing in on a platform curriculum lets researchers recognise the doings of digital architectures (Bratton, 2015), situate them in a wider ecology (T. P. Nichols & LeBlanc, 2021), and specify how educational practices are made (im)possible for a particular kind of learner. In approaching curriculum and technology together through the theoretical and methodological sensitivities of two fields, curriculum studies and STS, we invite these fields to enter (again) into a closer conversation, given their joint interest in the politics of practices. Rather than taking curricula and platforms at face value, analysing how 'curriculum meets platform' may aid in shedding a more profound and nuanced light on the running of a course in times of increasing digitisation, flexible or otherwise.

PART 2:

THE PLATFORMISATION OF AN OPEN AND DISTANCE UNIVERSITY

CHAPTER 3: EDUCATIONAL VANISHING POINTS

Platform interoperability, the ability of digital architectures to work together and exchange data, is proliferating in education research and practice but requires further investigation, especially in higher education. In this chapter, we aim to scrutinise how platforms enact specific ways of (inter)operating and contribute to the intersection of critical data infrastructure studies and platform studies in education. We adopt a concomitant, ethnographic approach regarding platforms and infrastructures to analyse how humans and other-than-humans do interoperability and the ramifications for knowing their environments. Employing Hannah Knox's concept of 'vanishing points', we demonstrate how data movements across a university's platform-infrastructure become self-evident or, conversely, highlighted in everyday life. Findings detail ways an open and distance university's supposedly interoperable platform turns infrastructural while enacting specific modes of operating: cooperating, teaching, transforming, intermitting, and dis/appearing are all effects of relations amongst technologies, materialities and humans. The findings thereby complicate the inter/intra dichotomy and imaginary of a seamlessly interoperable platform to one with multiple, messy, value-laden operations entailing sociotechnical and political consequences. We advance the notion of 'educational vanishing points', when/where education platforms turn infrastructural and back, so others can scrutinise platform dependencies, pedagogical underpinnings and reconfigurations of how actors come to know each other and the world.

This chapter is based on: Vanermen, L., Vlieghe, J., & Decuypere, M. (2024). Educational vanishing points: Or how interoperable platforms turn infrastructural and back in higher education. In B. Williamson, J. Komljenovic, & K. Gulson (Eds.), World Yearbook of Education 2024: *Digitalisation of education in the era of algorithms, automation, and artificial intelligence* (pp. 70-86). Routledge.

Introduction

Digital education platforms, programmed architectures that operate in and are constitutive of emerging organisational forms across the education landscape, increasingly forge relations with other digital technologies. These relations typically entail data, information, or content exchanges among public, commercial, and governmental actors to improve education and associated management practices (Decuypere et al., 2021; Pangrazio et al., 2023). Learning management systems (LMS), student information systems, and digital assessment systems are examples of platforms that researchers and practitioners have long been trying to link because of alleged gains in cost-effectiveness, efficiency, and innovation. LMS platforms like Moodle or Blackboard are

being used worldwide because of their ability to communicate or work *with* other platforms – that is, to interoperate – thereby integrating data and services from those platforms (e.g., for proctoring or conferencing) while only needing a single user sign-on (Bakhouyi et al., 2017; Chirumamilla & Sindre, 2021; Naim & Alahmari, 2020). From a technical perspective, platform interoperability is seen as "the capacity of an autonomous system to exchange considerable information and start actions that belong to other systems in order to operate together and accomplish a common advantage" (Jakimoski, 2016, p. 33). While the idea of such autonomous platforms is attractive, critical researchers have begun to highlight that platforms work *because of* wider infrastructures supporting the employment of data for informing and governing education (Piromalli, 2022).

With this chapter, we aim to contribute to the growing body of critical scholarship at the intersection of platform studies and infrastructure studies by investigating at least some aspects of platforms *as* infrastructures and how they *do* interoperability in higher education (cf. Plantin et al., 2018). Platform and infrastructure research is best done concomitantly, through a cross-pollination of vocabularies and insights that attunes researchers to the complexities of both platforms and infrastructures. In sectors beyond education, a transport firm like Uber acts and is organised as data-driven platform to optimise relations (e.g., between consumers and providers) and requires a wider infrastructure (e.g., roads, data centres, standards, platforms) to realise its mobility services (Constantinides et al., 2018). In education, educators and administrative staff become gradually more dependent on an interconnected infrastructure of platforms for data-driven decision-making. Data infrastructures include, for instance, the repositories for storing, retrieving, and managing information about student attendance and performance. Well-established platforms, such as LMSs, are progressively working within, with, and because of such data infrastructures to power learning analytics dashboards that inform pedagogical actions (Perrotta, 2021). A conjoined approach is helpful since learning, teaching, and related management practices increasingly rely on data infrastructures, i.e., the assemblages of objects, people, standards, and policies working to process data in/for education (Sellar, 2015).

Researchers interested in the operations of data infrastructures and platforms have pointed to at least two overlapping educational issues. The first issue revolves around *governing education*, the ways education is given form when platforms, often from commercial vendors, get "plugged into" data infrastructures of public institutions and function as "relays" for enacting particular ideas about education (Williamson, 2018, p. 1). Platforms create proprietary connections when they integrate technology for content, information, or data exchanges exclusively within the architectural and organisational boundaries of one commercial owner and govern other organisations by delineating what can(not) be done within those boundaries. This is typically

referred to as intra-operability, the capacity of hardware, software, data formats, and other infrastructural nodes to support exchanges within a single – and therefore more dominant – actor's ecosystem (Sutor, 2011). Educational institutions and infrastructures, then, risk becoming dependent on intraoperable platforms, which potentially engenders issues regarding data control, lock-ins/lockouts of other actors, student/teacher agency, and may pressure public education values. To safeguard the public aspect of education, some stakeholders favour inter-operability because it allegedly ensures open, transparent connections between technologies that can be negotiated/controlled by public actors (Kerssens & van Dijck, 2021). A second, related, and more frequently overlooked issue concerns *knowing education*. Research shows interconnected technologies do more than capture, exchange, and process (depersonalised) data for research, policy, and practice; they also prompt data-driven decisions that, in turn, transform infrastructures for managing, monitoring, and assessing education. Aspects of education, for example, comparing student or school performance through platforms, are turned into data and become de- and recontextualised across national education landscapes (Hartong et al., 2021; H. Ratner & Gad, 2019). Given that these critical studies primarily scrutinise platform operations in compulsory education, there still is a lack of empirical and theoretical insights from elsewhere about operations – inter, intra, and otherwise – as a socio-technical practice in which platforms, infrastructures, standards, and humans can play an active role (Hodapp & Hanelt, 2022). More specifically, researchers have yet to demonstrate how platform-infrastructure operations transform the way people *enact* and *know* higher education practices in light of often hidden data work (cf. R. Edwards & Fenwick, 2017).

Given this research gap, we seek to answer the following questions: (1) How does a digital education platform, working with, as, and because of data infrastructure, enact specific modes of operating in higher education? (2) What consequences do these different socio-technical operations pose for knowing practices in higher education? We will zoom in on an open and distance university in Europe, its LMS platform and related actors especially, when it undergoes an infrastructural overhaul to become a "digital university". It offers a telling case about platform operations with other infrastructural components and the implications for university life.

An STS approach to the operations of platform-infrastructures

We draw from critical platform studies and (data) infrastructure studies because they offer theoretical and methodological resources to analyse pervasive socio-technical operations – relations or doings – enacted by and through platforms (Decuypere, 2019c; Easterling, 2014). They are situated in the science and technology studies (STS), an interdisciplinary field with a particular strength for reimagining restrictive analytical binaries (e.g., inter/intra, social/technical,

visible/invisible) by attending to the fluidity and heterogeneity of platforms and infrastructures (J. Law, 2002, 2004). Both have been understood as assemblages of human and other-than-human actors that effectuate change in multiple ways and mundane situations within and beyond education (Decuypere et al., 2021; Hartong, 2020; Piattoeva & Saari, 2022).

Thinking with resources from infrastructure studies provides an analytical edge for understanding how heterogeneous actors pre-structure everyday practices, how people re-structure them, and mutual dependencies become (in)visible (Easterling, 2014). Following Hannah Knox (2017a), we focus on *vanishing points* to trace the moment when (and where) technologies turn infrastructural. The concept of vanishing points originates from perspective drawing and expresses the visual effect "where lines converge into a point of disappearance" (p. 357). Exemplary is when/where railroads blend with the horizon and disappear into the distance, no longer visible to the naked eye. Thinking about data infrastructures in terms of vanishing helps imagine their double life: technologies can (literally) vanish by moving out of sight and (figuratively) by becoming self-evident in people's routines. Conversely, infrastructures can become (again, literally) visible by repositioning oneself, or (figuratively) becoming aware of the "overt points of contact and access" between actors sending implicit messages about what can or cannot be done to delineate users' lives (Easterling, 2014, p. 10). Infrastructures thus have more and less apparent implications for how humans can act and "come to think about the world" (Slota & Bowker, 2017, p. 529). Infrastructures, those in education included, are not static but rather an ongoing process of infrastructuring that contributes to the stabilisation and destabilisation of educational practices in specific ways (van de Oudeweetering & Decuypere, 2021). Taking infrastructures as an analytical dimension besides platforms, helps identify vanishing operations of actors and their ramifications.

Resources from critical platform studies, in turn, bring into view how platforms become *self-evident* for users as infrastructures despite actively (re)configuring their practices. Think, for instance, about how people have woven social media platforms into their daily habits of communicating with others (van Dijck, 2013, p. 155). Education researchers suggest that platforms operate in everyday practices according to specific pedagogical underpinnings (e.g., behaviourism) and reshape specific kinds of learning and teaching relations (e.g., feedback on observable behaviour) (Decuypere et al., 2021). Platforms "teach" users to operate technologies and conform to particular educational principles, and users "learn" the possibilities and constraints of those technologies (Sefton-Green & Pangrazio, 2021). Moreover, technologies and operations for educational purposes become situated in and constitutive of taken-for-granted infrastructures. Learning/teaching with laptops, for example, is interwoven with Internet technologies in school buildings but their interdependencies typically only reveal themselves upon cutting wireless

connections or cables (Alirezabeigi et al., 2020). Platforms thus gain and lose their infrastructural qualities as people (learn to) use technologies, which is of interest to demonstrate how things could be different (Plantin et al., 2018). A platform-infrastructure approach, then, permits analysing how platform operations reconfigure mundane practices and how people come to know and live with seemingly self-evident entities. Approaching educational practices in terms of platforms and infrastructures means attending to moments/places technologies become normal yet altering aspects of life in educational settings, or not.

Both platform studies and infrastructure studies recognise that technologies are *made operable* through standards (see Hodapp & Hanelt, 2022). These "agreed-upon rules" make things work together; they enable different entities to operate across space and time, can be called upon by organisations and governments, and possibly be enforced by legal bodies (Bowker & Star, 2000, p. 13). Standards, such as those issued by the International Organisation for Standardization, have been widely acknowledged as political acts with far-reaching consequences for the interoperability of systems found in organisations (Sutor, 2011). Data standards, for example, have allowed platforms to plug into higher education infrastructures so data can be gathered, shared, analysed, monitored and reported (Williamson, 2018). Standards first make platform interoperability possible and then have consequences for who/what is made visible and invisible on data visualisations specifically, or included in and excluded from educational settings more generally (Piromalli, 2022). Therefore, a platform-infrastructure approach necessitates taking the standardising work of humans, technologies, and policies into account to acknowledge the modalities for socio-technical operations in education.

Furthermore, we as researchers equally "operated" by performing a digital *ethnography* to scrutinise the relational production and deployment of technologies *in situ*. Such a take on ethnography foregoes an understanding of platforms that essentialises the work of non-human actors or takes them for granted as neutral backdrops of social life (Pink et al., 2016). The data from our fieldwork at the university was analysed by paying attention to vanishing points, platforms turning infrastructural (and back), and considering their ambivalent (in)visibilities head-on. The ethnography allowed us to deal with the "partially visible, accessible only from a particular vantage point or via diagrammatic abstraction" (H. Knox, 2017a, p. 358). The first author did eight months of fieldwork with several protocols (Appendix B), followed by an inductive data analysis and collective thinking with the aforementioned theoretical resources (LeCompte & Schensul, 2013). The data collection involved making descriptions and screenshots of different operations regarding the open and distance university's digital education platform (Learniversity), technical walkthroughs of its graphical user interface, and other related systems. A total of 14 semi-structured

interviews with participants (students, educators, and supporting staff) were conducted, elucidating who and what in their day-to-day activities operated with data-driven technologies. The interviews were supplemented by 13 observations to shed further light on people's interactions with other actors. Over 50 documents, websites, and diagrams were scrutinised to further situate relations at the university undergoing an infrastructural overhaul.

The case of Learniversity

This section details the conditions for and modes of platform operations, and their consequences. Figure 17 is provided as a reading guide that accompanies the different operations analysed below.

Cooperating: Operations that make platforms work

> In a written report from 2021, the rector announced an infrastructure project called "The Digital University" to "modernise the university's hidden technical architecture". Employees and students have been relying for years on the university-made and open-source LMS, Learniversity, to organise their open and distance education; IT personnel, educators, project coordinators, system designers, and programmers all make the LMS operational, i.e., integrated into the university infrastructure (Figure 17A). Lanze, the first author of this chapter, reads in the report the modernisation project is directed at platforms for online distance "education, work, and interactions" and marks a discontinuity in the university leadership's pre-pandemic plans to endorse Learniversity's further development. Instead, Learniversity is being "disintegrated" since people gradually stop developing, maintaining, and using it. The report's financial section foreshadows the €2,5 million infrastructure investment and implications for technologies and people: platforms are replaced, and employees relocated to different departments. The "infrastructural overhaul" triggered ambivalent responses from employees and students about platform use, purpose, and development.
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> Hunter, an employee, has a long history of developing Learniversity and is now part of the team replacing it. He usually prepares the LMS's default settings and templates (e.g., for online course modules) and has just wrapped up negotiations with potential platform providers that uphold free/open-source or proprietary standards. "We made a good choice," Hunter says in an interview with Lanze, and after the higher-level management had selected a commercial vendor, "they [Brightspace] can build on much of our work." At the same time, he expresses "mixed feelings" about cooperating with Brightspace. While Hunter recognises this "off-the-shelf platform" could be interoperable, that is, capable of "connecting to different systems", he voices reservations about the university's dependency on proprietary technology. "I am much more in favour of 'open' thinking; that we continue working with open-source applications." Learniversity is embedded in an open-source infrastructure of cooperative platforms, named Apache Kafka, which gives Hunter and his colleagues some freedom to alter templates and programming, and to retain ownership over data. He had hoped to grow Learniversity: "We could develop things much more nationally with other universities. We are mainly financed with public money. Let's give it back so others can benefit from it."

The foreseen re-platformisation of infrastructure, including its underpinning open values, stirs controversy about the *cooperation* between professionals, technologies, and standards needed

to *make* the university's platforms operational. A platform typically starts working as infrastructure when it provides comprehensive coverage of services and becomes embedded in, embroiders on, and competes with other infrastructural nodes. Conversely, the "platformisation of infrastructure" means the existing, dependable digital architecture makes way for an externally owned alternative (Plantin et al., 2018, p. 306). In this case, employees maintain the existing platform (Learniversity) but prepare its replacement with another platform (Brightspace) in the cooperative, open-source infrastructure (Kafka), thus disrupting everyday routines. The story resonates with other data infrastructure undertakings in higher education where the emergence of a new hidden architecture induced a turn to different "experts, standards, values and practices that will permit new big data technologies to be plugged-in to institutions and processes" (Williamson, 2018, p. 1). Standards enable actors in sociomaterial assemblages to cooperate but also inevitably favour some values over others – here, proprietary over open ones (Slota & Bowker, 2017). Therefore, the replatformisation of university infrastructure is as much a technical as a social endeavour: besides technical features, the (anticipation of) proprietary technology (Brightspace) instigates an infrastructural reorganisation since its standards delineate who (e.g., developers) will be permitted to work (e.g., adjusting templates) on/with technologies. Before plugging into the infrastructure, an education platform's standards already (re)organise the *cooperations* amongst existing and impending actors needed to make platforms operate.

The university's leadership described the platforms as a "hidden architecture", suggesting they have mere technical, neutral characteristics. Being reported as the "background" of social life, these vanishing digital architectures *become infrastructural* in the sense that they (pre)structure people's daily activities, but their dependencies are not always acknowledged. Regardless, the reorganisation of employee-technology relations engenders and emphasises the politics of infrastructure (H. Knox, 2017a). In contrast to research that primarily approaches platforms as some-*thing*, requiring the right set of knowledge to overcome technical problems (e.g., Bakhouyi et al., 2017), the university's debate is not settled by determining what standards or technologies are "better" for education. The controversy arising from the alleged modernisation demonstrates how some-*one* brings education infrastructure back into view when expressing the *educational* values (e.g., open and cooperative thinking) they wish to live by, namely, a freer mode of *operating together* with humans, technologies, and organisations.

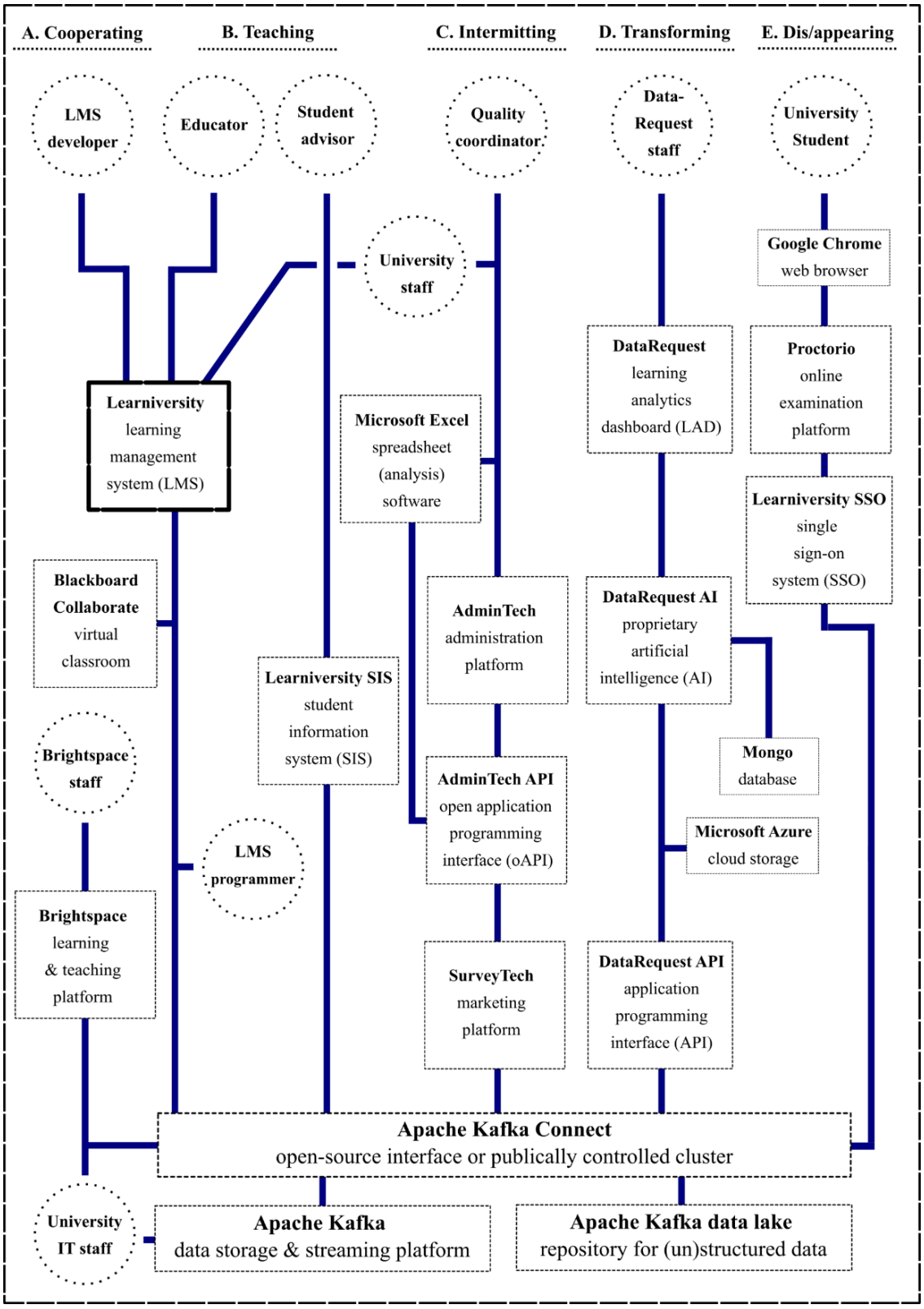

Figure 17. Diagram of the analysed platform-infrastructure and its operations.

The diagram shows heterogeneous actors (nodes) and the operations (lines) amongst specific actors. The names of these operations are indicated on the top with a letter. The diagram was made manually in the free and open-source vector graphics editor called Inkscape as a way of paying attention to the partially visible aspects of the platform-infrastructure.

Teaching: Pedagogical operations that attune platforms to education

> Unlike her colleague, student advisor Rose takes no issue with the modernisation of infrastructure when she shows Lanze the student information system (SIS) of Learniversity. She uses the SIS to answer students' questions about learning pathways, credits, or methods and seeks to (re)engage them in open and distance learning (Figure 17B). Rose rarely uses the "tools" educators rely on and has already seen several platforms come and go. The current LMS only exchanges data with the SIS whenever a student has completed a course, turned in an assignment, or completed a task, and thus tells her little about their study practices (e.g., reading handbooks). Scarce student data about proxies for learning (e.g., uncompleted course status) move from the LMS via another platform (Kafka) to the SIS dashboard. What matters for Rose is that a new platform replaces, or is more interoperable with, the SIS so she can monitor students' learning pathways, know their progress, and intervene if disengaged. "Because now," she says in an interview, "all I can do is give advice. I have no idea what students' next steps are in our bachelor's program unless they have a study plan that they stick to. I don't even know what to email them about. The university will improve when all systems start to connect."
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> Michael, on the other hand, is an educator who is not yet on board with the decision to replace Learniversity because he values the "activating, personal, and self-paced education" it enables. "On Learniversity," he tells Lanze in an interview, "the course structure has been divided into weeks, and tasks are divided further within those weeks." Michael takes care of these online learning pathways daily, assisted by "automatic feedback and all kinds of feedback functionalities" allowing him to attend to students' questions and assignments from a geographical distance. Learniversity has been designed for the university's constructivist pedagogy, emphasising student interactions with peers and educators through the affordances of digital technology. Michael's "major concern" revolves around the LMS's replacement with a generic platform that may not be attuned enough to the preferred pedagogy. "Learniversity," he stresses, "is essential for how our education is now organised". Notwithstanding, he hopes it will be possible to automatically transfer his content modules from the old to the new platform by late 2022; that is when the Brightspace platform should be operational and aligned with his teaching.

Open and distance education in the form of online learning modules generally depends on a combination of platforms, IT staff, and prescribed learning objectives. Research following a solely technical approach to infrastructures considers "tools" (platforms) and carefully evaluated "formats" (modules) to be essential components for achieving such objectives but undervalues the role of human pedagogical actors herein (e.g., Moore & Fodrey, 2018). Practitioners, though, are often aware data-driven technologies configure their work in education (Hartong et al., 2021; Pangrazio et al., 2023). The university's case shows how a more extensive infrastructure of intertwined technologies (e.g., Learniversity, databases) and professionals (e.g., educators and advisors) operate together to perform higher open and distance education. Whereas the human and educational contributions in the platform-infrastructure disappear from narratives, and consequently seem undervalued, they reappear through the conjoint operations of *pedagogical* actors – human and non-human – in teaching practices.

What is at stake here is that simplifying digital platforms to generic, interchangeable tools within the infrastructure risks overlooking the pedagogical values (e.g., students should construct knowledge through active engagement) that inform people's technology-mediated teaching. It has been argued that platforms monitor, structure, and reward students' activities in an invisible manner and this pedagogical dimension poses risks to education (Sefton-Green & Pangrazio, 2021). While it is alluring to view technologies only as standalone automated systems exchanging data between each other, users equally operate with platforms to intervene on practices. Operations constitute literal vanishing points (H. Knox, 2017a): student data disappear from human eyes when, for example, buttons are clicked and reappear once reductive representations of learning progresses are visualised. In this case, the platforms (e.g., LMS, SIS) and data actively enable/constrain the educator's and advisor's teaching; together, they perform a pedagogy of attending to students and (re)engaging them (e.g., by sending messages) in meaningful activities. Here, the educational infrastructure – platforms, data, advisor, and educator – engender *teaching operations* to follow-up and intervene on learning practices according to ideals about "good" teaching.

Intermitting: Operations that stop and start platforms repeatedly

> The infrastructural overhaul is also expected to make data work via education, marketing, and administration platforms more efficient (Figure 17C). A quality coordinator, Elly, demonstrates to Lanze how she uses Learniversity-related applications to evaluate course performance. Students are asked to make quality evaluations during their final course module through a survey that Elly and her colleagues prepare. "When I look on Learniversity," she explains, "I can't see what settings are on the back of a course. I have access to specific functionalities but need certain rights to make changes. I email someone from the bachelor program to do that." Legal standards, following the General Data Protection Regulation (GDPR), specify who can access data, meaning Elly and her colleagues only have a partial view. "He does not need to know what is in the survey, just that things are properly linked in the system. And I cannot see the technical side." Consequently, the evaluation process is frequently interrupted before the data are stored on a marketing platform (SurveyTech).
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> Next, the aggregation of student data into an "evaluation history log" does not happen without effort either. Elly copy-pastes a course's identification code to AdminTech, an administrative platform, to retrieve the spreadsheet with responses. Using Microsoft Excel, she automatically pseudonymises personal information, extracts data about gender, birth year, and course performance, and transfers these to another spreadsheet. However, "the exchange between Excel and the administration platform often goes wrong," Elly says. AdminTech's database should generate reports with longitudinal graphs about course performance automatically, but local Excel files and AdminTech only synchronise once per day to avoid network overloads. Lanze observes a screen indicates: "this site is not available. [Authentication number] has refused the connection." Any rendered visualisation is incomplete and inaccurate. Therefore, Elly makes the graphs manually with interlinked spreadsheets. But since these increase her workload, she hopes the modernisation provides a steadier, interoperable cloud platform.

The employee demonstrates a specific sort of operability, a capacity to exchange in/accessible data amongst specific socio-technical actors involved in the course performance evaluations. Here again, then, we see platforms constitute vanishing points, moments and places at which technology (i.e., data) literally becomes invisible for humans from a particular position (H. Knox, 2017a). The data exchanges are not straightforwardly open/transparent to everyone involved: depending on the roles and assigned rights, the quality coordinator and researcher see data appear (e.g., original survey), disappear (e.g., survey on Learniversity) and reappear (e.g., downloaded AdminTech spreadsheet). Given certain legal and technical standards, data *have to* move in and out of sight for specific actors to ensure responsible usage. Our inquiry thus concretely shows that interoperability is not solely the ability of two technical actors making open connections (cf. Jakimoski, 2016). Rather than that, the university's infrastructure indicates data operations are sometimes designed to be interrupted, for instance, to prevent network overloads or protect privacy, and necessitate intensive *human* work.

Similar to other education infrastructures, these heterogeneous assemblages do delineate data flows between several platforms and employees to enact a mode of interoperability (Pangrazio et al., 2023). Indeed, professionals (e.g., the quality advisor) and platforms (e.g., for marketing) within universities work with, depend on, and act as infrastructures at the backside of educational practices, resulting in educational governance through data (Piromalli, 2022). The case shows how the coordinator has to stop and start her data transfers repeatedly to make performance evaluations possible, consequently increasing her workload. Instead of always moving data "seamlessly", we thus argue these socio-technical assemblages equally perform *intermittent operations* by (dis/re)connecting at certain points.

Transforming: Operations that cross and change platforms

> One step towards the further infrastructural modernisation is a recently developed learning analytics dashboard (see also Chapter 4); the result from a partnership between an education technology (edtech) company (DataQuest) and the open and distance education institution (Figure 17D). The university's project leader, Wyatt, explains this to Lanze during another interview: "We wanted a monitoring tool that we can connect to Learniversity to extract and visualise more information from it". Information is derived from student interactions with the LMS (e.g., proxies about learning such as clicks) and is used to inform people's teaching/learning. Wyatt's task was to negotiate with the company's project manager, designers, educationalists, and programmers, and to deliver a tailor-made dashboard that aligns with the university's pedagogical and legal standards. Such tailoring, however, comes at a price. Expensive technologies were needed to "transform the existing infrastructure and make the dashboard work".
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> One of these "expensive technologies" is DataQuest's application programming interface (API), "a connective surface" wedged between the company's dashboard and the

> university's data infrastructure. The commercial API ensures student data move from a university-controlled database to the dashboard designed and delivered by the company. More specifically, a report states the student data captured via the LMS first flow via Kafka's open interface to the "Kafka data late," a centralised open-source repository for (un)structured data and hosted by public organisations. "The lake," Wyatt clarifies, is part of the Kafka platform that organises "a real-time connection between the learning environment and other systems". The data then flow through the Kafka infrastructure to the DataQuest API and, finally, the dashboard. This ended abruptly, Wyatt knows, when "the deliverer of the monitoring tool went bankrupt". DataQuest had customised technology for "learning analytics aligning with the pedagogical views of the university staff" but "lost the confidence of investors because the company did not generate a steady flow of revenue through software licences." The bankruptcy left the university with an operative dashboard but an inoperative API. Staff members are searching for a replacement to continue the modernisation.

APIs are interfaces, typically handled by programmers and programmes, that allow several technologies (e.g., databases) to connect as long as they follow the same specifications (Perrotta, 2021). The vignette underlines how technologies, the API included, do not simply interoperate by moving data between actors (e.g., data lake, dashboard) but can equally render them *inoperable*. APIs, establishing the connective tissue of LMSs and analytics platforms, operate across various infrastructural nodes and, ideally, result in new or improved possibilities for several actors. Connective technologies come with infrastructural affordances, dependencies, and implications that become clear during a breakdown. That is, the "normally invisible quality of working infrastructure becomes visible when it breaks" (Bowker & Star, 2000, p. 35) and breakdowns have ramifications for which activities can be organised (Alirezabeigi et al., 2020). In this case, an initial organisational breakdown *outside* the university (the company's bankruptcy) triggers a cascade of effects including an infrastructural breakdown within the institution: as the DataQuest API turns inoperative, the dashboard stops working as an interoperable part of the infrastructure. The relations between public technologies (Learniversity, Kafka) and commercial ones (DataQuest) ought to synergise and visualise student data but the collapse of the latter results in socio-technical consequences for users who are unable to teach/learn with the dashboard because no one maintains the API. The breakdowns indicate the dependencies of a publicly owned open-source infrastructure on technology with proprietary standards.

Additionally, the commercial technology *transforms* the university's infrastructure into a public-private hybrid by exchanging data with other actors, which, in turn, leads to specific modes of learning/teaching with data visualisations (see also Chapter 4). Again, horizontal relations between platforms are typically named 'interoperable' when data move openly amongst a diverse constellation of platforms/organisations. Intra-operability, conversely, is usually understood as the closed, vertical relations within a platform where data primarily benefit the owner (Kerssens & van

Dijck, 2021, p. 3). Our analysis, though, complicates the straightforward understanding of ridged boundaries vis-à-vis data-driven operations between (inter) and within (intra) platforms in at least two ways. First, even if a proprietary API enables/disables data movements to a platform of the same company, it makes *transversal* connections across public (e.g., database) and commercial infrastructural elements (e.g., dashboard) so the university, and not the company, retains data ownership. The data do not stay within one environment and ultimately benefit the public institution. Second, the boundaries of actors comprising the data infrastructure are more *fluid* than rigid (cf. Piattoeva & Saari, 2022), and the described breakdowns complicate this strict conceptual boundary between inter/intra-operability. The commercial API reconfigures the company's and institution's infrastructures into a public-commercial assemblage where data vanish before reappearing as data visualisations about education. This "invisible" work becomes apparent again when the technical/organisational breakdowns render some infrastructure out of order. The concept of *trans-operability* helps recognise the fluid borders of technologies, public and otherwise, transforming infrastructures by enabling and, unintentionally, disabling the substrates educational practices rely on.

Dis/appearing: Operations that organise platform practices and knowable actors

> The university modernised how students take exams during the Covid-19 pandemic. Whereas students used to complete summative tests with university computers in brick-and-mortar examination centres, they now use personal laptops and the Proctorio assessment platform from their own homes (Figure 17E). Amber is a Psychology student whose daughter is at home during the weekend; when she is free to take exams. Amber needs to visit her own mother's apartment to do so. "This is important," she explains during an interview, "because your exam is invalid if someone were to walk through your room. My mother has no pets and goes to have coffee with her neighbour when I take the exam (laughs)." Like other students, she downloads Proctorio, uses Learniversity to log in, shows her ID card to the camera, and scans the room by turning her laptop around.
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> "One time, things didn't go so well,… technically", Amber recalls. "I had already taken several exams, but I had just bought a new laptop and had not yet used that specific web browser. I always use Firefox, but Proctorio works on Chrome." After quickly downloading the commercial browser, Proctorio signalled an active application that Amber should terminate. She remembers calling the university's support centre but, given they were closed for the weekend, had to consult the online manual instead. "And then I figured out what it was!" she says. That Saturday, Amber needed to know which privacy setting should be "switched" but failed to do so in time. "It was the exact starting time – it didn't work. The screen said it was already 'nine dot zero-zero: login time expired'". Later that month, Amber passed the extra exam opportunity the university had granted her as compensation for the technical problems.

Platforms have long been used for formative assessments, but the Covid-19 pandemic has accelerated the deployment of specialised examination platforms. These "proctors" are designed

to watch people take exams, safeguard data, and likely to integrate in a "digital ecosystem where open standards and APIs would allow for smooth integration between various tools" (Chirumamilla & Sindre, 2021, p. 15). The case, however, demonstrates how such a platform has more than technical or legal implications by reconfiguring educational practices and relations between actors (cf. Sefton-Green & Pangrazio, 2021). Here, the university infrastructure entails unforeseen consequences for students' *home infrastructure*: people, animals, and materials need to be vacated from the exam room to ensure a quiet space that does not afford cheating. The proctoring platform presumes that other actors should vanish to avoid interference with its operations. Students and their location thus need to be *in sight* of the camera and platform, while other humans, technologies, or animals are expected to remain *out of sight* by relocating temporarily.

Automatic operations of and between data-driven technologies often happen "behind the screen" and result in aspects of education becoming (literally) invisible to people (R. Edwards & Fenwick, 2017, p. 60). This has raised questions about, *inter alia*, who controls student data, for what purposes data are used, and how (cf. R. Edwards, 2015b). The story about the platform does not raise issues about data security, but rather about the dependencies amongst the actors it dis/allows. Data only move from the platform to the university's data infrastructure (Kafka) for users who install proprietary technology – the student preferred Mozilla's open-source browser (Firefox), known for its adjustable privacy settings, but needed to use Google Chrome. Although the assessment platform complies with the university's standards regarding open data exchanges, users follow the platforms' standards and *learn to include* certain technologies in their everyday lives. Indeed, when technology becomes infrastructure, it permits "certain kinds of human and non-human relations while blocking others, and shapes the very ways in which we think about the world" (Slota & Bowker, 2017, p. 529). Platforms strengthen the position of specific actors by performing *dis/appearing operations*, that is, they exclude actors interfering in their activities (which, consequently, cannot be known), and include the facilitating ones.

Concluding discussion

In this chapter, we critically examined the disappearing and reappearing of reportedly interoperable platforms in higher education, zooming in on the moments and places they turn into infrastructures and back. This allowed us to discuss the politics and consequences of data-driven technologies for humans and other-than-humans in everyday practices (Easterling, 2014; H. Knox, 2017a). Previous studies have referred to the politics of interoperability with a focus on the governance of education (Kerssens & van Dijck, 2021), revealing how interoperable platforms (re)organise education through interconnections (Piromalli, 2022), and technical relation-making has particular implications for knowing education (Hartong, 2020). Research in the social sciences has theorised

that digital technologies are platformised and infrastructuralised, and therefore necessitate a concomitant approach that takes both sorts into account (cf. Constantinides et al., 2018; Plantin et al., 2018). Our contribution to this growing corpus of studies lies in approaching platforms and data infrastructures together and empirically disentangling their multiple *modes of operating*.

Inspired by Hannah Knox's (2017a) take on digital ethnography, we demonstrated how a European university's platform-infrastructure, and the data moving across it, vanish for some related actors. Starting from a controversy about the higher education institution's so-called digital modernisation project, ethnographic findings helped us distinguish five operations amongst humans and non-humans: (1) *co-operating,* the work of making platforms operable; (2) *teaching,* the co-shaping of a particular pedagogy with platforms; (3) *intermitting,* starting/stopping the data exchanges of platforms; (4) *transforming,* the changes of and across platform-infrastructures; and (5) *dis/appearing,* the exclusion and inclusion of actors from platform-related practices. These findings show platform operations are not merely inter/intra actors in (higher) education, effectuating issues regarding privacy and lock-ins/outs, but are equally messy, value-laden, and resulting in sociotechnical and political consequences for educational actors. With the concept of *educational vanishing points*, meaning when/where education platforms turn infrastructural and back, we wish to complicate the imaginary of a single, seamlessly interoperable platform to a heterogeneous assemblage with (often implicit) pedagogical underpinnings that reconfigures of how students and educational professionals come to know each other and the world.

Rather than viewing the opaqueness of connecting platforms necessarily a risk (Sefton-Green & Pangrazio, 2021) or something to overcome (R. Edwards, 2015b), our inquiry suggests a way of attending to some complexities of platforms working with, as, and because of infrastructures. The operations we identified here may help researchers, practitioners, and policymakers in the education field rethink the imaginary of an autonomously and continuously interoperating platform with clear-cut boundaries. Platforms dis/appear while they are interwoven with, and have ramifications for, other social and technical actors (Pangrazio et al., 2023). This requires alternative ways of "living with", as opposed to simply "knowing about", complex infrastructures. People are increasingly searching ways of traversing "techno-environmental materialities that for the time being remain predominantly imagined as a world filled with technological objects" (H. Knox, 2022, p. 248). Thinking in terms of educational vanishing points helps actors confront the entanglement of data-driven platforms that is not and, possibly, does not always have to be, known. Perhaps the question is not only what 'interoperability' is, or how it works, but also how humans can learn to live productively with technologies that operate in multiple ways.

CHAPTER 4: LEARNING TO DASHBOARD

Educational dashboards are an increasingly prevalent, commended, and diverse set of visualising technologies that display outcomes of datafied educational processes to help learners and pedagogical actors keep track of learning pathways, alert for deviations, and make interventions so learners remain on track. This inquiry aims to contribute to the body of critical studies about data visualisations in education by investigating the dashboarding of learning in higher distance education as an instantiation of such visuals. Taking theoretical and methodological inspiration from science and technology studies (STS), we investigate different modes, or patterned ways of relating, concerning educational dashboards at an open and distance university by focussing on their production and deployment. Our ethnographic findings demonstrate how dashboards are produced through public-private and interdisciplinary co-creation and in accordance with predominant pedagogical ideas at the university. Producers align dashboards with a specific sort of learning, which, in turn, makes learning aligned as students are being persuaded to use technologies correctly. When dashboards are deployed, students learn to filter between what matters for their learning or not, check dashboards as self-monitoring practice and keep them in check. The case exemplifies a 'dashboarding of learning' and a 'learning to dashboard', meaning dashboards not only enter education practices but also encourage – though not always successfully – actors to understand and realise their education in close proximity to specific techno-pedagogical ideas.

This chapter is based on: Vanermen, L., Vlieghe, J. & Decuypere, M. (Under review). Learning to dashboard: Modes of producing and deploying data visualising technologies in higher distance education. *Discourse: Studies in the Cultural Politics of Education.*

Introduction

As digital technologies are becoming ubiquitous in everyday life, graphs, diagrams, and other data visualisations increasingly pervade education and convey information to their users about specific aspects of educational realities (H. Kennedy & Engebretsen, 2020). Turning such realities into data (datafication) and visuals (visualisation) is gaining importance in several sectors, including but not limited to compulsory education, higher education and online education (Hartong, 2020; Jarke & Breiter, 2019; van de Oudeweetering & Decuypere, 2022; Williamson, 2016). Here, technologies for visualising data (e.g., dashboards) are working in, as, and because of education data infrastructures that often encompass interconnected databases, application programming interfaces, and platforms, but also statisticians, computer engineers, and programmers (Perrotta et al., 2020). Technologies and people cooperate to convert data into – often intuitive, persuasive, and aesthetically-pleasing – graphical representations about past, current, and future educational realities, and to intervene in those realities (Gorur & Dey, 2021; Mikhaylova & Pettersson, 2024). However, nascent critical scholarship argues data visualisations may also evaluate, inform,

emphasise, and change aspects of teaching, learning, and other education practices (Decuypere & Landri, 2021; Kerssens, 2023; H. Ratner et al., 2019).

Encounters with data visualising technologies, particularly in the form of dashboards, are becoming so routinised and proliferated in day-to-day practices that this process is being called the "dashboarding of everyday life" (Tkacz, 2022). Whether in sports, administration or education, dashboards are believed to function as "a number of visual representations brought together, typically on a single screen" and in an (inter)active, purposeful, and dynamic manner (Tkacz, 2022, p. 6). Dashboards are not to be confused with static images since the screen's symbols, numbers, words, shapes and colours can quantify, order, and value realities continuously (Tkacz, 2022). As exemplifications and arrangements of data visualisations, dashboards are meant to be readable and actionable upon a glance, often in real-time, so users are alerted about what is important (Gorur & Arnold, 2021). They are one example of data visualisations in a history of formats that arrange information graphically while being arranged by technoscientific infrastructures (Friendly, 2008). Despite dashboards and data visualisations being nothing new, critical scholarship has yet to fully disentangle their specific characteristics with respect to how they impact learning practices (Jarke & Macgilchrist, 2021; Kerssens, 2023; Perrotta, 2021; Whitman, 2020).

In this chapter, we aim to contribute to the growing body of critical studies about data visualisations in education by investigating at least some modes learning with, or patterned ways of relating to, dashboards in higher distance education. This form of higher education matters because it involves a collection of learning and teaching practices in which geographically dispersed people and materials depend more heavily on digital technologies (e.g., learning management systems) to create proximities to each other and several preconditions for education (Anderson, 2001; Bayne et al., 2014). Higher education institutions have accelerated the research on the production, deployment, and evaluation of educational dashboards to alleviate much-reported issues regarding distance education, most notably during the Covid-19 pandemic, including the difficulties of handling a more self-directed learning process and unwanted student attrition (Celik et al., 2022; Safsouf et al., 2021; Tsai et al., 2020). Considering the higher education sector is relying on and being changed by data-driven technologies at the largest scale and fastest pace (see OECD, 2023), we zoom in on an open and distance university (Learniversity) and two of its dashboards. We thereby fill a lacuna in literature that has hitherto largely concentrated on the advancement of such technologies and has yet to show how higher distance learning is changing due to those technologies (Jones & McCoy, 2019; Kaliisa et al., 2023).

Perspectives on educational dashboards

Advancement-oriented and critical studies, while not being two homogenous fields, have different takes on educational dashboards. On the one hand, studies for the *advancement* of data visualisations in education (e.g., in the form of dashboards) have gained momentum in the emerging, interdisciplinary field of learning analytics (LA), where they are regarded as promising instruments for improving education (Gašević et al., 2022; Guzmán-Valenzuela et al., 2021). Such studies strive for advancements that pertain to the design, implementation, and evaluation of LA dashboards, especially to offer educators better actionable insights about learning, be it with little attention to the fine-grained changes these technologies effectuate *in situ* (Kaliisa et al., 2023). LA researchers portray dashboards primarily in technical terms; as "visualised and intuitive displays", objects to be implemented in educational contexts for learning support and progress (Yoo et al., 2015, p. 147). Dashboards are presented as a more and more prevalent, commended technology of visualisation that graphically displays data(fied processes) to help learners and pedagogical actors keep track of learning pathways, alert for deviations, and make interventions so learners stay on track (Gašević et al., 2022; Yoo et al., 2015). Dashboards are said to depict – and, at times, predict – learners' course progress based on predefined indicators and categories (e.g., the number of submissions before a deadline) and are assumed to function as neutral tools in the decision-making of learners and instructors (Arnold & Pistilli, 2012; Safsouf et al., 2021).

On the other hand, and somewhat distancing themselves from the former perspective, *critical studies* increasingly view dashboards not as neutral displays of information but as technologies incorporating many heterogeneous, active agents situated in a broader constellation of sociomaterial relations (Grimaldi & Ball, 2020; Jones & McCoy, 2019; Williamson, 2018). Critical studies have been investigating how data visualisations and analytics govern education, typically demonstrating how mixtures of visuals and data actively (re)arrange – rather than neutrally represent – teaching and learning (Decuypere & Landri, 2021; Gorur & Arnold, 2021; Martinez Lunde, 2021; Williamson, 2016). This non-neutrality appears at the production side of the dashboard, i.e., the work people put into data visualisations, as well as the deployment side, or what users do with these visualisations (Decuypere, 2021; Jarke & Macgilchrist, 2021). During the production, dashboards are inscribed with producers' ideas about their users (e.g., educators) and how the technology is expected to be used in practice (H. Ratner et al., 2019). Dashboards co-shape user subjectivities through aesthetic features such as coloured icons, dates, and charts one must interact with to perform tasks. For example, software for monitoring student attendance allows but also encourages educational leadership to focus and act on problems highlighted by the screen (Martinez Lunde, 2021).

Bridging the two positions, Selwyn and Gašević (2020) argue that a division between advancement-oriented and critical scholarship does not mean the former is uncritical. People in both fields are often very much capable of seeing various issues, like the inherent limitations of data (models) to represent educational realities, but address them in their own ways. However, one important point of difference arises when proponents envision that technical improvements will eventually lead to accurate learning representations, or predictions of academic achievement (Whitman, 2020), while critics maintain that data-driven technologies inevitably reduce the complexity of realities (too much). Brown (2020) warns that when dashboards are treated as panaceas in and for all learning, institutions may, unintentionally, overlook the fact that these technologies are designed with learning theories in mind (e.g., behaviourism) and fail to recognise the numerous ways people teach and learn. In higher education physics classes, for example, educators frequently encourage and assess knowledge-making about natural phenomena by having students create hand-drawn illustrations. Here, dashboards risk ignoring the materiality and complexity of practices because they only capture and distinguish a small set of student interactions, mere proxies for learning (e.g., clicking behaviour as a proxy for active engagement). At stake is a "pedagogic reductionism", the possibility "that not all forms of teaching and learning will 'count' in terms of how teachers and students are measured and assessed" (Williamson, Bayne, et al., 2020, p. 358).

In light of these stakes, we raise two *research questions* in this chapter: What modes of learning are enacted during the production and deployment of educational dashboards in an open and distance university? And how does this enactment occur? Answering these questions requires an approach that treats dashboards as non-neutral technologies through which people acquire partial knowledge and that recognises their performative implications – positive and negative (Burri & Dumit, 2008; Kerssens, 2023). A fine-grained analysis contributes to identifying the sociomaterial relations between educational actors, dashboards being no exception, as well as how these engender (un)foreseen effects in everyday learning (Jarke & Macgilchrist, 2021; Jones & McCoy, 2019).

An STS approach to the dashboarding of learning

The field of science and technology studies (STS) provides theoretical and methodological tools to scrutinise ways humans and nonhumans can become actors *relationally*. That is, how actors are shaping and are being shaped by one another and how they contribute to ordering educational realities (Gorur et al., 2019). For Law (1994), these tools permit analysing the myriad ways anyone (e.g., users) and anything (e.g., dashboards) can become co-constitutive of "modes of ordering" which, similar to discourses, entail contingent, relational patterns that characterise actors and effects – such as particular modes of learning or learner identities (p. 109). For example, STS

researchers trace a scientist's drawing of scientific visualisations (e.g., charts) about a social phenomenon to elucidate how these are the result of well-demarcated technoscientific procedures and, subsequently, bring distinguishable populations into being (J. Law, 1994). Thinking in terms of 'modes' provides an analytical opening to consider how human actors "speak through, act and recursively organise the full range of social materials" (J. Law, 1994, p. 111), including dashboard-mediated education (H. Ratner et al., 2019). The STS take on learning thereby allows data visualising technologies to contribute to specific modes of learning that are not restricted to those emphasising individual human cognition. In that sense, distance learning is just one of the possible ways of learning (e.g., online learning, open learning) where dashboards may help bridge geographical distance amongst different actors.

Moreover, the attention to the social and technical dimensions of learning helps to situate it beyond traditional settings, such as the lecture hall or the workplace (Fenwick & Edwards, 2010; van de Oudeweetering & Decuypere, 2022). Learning is not done in a vacuum but within a broader set of relations that make up the open and distance university, where people and technologies engage in distance learning and teaching from various locations (e.g., they access a virtual classroom from home or the office). Modes of learning are enacted by and situated in a university infrastructure that is more than a bounded, on-campus location – which distance learners rarely visit; they are an intertwinement of students, educators, technical staff, modems, laptops, LMSs, dashboards, and so on (Bayne et al., 2014; Perrotta, 2021). The dashboarding of learning, then, is regarded as a non-deterministic, relational effect in which dashboards can, but not necessarily do, make a difference in how people act and think.

To disentangle different modes of learning regarding educational dashboards, we focus on who and what is *producing* visuals, i.e., the technoscientific negotiations behind the dashboard, and *deploying* these visuals, i.e., the interactions with the dashboard and their effects in social situations (Burri & Dumit, 2008). We thus adopt two pertinent yet distinguishable analytical dimensions to scrutinise the dashboarding of learning: what happens with and behind the screens of data-driven technologies (Decuypere, 2021). The visualisations themselves come to matter because they frequently work convincingly, almost naturally, in settings where they are made and used. We investigate dashboards by treating them as inscriptions, purposefully arranged signs and lines (e.g., progress charts, deadline notifications) through which (educational) actors come to know and act on other actors (Latour, 1986). STS researchers analyse ethnographically what people do with platform dashboards, and what dashboards do to people, data, and other actors in day-to-day activities (e.g., Lange, 2021; Tkacz, 2022). Analysing the "dashboarding of everyday life", particularly of learning, makes it possible to foreground and conceptualise some subtle negotiations. While

acknowledging dashboards as formats of technical elements (e.g., data, shapes, colours, texts, code) that calculate, differentiate, and prioritise some things over others, ethnographers show how these take part in ordering social life (Tkacz, 2022). We contend that educational dashboards must be understood in relation to the situations in which people produce and use these data-driven technologies.

Ethnographic fieldwork is one of STS's methodological tools used in this inquiry, providing a method or way of seeing, writing, and drawing about how sciences and technologies order everyday practices (J. Law, 2017). The data collection was performed from March until December 2021 at a European open and distance university, centring around the university's learning management system, Learniversity, and two connected dashboards: the learning analytics dashboard (LAD) and the learning management system dashboard (LMSD). Since the Covid-19 pandemic was still at large, we had to rely on communication technologies (e.g., Microsoft Teams) to see and discuss learning modes in which dashboards could play a role. We conducted 14 semi-structured interviews and 13 observations with university actors (students, educators, and supporting staff) and studied over 50 documents and the website. While communication technologies permitted interaction with geographically dispersed participants, they posed challenges to building rapport (Bayne et al., 2014). To remedy some challenges, the first author of this chapter (Lanze) co-organised an online workshop with participants about data-driven technologies in the university, allowing him to get feedback on preliminary findings and gain additional insights from 11 practitioners. As Law (1994) reminds us: "There is no question of standing apart and observing from a distance. We're participating in ordering too" (p. 2). The workshop embraced the idea that researchers shape the practices under investigation and provided an opportunity for collaborative data collection.

Our analysis follows a "show-and-tell" format that reintegrates some multimodal characteristics of data visualisations, combining textual vignettes and visuals to avoid taking dashboards at face value (Tkacz, 2022, p. 7). The vignettes function as succinct ethnographic texts that foreground day-to-day relations between the participants, objects, and researcher, thereby (re)ordering and (re)presenting particularities that are then conceptualised, all to evoke thoughts and actions from the reader. The visuals are screenshots manually redrawn with illustration software (Inkscape) to denaturalise the dashboards in different learning modes and pseudonymise personal/institutional information. Both the vignettes and visuals – like any data visualisation – do not offer 'pure' descriptions of realities but accessible, descriptive analyses of specific learning practices; they are created by a researcher (connecting interview transcripts, observational fieldnotes, documents, and screenshots) and are performative (Bloom-Christen & Grunow, 2022).

Our descriptive analysis highlights details about the production and deployment of dashboards while keeping STS concepts temporarily at bay, thereby inviting the reader to see the relations between actors before theoretical inferences are provided.

Producing dashboards: The case of Learniversity's LAD

Coordinating: The organisation of who and what matters for dashboards

> Elias works at the Coordination Centre, an internal university organisation evaluating the merit, feasibility, and outcome of advancement-oriented research projects that may benefit their open and distance education. He, a co-worker, and Lanze, organise an online workshop to explore future possibilities of data-driven technologies. Educational researchers, data scientists, designers, and developers present and discuss their work regarding dashboards, learning management systems, analytical models, and so on. Elias explains during an interview that he has been "involved in projects concerning educational technology for over 20 years," and gathering and coordinating people is key to his job.
>
> In the workshop and his strategic plan, Elias refers to "education analytics." Like the narrow understanding of learning analytics, education analytics has a holistic, contextual take on processing data about and for learning, but seeks complementary, demographic data for additional purposes (e.g., preventing student attrition). His plan, a Word file, lists technologies, projects, and people expected to help realise comprehensive visualisations of open and distance education that may benefit students and educators. At the heart of the plan lies a diagram (Figure 18) and the "activating learning and teaching activities" believed to characterise the university. "To increase the course results of our students," Elias explains, "there are several 'buttons' that we as a university can push." These buttons are variables that future dashboards should recognise: the course design, student, and educator are all believed to influence open and distance learning/teaching and, ultimately, educational outcomes.

The vignette shows how an employee and document become *coordinating* actors in technology-related research and development projects; they help translate plans into reality by ordering relationships between stakeholders and materials (J. Law, 1994). Elias does not simply work at the Coordination Centre but *makes* and *becomes* a coordination centre of relations. In his many meetings (e.g., the workshop), he *inter alia* creates conditions to exchange knowledge about dashboards among stakeholders. His strategic plan and diagram, interpreted as inscriptions, play a relevant role in ordering the technoscientific work of geographically distributed actors. Inscriptions allow human actors to move materialised – and often simplified – knowledge across places so others may draw upon it for related purposes (Lange, 2021; Latour, 1986). Here, education is simplified to a discrete set of factors and then disseminated to university stakeholders about what matters during dashboard production: (bene)fitting the active mode of distance education. This mode is also put in the centre of attention by the Centre to delineate opportunities and expectations regarding technology production. Related research on educational dashboards has indicated that institutions tend to prioritise performativity, meaning that data-driven technologies are primarily

designed to improve quantified learning outcomes (Williamson, Bayne, et al., 2020). In producing such dashboards, "performance serves as a central organisational principle, framing learning through variables that can be optimised to maximise student performance" (Kerssens, 2023, p. 249). In our case, though, the actors reveal a pre-production process of the eventual dashboard in which educational activities are – quite literally – placed at the centre of attention. The coordinating work thus delineates possibilities and requirements for research on distance education by enticing researchers, practitioners, and technologies to work with and for that education.

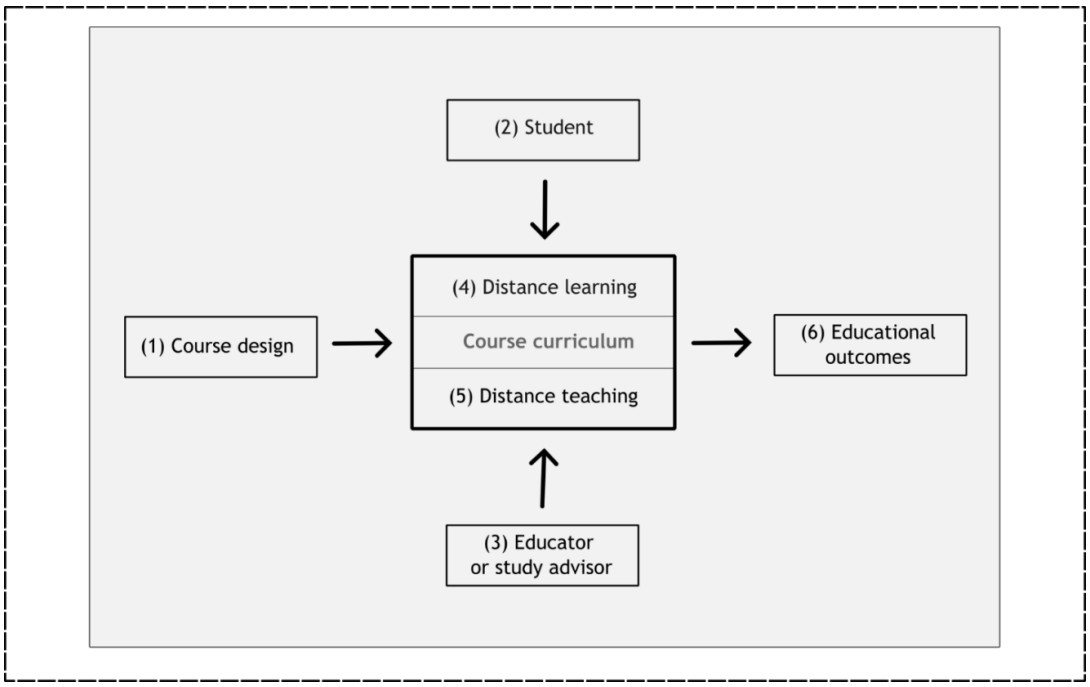

Figure 18. Diagram of the Coordination Centre's education analytics model.

The model shows how course design, students, and educators are expected to influence distance learning and teaching, and students' educational outcomes.

Co-creating: The public-private and interdisciplinary work going into dashboards

> Wyatt, who also works at the Coordination Centre, incorporates the Centre's plans for a learning analytics dashboard (LAD). The LAD maps and visualises when, where, and how long students traverse the LMS's flexible, modular, and linear learning pathways. "In distance education," his report states, "you have difficulties seeing students' pathways because you cannot physically see them. What you do see is lots of data about what and how they learn." Wyatt's team consists of members from the university (a digital-scientific designer, application manager, project manager, and educational scientist) and the edtech company DataQuest (another project coordinator, LA coordinator, LA specialist, digital architect, and chief operations officer). This is the same company that was involved in the technical breakdown of an API in Chapter 3. Together, the employees "co-create" and evaluate the dashboard for an "effective and efficient way of guiding" students, considering the wish of the Centre to analyse student attrition as an important issue on top of just learning.

> The team members had "lively discussions" and disagreements about technical, scientific, juridical, and educational specifications as well as what data, indicators, and algorithms would engender suitable overviews. During the online workshop, an expert states that LA should incorporate "as much data as possible" and not be bound to individuals and courses. Wyatt's team member disagrees and warns the data source conflation would obfuscate their view on an individual's context: "The data become hard to interpret," he says, "garbage in means garbage out!" Ultimately, the team provided three dashboard views: drop-out risk, assignment hand-in, and engagement level (Figure 19). 'Engagement', for example, is based on indicators for login behaviour, the user's absolute amount and timing of logins, and an algorithmic comparison with the norm of two weekly logins. The team scored 1, 0, and 0.5 for a higher, lower, and equal number of logins, adding to scores for login frequency, assignment completion, and assignment punctuality. The dashboard then visualises the proxy for learning as graphs of weekly averages. However, "students do not just learn with the [LMS]," the coordinator knows, "[t]his means we only collect partial data about learning behaviour and do not yet get a holistic view."

The vignette first indicates how technoscientific actors from a public (e.g., Coordination Centre) and private (e.g., the edtech company) organisation are involved in *co-creating* data visualisations according to a design plan (Burri & Dumit, 2008). Here, the plan turns into what Latour calls an immutable mobile, an object capable of moving to other places without being modified so it can be used to mobilise other actors in technological and scientific work (Latour, 1986). The plan moves among coordinators within and between the two organisations to further mobilise team members that may enact the written vision. The plan thus affords closer connections between the actors producing the dashboard while considering specifications desired by people more distanced from the production. Second, the dashboard is also produced through *interdisciplinary* co-creation (e.g., between an educational scientist and a digital architect). It is not uncommon that researchers and practitioners with dissimilar academic backgrounds are encouraged to foster interdisciplinary conversations and collaborations to produce data-driven technologies or analytical models (Selwyn & Gašević, 2020). However, others have equally argued that designers may have certain expectations about how users should interpret and act on the depicted information and inscribe those expectations in their technologies (H. Ratner et al., 2019). In our case, the diversity in disciplines serves the public demands of the university: relations among data scientists, managers, and so on, are ordered to ensure dashboard production for active distance learning. These interdisciplinary and public-private relations create and are being created by organisational circumstances for a *distance* educational dashboard.

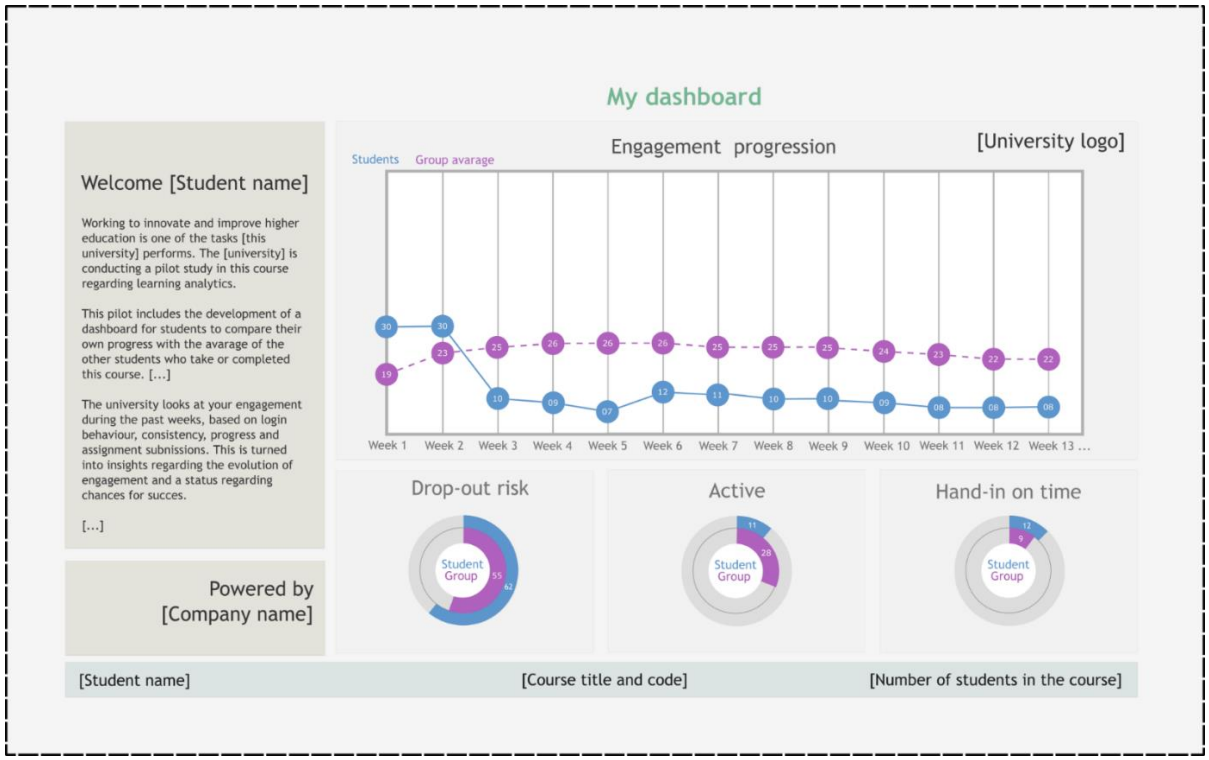

Figure 19. The student version of the learning analytics dashboard.

The figure was made with Inkscape by carefully identifying and redrawing the original screenshot's shapes, fonts, texts, digits, and colours. The top half of the figure shows the LAD's graph, calculating, visualising, and comparing student progress on the learning pathways prescribed by the LMS. The bottom half indicates three pie-chart diagrams (drop-out risk, activity, assignment hand-ins), categorising and comparing students according to predefined criteria.

Aligning: Ensuring everyone can and will relate correctly to dashboards

> Wyatt and his colleagues at the Centre also must ensure users become acquainted with their LAD. "Learning online without analysing study data is like sailing without a navigational system", a designer states. "You will reach your destination, but probably not the one you had in mind or an efficient manner. You likely take damage because you fail to see shallow waters." Because the dashboard is considered important for a successful learning process, the Centre has written a user manual that explains the dashboard in layperson's terms (Figure 20). Examples are annotated to tell the student what is visualised: "In this view, you can see the hand-in percentage per assignment. It shows the score inside the dot. The blue line is your score, and the purple line is the group's average. 100% means on time, but the score drops by 20% for each day the assignment's handed in too late." An employee explains that dashboards are useful in so far as they "align" with the LMS, curricular principles (e.g., fixed starting moments, deadlines) and constructivist learning theories (e.g., making assignments is considered active learning). The dashboard does not say much about the learning taking place or predict student performance, yet it is expected to help students monitor course progress.

Employees are *aligning* data visualisations with technical, scientific, and educational knowledge about and for distance learning in a dashboard manual. The earlier negotiations between experts have become hidden, and what counts as 'correct' knowledge during the production

process has turned natural in the document (Burri & Dumit, 2008). As existing research has already argued, actors need to specify and agree on possible or desirable learning indicators and predictions (Perrotta, 2021). Indeed, the knowledge higher education often seeks to utilise is centred around calculating and visualising so-called learning gains and engagements (Williamson, Bayne, et al., 2020). Actors in and outside the Centre have agreed to communicate a set of technical, scientific, and educational specifications: how to interpret the graphs' colour schemes or proxies for learning. Additionally, the alignment work here continues upon dashboard completion via user manuals. Data visualisations are re-inscribed in the manual so that users can relate 'correctly' to the dashboard and its underpinning technoscientific and educational ideas. Inscriptions are meeting spaces for words, images, facts, and fictions that create a coherent picture for the viewer; they are meant to have "optical consistency" (Latour, 1986, p. 7). The Centre's manual explains how the dashboard is composed and how different graphs and charts should be interpreted. They should be optically consistent visualisations of empirically observable behaviour that validly predict and represent active learning. However, as the visualisations are combined with texts and images to *convince* people of their representative capabilities, they equally create realities (see also Gorur & Dey, 2021). Open and distance learners are expected to *align* their actions with the manual's instructions and *become aligned* with dashboards.

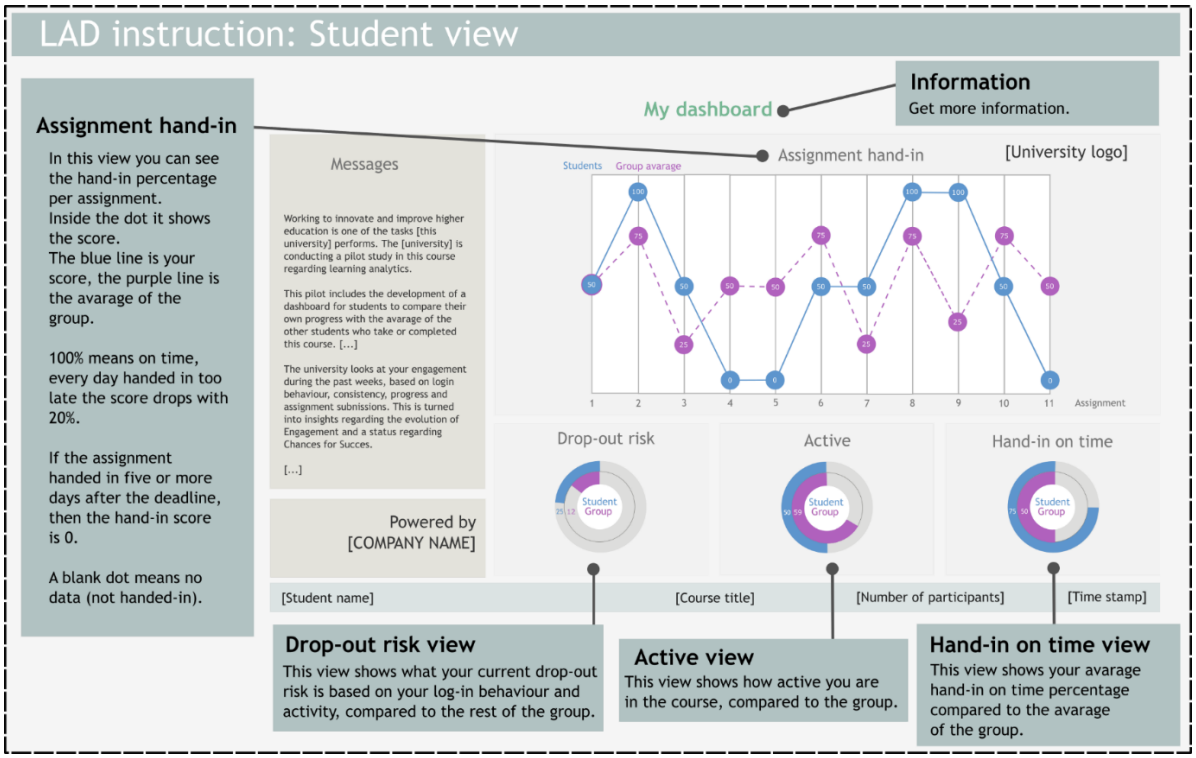

Figure 20. Learning analytics dashboard manual.

The figure was made with Inkscape by carefully identifying and redrawing the original manual's shapes, fonts, texts, digits, and colours. The manual arranges a screenshot (in the middle of the figure) and a mark-

up layer with text (the boxes surrounding the screenshot) to safeguard correct interpretation. Next to the purple and blue colours of the dashboard, drawing attention to the visualisations rather than the beige background, the high-contrasting boxes draw attention to the designers' explanations.

Deploying dashboards: The case of Learniversity's LMSD

In this section, we shed a light on how students related to the Learniversity learning management system and its dashboard (LMSD), an older display that was deployed longer ago but used more intensely than its newer LA counterpart.

Filtering: Pathways toward course deadlines are prioritised on dashboards

> Jane uses Learniversity's learning management system dashboard (LMSD) daily to view her course content, structure, and assignments (Figure 21). She shows what is on the screen: a rectangular set of items and signs, indicating one of three traffic-light colours to distinguish – mostly completed – tasks (green) from the uncompleted ones (orange, red). Exploring the dashboard and modules of a new course happens while waiting for the handbooks to arrive via postal services. "I begin by roughly scrolling through [Learniversity]," she says, "what should I read first? What is expected of me?" After getting an overview, she sets priorities: concentrate on unfinished courses before shifting attention to new ones. "I proceed by completing a learning path on the Learniversity environment", she explains, "this means reading chapters/articles, finishing assignments, making flashcards, and yes, learning until I can schedule my exam".
>
> Jane visits Learniversity to verify her progress and transcribes goals visualised on the dashboard to her paper notebook. She admits sometimes buying other students' summaries when she cannot meet the deadlines or process the required course materials. "I like to work with summaries to see, okay, this [content] was here and this there; yes, filter out the essence for the assignments." Dashboards indicate Jane is consistently on track, within the one-year time limit, and with excellent grades.

The dashboard depicts a triad of colours and acts *as a filter* on a traffic light, telling the learner where and when to go on the prescribed learning pathway that ends in successful and timely course completion. Indeed, the traffic-light colours for providing student feedback and increasing course success is a well-known and criticised trope in educational literature (Arnold & Pistilli, 2012). Dashboards convey particular messages to the learner that emphasise the importance of being on track – messages that misguidedly can be interpreted as causal indicators of "being at risk" of not completing the course successfully (Jarke & Macgilchrist, 2021). In this particular scenario, the dashboard becomes an "object of visual perception" (Tkacz, 2022, p. 7), successfully guiding Jane's gaze towards a set of open and distance learning activities with concise time intervals, thus maintaining a predominant green hue that signifies she is 'on the right path.' As learners note down directions and favour specific course materials on or beyond the LMS (e.g., bought summaries), they also *learn to filter* and prioritise those aspects depicted as educationally valuable on the dashboard.

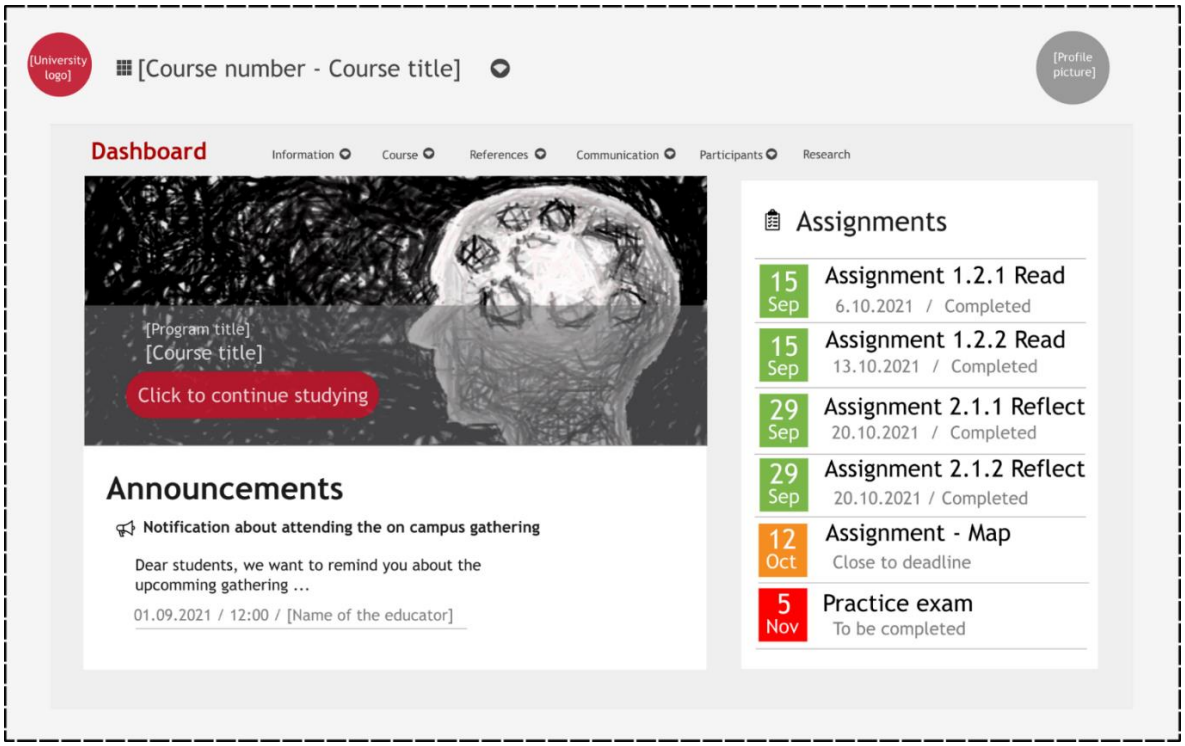

Figure 21. Jane's learning management system dashboard.

The figure was made with Inkscape by carefully identifying and redrawing the original LMSD's shapes, fonts, texts, numbers, and colours. The left side of the figure shows non-automated messages students receive from pedagogical teams about the course. The right side presents the colour-coded assignments deadlines (e.g., the items due in September are marked green to indicate completion) and warnings (e.g., the item due in November is marked red to indicate it is uncompleted).

Checking: How a student learns to (re)examine learning with dashboards

Timothy also uses the LMSD frequently but in a different way than Jane. He talks to Lanze about six weeks into a course and is, as he puts it, "behind schedule." He claims that some aspects of the dashboard and course evaluation don't correspond enough. "Is this important or not important? Should I complete this or not?" Timothy asks, somewhat agitated, pointing to a red-coloured dashboard item (Figure 22). He considers some assignment notifications confusing because they indicate a deadline in red but "do not count" in any formal evaluation. "They [the dashboard items] don't matter since you have a year to complete the course," Timothy knows, recalling the university's flexible enrolment policy.

To deal with this ambivalence, he skims the dashboard and all LMS modules to check/mark every item that does not correspond directly with the final grade. "I run through […] that eleven-week curriculum," he says, "to see if I can already do things in advance that I would have to do, uhm, at a later stage." After clicking a check box, the dashboard's assignment list turns greener. "I completed that on the 12th [of October]," Timothy continues, pointing the cursor to text in a module. "As I said, these are only three lines; this is redundant! That's why I check the curriculum from start to finish. […] I don't think it's about how I complete it, just that I complete it." Checking the notifications in advance brings Timothy "peace of mind," even though he must still learn all course materials and take the exam.

Here, the learner *checks* the dashboard to see whether the depicted information (e.g., the assignments, deadlines, and colours) is correct according to his interpretation of what counts as educationally meaningful. Burri and Dumit contend that the semiotics of visualisations are not always persuasive or self-evident and can be susceptible to numerous interpretations and responses. Yes, the "semiotic openness of images leaves many opening or contesting their meaning and calling into question their objective authority" (2008, p. 305). Timothy shows contingencies of learning with dashboards when he checks the assignments and deadlines for, in his eyes, redundancies that can be *checked off*, and learning can become – in his circumstances, at least – possible again. Besides questioning the visualisation's authority, users of data-driven technologies can go against producers' expectations and reshape their learning with technologies. Other research mentions that datafication can trigger affective responses, like anxiety, enticing individuals to perform in ways that can be evaluated, compared, and quantified (Williamson, Bayne, et al., 2020). In Timothy's story, facing alarming colours triggers an uneasiness and hasty response to establish peace of mind. The learner *learns to check* the display's correctness and *keep it in check* by skimming all associated modules and marking redundant ones as complete (sometimes prematurely) to smoothen the path. Learning with dashboards is not only a matter of staying close to the visualised pathway; learners also utilise openings to distance themselves from the displays and make learning possible once more.

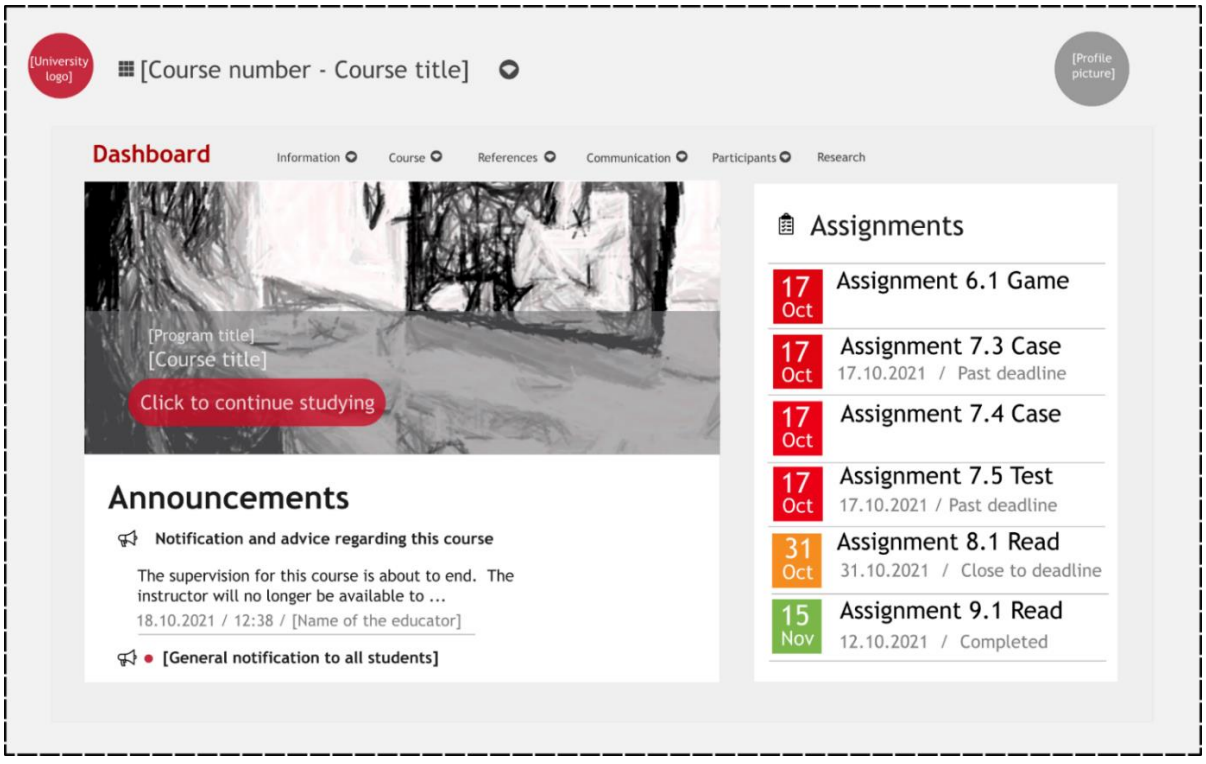

Figure 22. Timothy's learning management system dashboard.

The figure was made with Inkscape by carefully identifying and redrawing the original LMSD's shapes, fonts, texts, numbers, and colours. The LMSD highlights the (un)completed assignment items (e.g., the green, checked-off item due on 15 November). While the overall structure of the LMSD remains mostly the same, with exceptions in the colour-coding, the information that is shown depends on the course.

Persuading: How students are made to learn with dashboards

> Amber has also learned to use dashboards through hands-on interaction and the user manuals. The LMSD manual tells users what can be seen on the screen (Figure 23). "On the dashboard, you will find the assignments that need to be completed, the assignments that have been graded, or any other assignments that require your attention. When facing deadlines, these data blocks are colour-coded to provide visual cues." Amber regularly learns with the dashboard and can show Lanze its different functions. "The Learniversity screen is always open on my laptop", she says, giggling. "It provides precise information about the tasks and study materials I need to concentrate on."
>
> She navigates the dashboard by moving her cursor around swiftly, accessing information about the course, content, and assignments. The orange icon on the dashboard, she knows, serves as a reminder for the upcoming assignment deadline: submitting a PowerPoint presentation as preparation for an on-campus gathering. The LMSD, students read in the manual, indicates assignments that do not count towards the final grade and can still be turned in after the indicated deadline. The gathering, however, is not indicated on Amber's dashboard despite being graded on a pass/fail basis.

The LMSD and the corresponding manual *persuade* the learner that the (un)finished deadlines are valid indicators of course success. A visualisation becomes an authoritative, persuasive instrument for the person interacting with it, especially if it is endowed with compelling aesthetics and the legitimacy of expert producers (Mikhaylova & Pettersson, 2024). What is or is not visualised matters because people learn about and act upon the world through these visualisations, a kind of 'meta-learning' through the encounters of normative, multimodal depictions of the world (Burri & Dumit, 2008). Students need to familiarise themselves with the LMSD before it can contribute to achieving the prescribed educational goals (e.g., submitting the presentation). In a way, students are presumed to engage in "learning to learn" with digital technologies that organise distance learning (Anderson, 2001); they are learning how to use dashboards for open and distance education. On the other hand, students are also being *dissuaded* from neglecting the visualisations, suggesting that distance learning activities should be performed according to the priorities highlighted on the screen.

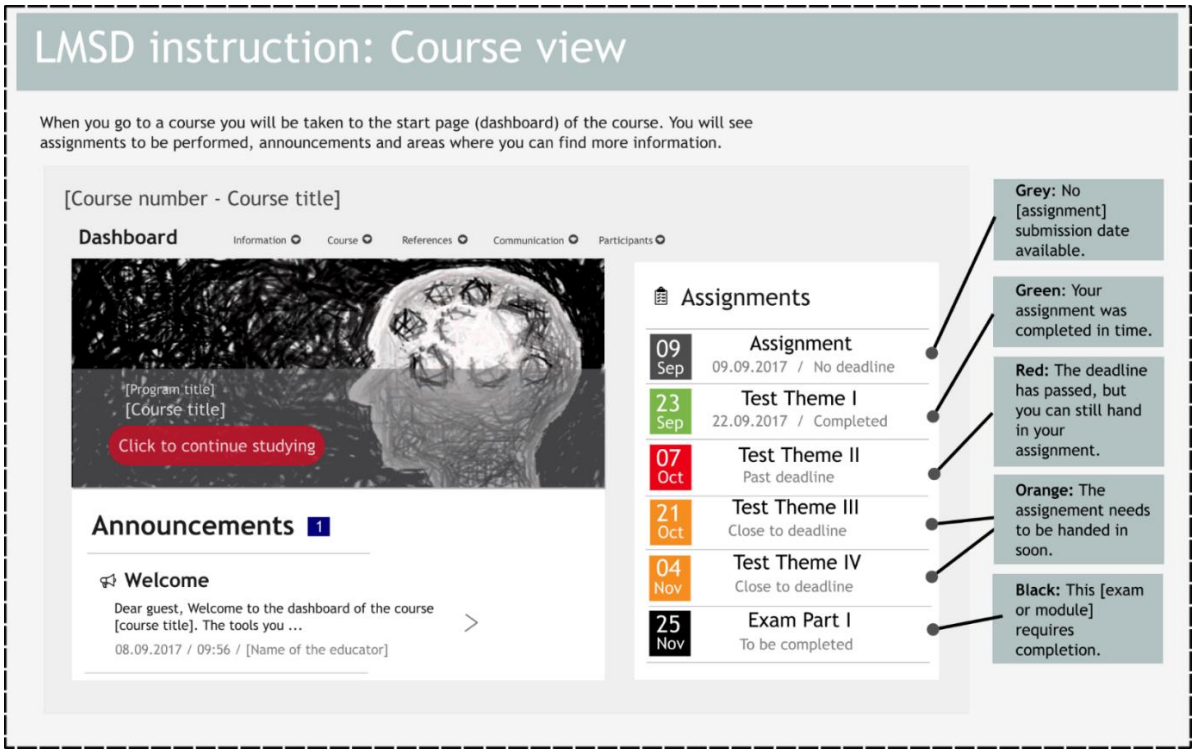

Figure 23. Learning management system manual.

This figure, too, was made with Inkscape by attentively identifying and redrawing the original manual's shapes, fonts, texts, numbers, and colours. The manual arranges a dashboard screenshot (left) and an explanatory mark-up layer (right). The color-coding of the assignment deadlines (black, grey, orange, red, green) in the manuals varies from the colours observed on the deployed dashboards.

Concluding discussion: Learning to dashboard

We scrutinised modes of learning with visualisations by zooming in on the production and deployment of dashboards as exemplifications of datafication in higher open and distance education. Datafication in education does not simply mirror visualisation practices in other sectors (e.g., commerce, sports) and is, therefore, to be scrutinised and interpreted by attending to those modes, practices, relations, and effects that are specific to education (Jarke & Breiter, 2019). Here, datafication presumes a particular kind of user (H. Ratner et al., 2019) and pedagogy (Williamson, Bayne, et al., 2020), meaning human actors may feel constrained by data visualisations as the production of the technology inevitably reduces some characteristics of education to fit them on a single display (M. Brown, 2020; Selwyn, 2019). Researchers who actively try to install and improve educational dashboards often reflect on the simplification of educational practices to proxies but may still benefit from more contextualised accounts about how visualising technologies operate in higher education (Gašević et al., 2022; Jones & McCoy, 2019). Whereas others focussed on the dashboarding of teaching and educational leadership practices (Jarke & Macgilchrist, 2021;

Kerssens, 2023; Martinez Lunde, 2021), we added to the body of critical scholarship by disentangling how dashboarding of learning is enacted.

This inquiry showed how particular pedagogies (i.e., constructivist and distance learning pedagogies) and learning proxies are valued during the production of dashboards. Employees at the university learn to *coordinate* technoscientific work, making it beneficial and standardised for a selection of courses, and engage in interdisciplinary and public-private *co-creation*. As employees *align* technical and educational ideas in the visualisations, the dashboard manuals *expect* users to align with these ideas. When deployed, data visualisations do not necessarily reduce students' education to one mode of learning. The dashboard shows learners what matters at the university: it *filters* and is being *used to filter* aspects of education. Learners also *check* their learning progress with the dashboards and *keep it in check* by contesting nudges and reminders. Overall, we demonstrated how dashboards become value-laden and taken-for-granted instruments for relating to the world and fade into daily routines (see also Decuypere & Landri, 2021; Gorur & Arnold, 2021). The dashboarding of everyday life, learning in particular, entails a prevalent way of seeing data and visualisations, which, in turn, has consequences for how people act upon other people, learning, and studying.

Learniversity, with its different displays, illustrates a *dashboarding of learning* as well as *learning to dashboard*: as dashboards and other sociomaterial actors enter educational settings, they also encourage – though not always successfully – people to understand their worlds, roles, and practices in proximity to the technoscientific ideas about data visualisations. On the one hand, the *dashboarding of learning* is an instantiation and intensification of data visualisations entering and delineating practices in mundane (higher distance) education (Jones & McCoy, 2019; Perrotta, 2021; Whitman, 2020). University employees learned by making knowledges and experiences in the scope of work-related tasks, i.e., an education analytics project that concerned technologies' design, implementation, and evaluation. These actors came to understand the production of data visualising technologies for education (e.g., coordinating) in the prominent vocabulary of dashboards. Similarly, university students' practices became characterised by materials and concepts related to dashboards and data visualisations (see also M. Brown, 2020). The LMS dashboard depicted the alleged learning of students in linear, progressive time charts that remained a simplification of the more complex practice. But as many researchers and practitioners know, data and visualisations "are not only simplifications but imputations too" (J. Law, 1994, p. 49). The dashboarding of learning encompasses a data visualising process in which human sense-making is calculated without having enough data about the sociomaterial surroundings to arrive at a comprehensive representation (see also Williamson, Bayne, et al., 2020). Data visualisations –

including those shown on dashboards – sometimes (are made to) act with persuasive authority according to technoscientific principles (Latour, 1986). On the other hand, people are equally *learning to dashboard*: actors relating to data visualising technologies begin to make sense of and work around their possibilities/constraints for completing certain tasks (cf. Anderson, 2001). In this case, university students and employees become familiar with dashboards for their production and usage, meaning they shape knowledge about data-driven technologies in and for a 'successful' education.

These findings have two analytical implications for the fields of critical data studies in education as well as open and distance education (Bayne et al., 2014; Jarke & Breiter, 2019). Firstly, analysing how data visualisations are *produced* not only critically disentangles the negotiations regarding ideas that are inscribed into technology (Perrotta, 2021), but it also shows contingent *organisational learning* practices of actors that are dispersed across geographic locations (Burri & Dumit, 2008). Secondly, analysing dashboards in higher open and distance education requires focusing on how data visualisations are *deployed*, meaning how users act and *learn to act* in proximate or distant relation to dashboard prescriptions (Celik et al., 2022; Jones & McCoy, 2019). Here, dashboarding everyday learning confronts researchers and actors with another sort of distance learning besides geographical distance: people learn to distance themselves from visualisations to avert or suppress their expected effects. STS research is particularly well-suited to demonstrate how learners, educators, or other educational actors (un/re)make dependencies with data-visualising technologies (Gorur et al., 2019; Lange, 2021; Martinez Lunde, 2021). Future inquiries can further foreground the myriad ways users/designers do not merely accept and utilise but equally contest and ignore data visualisations. Rather than being merely passive recipients of dashboards, people consistently look for multifarious modes of relating to data visualisations, reconfiguring practices, and making education possible (again) in their specific situations.

GENERAL CONCLUSION

REVISITING THE RESEARCH TRAJECTORY AND ETHICS

The overall purpose of this dissertation was to make empirical, conceptual, and methodological additions to the field of open education by disentangling how digital platforms (re)order open education practices but without taking them for granted. The inquiry used insights from a range of empirical cases and academic resources to take these ambivalent, platformised education practices seriously instead of framing them "as simply expanding openness" (R. Edwards, 2015b, p. 254). The general introduction of this dissertation elucidated that open education researchers make normative claims about the role of digital platforms, particularly corporate ones that are deemed (too) closed and should open up education for larger as well as broader audiences (e.g., Amiel & do Rozário Diniz, 2023; Bozkurt et al., 2023). Education researchers tend to favour the first part of the open-closed binary, namely the creation of openness for better (access to) education and resources, rather than investigating attentively how certain openings and closures are enacted in practice (J. Knox, 2016a; Oliver, 2015).

The field of science and technology studies (STS) has provided me with theoretical and methodological sensibilities to do just that (J. Law & Lin, 2022). Starting from ambivalences or heterogeneities, the many ways humans and non-humans relate to one another and can become actors, allowed me to acknowledge the compositions and effects of everyday practices as well as how these are ordered, unordered, and reordered (J. Law, 1994). STS was wielded as a "sensitising device" (Decuypere, 2019a, p. 137) that helped me pay attention to the relational characteristics of open education practices and show ways of relating between *inter alia* humans and digital platforms. The dissertation has empirically investigated and conceptualised how and under what conditions digital platforms shape open education practices, including the access to knowledge resources, flexible learning pathways, interoperations, and learning with data visualisations.

The findings are also the result of *how* STS was wielded as a sensitising device: a combination of seeing, describing, and visualising different orderings empirically, and then conceptualising those orderings through words primarily derived from my fieldwork. Using several protocols (see Appendices A and B), I directed my attention to what actors are doing and saying, thereby tracing what Bruno Latour (2005) calls an "infra-language" and refusing *a priori* categorisations (p. 49). Prioritising this sort of language permitted me to "become attentive to the

actors' own fully developed meta-language, a reflexive account of what they are saying" (p. 49). I took a particular "point of view" from which I could see numerous actors during the fieldwork and trace an ordered network of relations (Latour et al., 2012, p. 598). Such a viewpoint suggests an analytical interest in how practices are ordered by magnifying what actors do and say themselves, though the empirical findings were consistently confronted with words (concepts) from existing scholarly resources such as books and articles (J. Law & Mol, 2020).

Concretely, and in line with the reflections of John Law (1994), the manner in which STS has informed my results is twofold. First, my close engagements with the data corpus allowed me to identify – and, to some extent, shape – "modes of ordering", meaning the different ways people think about and act upon the world (Ibid., 1994, p. 20). I have discerned a number of such modes in the four case studies, such as modes of accessing (Chapter 1), flexibilising (Chapter 2), operating (Chapter 3), and learning (Chapter 4). Second, STS has granted a possibility to highlight – and, again, partly shape – several hybrids as a "way of connecting agency with structure, of resolving the dualism in favour of agency" (Ibid., 1994, p. 62). I have drawn the reader's attention to several hybrid practices, usually indicated by a dash, such as 'in/access' (Chapter 1), 'in/flexible' pathways (Chapter 2), and 'in/visible' operations (Chapter 3). Consequently, working with STS meant not only seeing heterogeneity to shun simplicity but also repeatedly magnifying that and how the platformisation of open education practices played out in a hybrid manner across different situations.

Revisiting the research trajectory

Chapter 1, *On making in/access together,* disentangled and magnified how a digital platform and learner conjointly shape access to knowledge and the organisational conditions under which this access was made possible. Existing scholarship has argued that there is a stark and worldwide increase in the number of people enrolling in higher education, resulting in issues concerning (un)equal access to high-quality education (Chien et al., 2017). I showed that and how the FutureLearn platform, like US-based platforms (e.g., Udacity), partners with companies to provide vocational education through various pay-to-access and subscription-based business models (Shah, 2021c; Stracke et al., 2019; Thomas & Nedeva, 2018). I did so by cross-fertilising resources from STS, including Lucy Suchman's (2012) notion of 'configuration', and Ribot and Peluso's (2003) theory of action. I set out on an autoethnographic exploration of the platform and three related courses (the so-called ExpertTrack on software development) to scrutinise and theorise how the platform and user ordered access to knowledge in a broader, supporting ecology of organisations.

The findings foregrounded that public-private actors ordered not only the identities of humans in education practices (see H. Ratner et al., 2019) but also the access to knowledge. This relational field was called an 'access ecosystem', comprising public and private education organisations that designed, legitimised, and disseminated (for-profit) resources. In the light of FutureLearn's ExpertTrack, vocational knowledge about software development was presented as a beneficial resource for economic purposes, such as finding a job in the IT industry. Embedded in this ecosystem, three modes of accessing emerged: access became a funnelling of the user (converging on the platform), turned into a monitoring and grouping of the user (tracking across the platform), and was improvised by the user with a personal toolbox (diverging from the platform). Each vignette and figure illustrated how the user and platform conjointly ordered, unordered, and reordered platformised access to knowledge resources. The hybrid concept of 'in/access' was proposed to stimulate nuanced discussions about (un)equal entry to platformised education in the fields of open education and critical platform studies.

Chapter 2, *The platform curriculum,* demonstrated and put into words how a digital platform orders, unorders, and reorders the learner's pathway – a trajectory – to knowledge in open education practices. Much of the prior open and higher education research has understood digital platforms as tools for creating more openness, i.e., a more flexible delivery of knowledge for the sake of improving educational inclusion, equity, and quality (Koul & Nayar, 2021; Michaela & Godonoga, 2020; Orr et al., 2019). The flexible learning pathway tends to be regarded more praiseworthy than its inflexible counterpart because it is said to grant learners personal, faster, and affordable types of accreditation (e.g., open badges) (Cliff et al., 2022; Ivancheva et al., 2020; McCowan, 2017). I argued that this bias toward flexibility (re)kindles an old discussion in which the curriculum is instrumentalised for personal and economic purposes rather than academic and societal ones (see Eisner & Vallance, 1974; van Dijck et al., 2018). To add to this discussion, and fill a paucity in open education and curriculum research (Krause, 2022), I performed a cross-pollination between the fields of STS and curriculum studies. I engaged with ideas found in actor-network theory (ANT) and Richard Edwards' (2011, 2015a) take on curriculum to analyse a flexible pathway during the course *How to learn a language*. Contrary to the previous chapter, this inquiry remained on the level of the putative user identity and trajectory (Bratton, 2015; Grint & Woolgar, 1997), expanding how a digital platform presumed a particular kind of learning pathway. Using visual network analysis (Decuypere, 2020), the results made clear how the platform expected the learner to traverse a specific learning pathway characterised by flexibilities and inflexibilities.

The case of OpenLearn foregrounded how digital platforms are not just facilitators of flexible learning but active constituents of a particular kind of curriculum that equally turns

inflexible. With its algorithms and graphic user interface, the platform architecture prescribed, mobilised, enrolled, evaluated, and rebundled certain trajectories and knowledge resources for the open learner. The concept of the 'platform curriculum' was advanced to understand the ambivalences engendered by the sociotechnical architecture during the running of a course, i.e., the in/flexibilities in a course of actions (cf. R. Edwards, 2011). To put it in hybrid terms, I analysed modes of in/flexibility, the tension the user faces between being enabled and constrained by the platform architecture and its wider field of relations. The combined approach of STS and curriculum studies granted a detailed understanding about the composition and consequences of providing (access to) knowledge and learning pathways in a platformised manner, highlighting how platforms actively (re)order them according to technical and curricular principles found in their design and ecosystem.

Chapter 3, *Educational vanishing points*, delved further into the sociotechnical modalities of education practices at an open and distance university, attending to when and where digital platforms turn into infrastructures and *vice versa*. This chapter, at the outset of this dissertation's second part, began from the observation that there is an ongoing datafication of education (Williamson, 2017) in which digital education platforms operate by exchanging data, information, and content with other digital technologies (Hartong et al., 2021; Kerssens & van Dijck, 2021; Piromalli, 2022; Selwyn et al., 2021). Specifically, the idea that a learning management system (LMS) can – and should – interoperate with other components of the university infrastructure has been discussed lately in some education literature (e.g., Bakhouyi et al., 2017; Chirumamilla & Sindre, 2021; Naim & Alahmari, 2020). Prior research has taken initial steps in the analysis of how platforms start to act in, as and because of data infrastructures, such as data lakes (Constantinides et al., 2018; Plantin et al., 2018). My investigation, in turn, has taken further steps by showing how a platform-infrastructure operates and has implications for knowing education practices at an open and distance university. Within the contours of STS, I once again cross-fertilised platform studies with another field, namely the field of (data) infrastructure studies (Decuypere, 2019c; Easterling, 2014). It allowed me to scrutinise 'vanishing points', a term borrowed from Hannah Knox (2017a) and perspective drawing, which afforded an analysis about the ways certain platforms could "flip in and out of an infrastructural mode" (p. 357).

The results complicated the idea of 'interoperable' platforms by showcasing additional modes of operating at the open and distance university: cooperating, teaching, transforming, intermitting, and dis/appearing, each depending to some extent on the same open-source infrastructure (e.g., Learniversity and Kafka). These five modes of operating alongside the concept of 'educational vanishing points' said something about how digital platforms start and stop being

natural aspects of everyday open education practices, i.e., how they turn infrastructural and back. Imagining such vanishing points granted a perspective on open education platforms in which they literally move out of eyesight but also seem so self-evident in their everyday use that one no longer pays attention to them. Moreover, thinking in terms of vanishing points permitted a hybrid view on open education platforms in which *other* heterogeneous entities in education (e.g., data, people) are made visible and invisible, included and excluded, through a concept that helps rethink such binaries.

Chapter 4, *Learning to dashboard*, looked even further into the sociotechnical circumstances under which the data visualisations of open education platforms facilitate access to education and knowledge. The inquiry focussed primarily on the visualisation of education (H. Kennedy & Engebretsen, 2020) and the observation by Nathaniel Tkacz (2022) that there is a noteworthy "dashboarding of everyday life" going on. Like other types of education, open and distance education is increasingly characterised by data visualisations in the form of dashboards (Boroowa & Herodotou, 2022; Chitsaz et al., 2016; H. F. Ratner, 2024). Given the lack of empirical accounts on how such dashboards are designed and used in practice (Jarke & Macgilchrist, 2021; Kerssens, 2023), my STS inquiry helped to shed a light on different modes of relating to this form of data visualisations at the open and distance university.

The results showed how educational dashboards seldomly act as neutral data visualising technologies; instead, they aligned with dominant techno-pedagogical ideas of the open and distance education institution. Rather than being explicitly designed for open pedagogy or open learning, the Learniversity dashboards were first and foremost made for a constructivist perspective on teaching and learning. Additionally, the analysis demonstrated and, again, magnified some modes of accessing knowledge in the form of dashboarding: while university staff acquired expertise about a platform's display, students learned to use it. The case exemplified both a 'dashboarding of learning' and a 'learning to dashboard' as students adapted their ways of accessing and constructing knowledge with data displays alongside other resources. Consequently, the inquiry added concepts to the educational vocabulary that helps researchers understand how platformised knowledge is being made in and about open education practices.

STS researchers have repeatedly emphasised that completing a technoscientific project and a curriculum – this doctoral research and education being no exception – is never a straightforward trajectory; what people plan and how those plans are enacted in everyday life is always the outcome of negotiations and, therefore, susceptible to discrepancies and ambivalences (R. Edwards, 2011; Felt et al., 2017). As a doctoral researcher, I set out to investigate *curricular* aspects of open education like it was devised in the university-funded research project and written by my supervisor, a

trajectory that materialised in the first part of this dissertation (especially the chapter on the platform curriculum). Scientific texts such as research articles, Law (1986) argues, are the outcome of a construction process in which several actors may participate: the author, yes, but also the words that are used to think with (e.g., theoretical resources the researcher relies on) as well as the imagined, target audience of the text (e.g., the journal that the researcher writes for). This dissertation, too, was influenced by such forces; the research project suggested using specific theoretical resources from the field of curriculum studies as well as possible spaces to publish, thereby steering my research practices from the very beginning. To some extent, I did not merely choose to research the curricular aspects of open education; from a particular vantage point, I was also *made to choose* this trajectory until the circumstances compelled me to change it.

During the time spent with participants at the open and distance university it became clear that the issue at stake was not curriculum but *platformisation* (though participants did not use that term explicitly). With the Learniversity platform undergoing a major overhaul, a possible de- and re-platformisation (Plantin et al., 2018), participants looked and made me look at their sociotechnical architecture. Consequently, the second part of the dissertation (i.e., the platformisation of an open and distance university) embraced STS resources from within (e.g., Hartong, 2020; H. Ratner & Plotnikof, 2021) as well as outside of education research (e.g., Burri & Dumit, 2008; H. Knox, 2017a). It did so more extensively and explicitly, allowing me to attune the theoretical and methodological sensibilities to these local circumstances (J. Law & Lin, 2022). The attuning let me see some effects digital platforms engender in open education practices from a different vantagepoint (e.g., infrastructure studies helped me understand platform operations in a different way than curriculum studies could) and let me add new concepts to the education glossary (e.g., dis/appearing) next to the existing ones (e.g., platform curriculum). Overall, the enacted research project concerned a balancing act between engaging with well-established academic resources and the emerging field of STS in education (see Gorur et al., 2019). As STS researchers have been contending in various contexts (Felt et al., 2017), the outcomes of the research are inevitably ordered by such engagements but also heavily implicate the researcher who brings a particular ethics into the ordering of realities.

Revisiting the research ethics

Given that the researcher is implicated in the networks they trace, a reflection is warranted on the procedural and relational approaches to *research ethics* practised throughout this research project. On the one hand, I engaged in a *procedural approach* to research ethics, a set of formal methods meant to safeguard and optimise ethical conduct in research, protecting participants from coercion, deception, judgment, exposure, and burden (Ravitch & Mittenfelner Carl, 2021). For example, I

followed such procedures by letting the institutional review board of KU Leuven evaluate my research proposal, by providing participants with information about the research (in the form of a letter, meeting, and/or presentation), and by asking for their informed consent in a written as well as verbal manner (Appendix F). On the other hand, I followed a *relational approach* to research ethics to complement the former one, an attentiveness to the context-specific, sociopolitical issues that stem from the interactions between the participants and the researcher before, during, and after the research – something that is highly relevant in ethnographic fieldwork with a lot of visual materials (Mannay, 2016; Ravitch & Mittenfelner Carl, 2021). The ordering of how people come to know and act in the world, I have explained through the work of John Law (1994), is the effect of such heterogeneous relations in which the researcher, too, takes part. Law characterised social order as "a modern dream", an effort to make the world seem simple, knowable, and actionable (1994, p. 5). For him, 'order' is an imaginary stable state, "the product, the outcome, or the effect, of a lot of work – work that may occasionally be more or less successfully hidden behind an appearance of ordered simplicity" (p. 5). The notion of 'ordering' brings into view the messy and ongoing way people, the researcher being one of them, understand and shape the world. He expresses some ethical concerns an STS researcher may have during fieldwork:

> We want to order. In particular, we hope to tell stories about social ordering. But we don't want to do violence in our own ordering. And in particular, we don't want to pretend that our ordering is complete, conceal the work, the pain and the blindness that went into it. (J. Law, 1994, pp. 8–9)

While I certainly and consistently tried to avoid doing harm as stories were told, those stories have been hiding some of my work, pain, and blind spots; they concealed certain aspects of what it means to strive for ethical conduct in qualitative research. One thing that was concealed is what Ravitch and Mittenfelner Carl (2021) refer to as "reciprocal transformation", particularly in research collaborations between participants and researchers, the idea that the interactions between these people can be and often are a mutual exchange where both parties (are open to) learning from one another and changing their actions and beliefs (p. 492). To put it in STS terms, it means that in order to find an answer to the research questions, the researcher needs to be willing to receive a (re)education of his/her sensibilities from academic and professional resources as much as participants (J. Law & Lin, 2022).

For example, I co-organised a workshop on learning analytics (LA) with two participants, so-called gatekeepers in the jargon of ethnographers (Ravitch & Mittenfelner Carl, 2021), that could bring different university stakeholders around the same (digital) table (Appendix D). During a three-hour workshop, 11 practitioners would: (1) pitch their LA-related work and research activities;

(2) enter a seminar discussion about an academic article (see Kelchtermans, 2020); (3) hear and discuss Lanze's presentation on how students 'really' learn with technology; and (4) reflect on the (future) use of LA at Learniversity. The workshop allowed, amongst other things, to share preliminary ethnographic findings about students' learning in courses where data-driven technology was being tested (see Chapter 4). Vignettes were put up for discussion and refinement as a kind of participant validation: by design, a part of the workshop was to educate myself more than that it was to 'educate' the audience (Ravitch & Mittenfelner Carl, 2021). Second, the workshop created a way to reciprocate the gatekeepers' efforts in making the ethnography possible by working together on a topic *they* considered important, and I had yet to master – I did not know much about LA prior to the workshop. The preliminary results were received with mixed feelings: ranging from a positive appreciation of these "use cases", as a senior developer called them, to a negative depreciation of the research in general. One educational scientist and faculty dean suggested it was not "sound qualitative research", mainly because of its reliance on vignettes and a limited number of participants. If anything, the workshop hints at the complexity and messiness of research ethics when you are entangled among people and objects during fieldwork. It also hints at the fact that reciprocity in fieldwork may need anyone – me being no exception – to proceed with modesty in scientific endeavours, and, perhaps, as 'the learner' rather than 'the expert'. It is with this modesty that I present the three main conclusions to this doctoral research, unfolding over the course of the next three sections.

OPEN EDUCATION PLATFORMS SHAPE ACCESS BY MAKING ACTORS DIS/APPEAR

As open education platforms continue to appear in today's education landscape to let growing crowds of users access knowledge, the issue of crowdification, i.e., the trend that an increasing number of people seeks (higher) education, takes an important place in academic literature (de Andrade et al., 2023). Open initiatives to a large extent seek to address that need for (specific kinds of) education against rapidly changing expectations from employers and labour markets (Ivancheva et al., 2020; Swinnerton et al., 2020; Zawacki-Richter et al., 2020). Zawacki-Richter and colleagues (2020) have argued that open education initiatives often spring from highly specific societal conditions, making the increased and widened access to education a necessity for some and a convenience for others. For those people who have a plethora of 'traditional' higher education institutions to choose from, open universities and platforms may look like just another convenient solution for learning and knowledge-making at a preferred pace, place, and time. However, for those who cannot afford or reach traditional education, or need to gain professional expertise in specific subjects quickly, open education platforms and universities may indeed be a necessity (van Deursen & van Dijk, 2019; Zawacki-Richter et al., 2020). That being said, it has become clear that

and how "technologies do not overcome occlusion, but reconfigure its possibilities" and these educational occlusions deserve our attention because they can be as meaningful as openings (R. Edwards, 2015b, p. 255). Revisiting some findings from the aforementioned cases sheds a different light on how open education platforms (re)order such openings and occlusions for those looking to benefit from education.

In Chapter 1, the FutureLearn platform made a collection of knowledge resources accessible and inaccessible for the learner just as much as it made them *appear* and *disappear*. The knowledge resources about software development appeared on the graphical user interface (GUI) in so far as the learner moved to and across the platform as expected (e.g., by viewing information, clicking buttons, registering, and paying). These resources did not appear out of thin air but were shaped for and placed on the platform by a constellation of education platforms, institutions, and (commercial) organisations that were equally present in other open education initiatives (Thomas & Nedeva, 2018; see OpenLearn). As others have argued, such actors tend to be more explicit about their quest towards accessible education than about the forms of interaction they made possible (Grimaldi et al., 2023). While the open education platform made knowledge resources (e.g., course texts, comments from other learners) appear for the user, it also made other contributing actors disappear from the education practice (e.g., the HTML source code stayed underneath the platform). This is a normal feature of the digital platform since it would be hard to handle for most people if there were no graphical symbols to manipulate (Cramer & Fuller, 2008; van Dijck, 2013). While the fact that source code is obscured in digitalised education practices is by no means new (R. Edwards & Carmichael, 2012; R. Edwards & Fenwick, 2017), exploring FutureLearn made more tangible how and what kind of source code disappears from the user's view (e.g., the programming language Ahoy for tracking the learner). Some of the code, as we have seen, is implicated in surveillance/monitoring practices that are debated in and beyond education research (see Prinsloo et al., 2019; Selwyn, 2015), but can reappear as a knowledge resource for learners to explore. This was the case in the ExpertTrack on software development.

In Chapter 2, the OpenLearn platform equally made certain knowledge resources appear in education practices and made others disappear. Like on FutureLearn, the platform made learning materials appear on the architectural surface but concealed much of the sociotechnical work happening beneath it – at least, from the perspective of the user. First, the user could see little of the activities education teams performed to make (existing) university course materials appear online as part of an open education resource (OER) or massive open online course (MOOC). The platform and university framed these resources as being 'open', 'free', and 'flexible', thereby repeating normative ideas in open and distance education literature about removing barriers to

participation and democratising education (Veletsianos & Houlden, 2019). One way open education platforms tried to accomplish these ideas is by making content appear on the level of courses as opposed to comprehensive programmes (van Dijck et al., 2018). OpenLearn's badged course offered an introduction to the subject of language learning instead of an introduction to a broader academic discipline that could tackle such a subject. Second, the platform rearranged these separate courses into new programmes via its concealed algorithmic activity. Algorithmic activity in education, too, remains hidden from certain educational actors, such as learners (R. Edwards, 2015a; R. Edwards & Carmichael, 2012). OpenLearn's algorithms made the automatic mechanisms underlying the curricular rearrangement disappear and, conversely, made the (new) programmes appear on the screen, thereby directing the user to resources from one of the organisations within one-and-the-same ecosystem (e.g., the ecosystem of the Open University). This digital platform offered a glimpse of the deterministic algorithms working behind a technical barrier (the graphical user interface) and shaping pathways to different knowledge resources, making them appear and disappear at certain parts of the learner's trajectory.

What does revisiting these two cases tell us about the platformisation of access to education and knowledge? STS research reminds its audiences that in heterogeneous practices, comprised of humans and non-humans, actors simply cannot all fit on a single screen or paper and, therefore, are sometimes reduced to a representation or made absent altogether (J. Law, 2002; J. Law & Lin, 2022). For example, in open and distance education, the educator may create an online learning module under his/her name for students to see, while remaining out of sight and unavailable for said students. STS research also reminds us there is always some kind of hidden work involved in making something visible; the actors involved in producing a depiction or visualisation cannot and do not always have to be present (Fyfe & Law, 1987). For instance, certain algorithms of open education platforms may help produce data visualisations on educational dashboards for students and educators to consult, but the technical operations remain far away from their human eyes. Reframing how open education platforms turn entities inaccessible and accessible as a way of disappearing and appearing – dis/appearing – helps people acknowledge how heterogeneous entities are taken out of and brought into education practice and draws attention to the tendency that only some parts of reality are made knowable for students and educators.

The cases help reframe the openings and closures created by digital (education) platforms (Bratton, 2015; R. Edwards, 2015b), turning them into a *first mode of dis/appearing* or a way of imagining sociotechnical architectures as simultaneously allowing and disallowing specific actors to be encountered in education practices. They tell something about how digital platforms order access to knowledge in education practices: they make certain educational actors literally appear,

disappear, and re-appear for a potentially large number of people. At least in this dissertation, people relied on platforms to access education in a primarily visual format; the clickable texts, images, and videos in online courses were available to their eyes first and their hands second. On the one hand, learners, educators, and educational resources (are made to) *appear* and become present on the platform, that is, the sociotechnical architecture discloses possibilities for certain kinds of knowledge-making and learning to occur. On the other hand, the architecture also (made) human and other-than-human actors *disappear*, they became absent from the platformised practice, indefinitely or until their reappearance. The subtle interdependency of appearance and disappearance elucidates a kind of heterogeneities or ambivalences that are enacted in open education practices, putting into words the interplay between digital platforms and other entities instead of simply facilitating democratic access for crowds of learners.

OPEN EDUCATION PLATFORMS DIS/APPEAR WHEN AND WHERE THEY SHAPE ACCESS

As was elucidated in the general introduction of this dissertation, two additional issues emerge when homing in on the platformisation of open education practices besides crowdification, namely datafication and visualisation. First, the *datafication* of education has been a key issue in the last two cases, pointing to the process in which digital technologies convert various human behaviours into quantitative data that can be tracked, combined, analysed, and utilised for present or future strategic purposes (Dencik et al., 2018; Jarke & Breiter, 2019; Williamson, 2017). Second, and connected to datafication, was the *visualisation* of education or the process of transforming data about someone or something in education settings into visual representations which, in turn, allow analysts, students and educators to derive practical insights about specific populations and trends (H. Kennedy & Engebretsen, 2020; H. F. Ratner, 2024). Indeed, as we have seen in the second part of the dissertation, data and data visualisations may also reshape the very practices they are believed to represent (Grant, 2022; Mikhaylova & Pettersson, 2024). The cases demonstrated how open education platforms *themselves* appear, disappear, and re-appear when and where they ordered access to knowledge – the subject materials as well as data visualisations.

In Chapter 3, the Learniversity platform-infrastructure was mostly responsible for making access to knowledge resources possible and was characterised by university's leadership as a "hidden" aspect of their open and distance education. Others researching higher education infrastructures (Williamson, 2018) have also found that such a disappearance primarily concerned the data exchanging between different interconnected technologies and, secondary, concerned the resources being placed on or off the digital education platform (Forment et al., 2009; Naim & Alahmari, 2020). When students and employees interacted with the GUI, each focussing on their

distinct activities, the Learniversity platform indeed turned into a seemingly insignificant and almost invisible aspect of education. The platform usually appeared as visible, full-fletched actor upon a technical or organisation breakdown, or upon clicking a button that made data blink away from human eyes (cf. Bowker & Star, 2000; H. Knox, 2017a). For example, the commercial application programming interface (API) that connected Learniversity with the learning analytics dashboard (LAD) permitted data to move from the digital education platform, through the Kafka database, to the dashboard that displayed the open and distance learning in the format of data visualisations. While employees were very much aware of this behind-the-screen process and potential problems, this was not the case for the students whose attention, understandably, was directed toward the knowledge resources on the screen. It became clear that and how students and employees were confronted with not only the data disappearing from their view but Learniversity becoming self-evident, only to appear again moments later – often prompted by someone or something drawing attention to the platform.

In Chapter 4, Learniversity's data visualisations were encountered in the form of educational dashboards and accessed by students *as* knowledge resources, capable of shaping their open and distance learning. If not completely absent, the data visualisations disappeared in the routine of everyday learning and (re)appeared when that routine was interrupted. The Learniversity dashboard (LMSD), to give one example, turned into the centre of attention for some students when they talked to me about questions, frustrations, and anxieties that were triggered because of the digital platform and its data visualisations. Some students questioned the composition of the dashboard and the way they were instructed to navigate the course. Other researchers have touched upon the fact that datafication can instigate affective responses which lead to additional (and more easily quantifiable) actions (Williamson, Bayne, et al., 2020). To put it in the words of Hannah Knox (2022), digital technologies are at times "felt but not known, sensed but not located" – at least, not to their fullest extent as part of a digital infrastructure (p. 240). Infrastructures can be so extensive that they become almost impossible grasp, yet some effects and characteristics may still be noticed by the people relying on them (H. Knox, 2017a). In the case of the Learniversity LMSD, the affective outcomes of relations between the students, dashboard, and researcher also indicate how data visualisations at the open and distance university induce both agreement and disagreement about learning with data-driven technologies. Students are not passive recipients of education dashboards and, by extension, platforms; rather, they alter their learning practices when and where they deem it necessary. Although students did not express complex details about the composition and operation of these technologies as some employees did, the digital platform

sometimes became an extensive, surrounding, and unknowable actor that engendered knowable effects, drawing the eyes of the users and researcher toward it.

Digital platforms, and the wider field of relations they are enmeshed in, are all too easily framed as neutral instruments for accessing education and knowledge in popular and academic discourses, and, sometimes, with little attention paid to the way access is (re)shaped and what the consequences are of that shaping for other educational actors (R. Edwards, 2015b; Ramirez-Montoya, 2020). When users and researchers interact with a platform, it first appears as an unfamiliar terrain to their eyes, a place where knowledge resources can be accessed and education practices organised. Although that terrain may first be navigated with a great deal of attention, it soon becomes overly familiar and seems to disappear. Given that these programmed architectures are immensely complex, comprising a particular kind of content, usage, technology, ownership, governance and business model, researching platforms in the daily routines of everyday life can be daunting (van Dijck, 2013). Edwards (2015b) has reminded education researchers that the "performances of software become too complex and dynamic to be 'read' or fully understood" (p. 275). This dissertation has shown how, open education platforms, too, *disappear* into the routines of everyday life until their dependency on, and position in, infrastructures or ecosystems is disrupted. When one starts to pay closer attention to them, upon a break-down, overhaul, vanishing point, or affective response, the open education platforms (*re*)*appeared* as unfamiliar terrains, inviting researchers to interact with them more attentively.

Crossing platforms as a day-to-day activity confronts people with a *second mode of dis/appearing*, a continuous back-and-forth between the disappearing and (re)appearing of sociotechnical architectures at certain times and places, by design or otherwise. While it is a typical effect of sociotechnical relations that platforms and their aesthetic data visualisations start to disappear when being used, this does not have to be problematic for the users. (How can one learn course materials if one is simultaneously supposed to be attentive to how they are presented?) That being said, and given the persuasive capacities of these technologies, for good or bad, researchers have little reason for complacency and cannot take the situation for granted (cf. Burri & Dumit, 2008; Rose, 2016). It has long been argued that the sociotechnical modalities of visualising technologies invite specific modes of seeing; "a television in a living room and a canvas in a modern art gallery do not invite the same ways of seeing" (Rose, 2016, p. 39). Open education platforms, at least in the cases presented here, invite users not just to see the world in a particular manner but are both opening up and closing down different worlds for students to encounter – they are making *themselves* dis/appear. These platforms are visualising technologies as much as they are pedagogical technologies: they can be produced and deployed to make users very much aware of their own

operations in various ways. For example, the Learniversity LMSD user manuals highlighted and annotated information about the dashboard's different functions. The OpenLearn platform, to give another example, included a real-time annotation system that – like a tutorial – directed the gaze of the learner to important privacy settings. In this sense, the dis/disappearances induced by digital platforms can be put to use as pedagogical technique that draws one's attention to subject materials as well as more architectural aspects of the educational setting. Education researchers and practitioners can play an important role in the design of open and digital education platforms by carefully reflecting on when and where people's attention needs to be drawn to the architecture, the platform's continuous points of dis/appearing that can be in need of and used as a pedagogical intervention in particular situations.

RESEARCHING OPEN EDUCATION PLATFORMS, TOO, MAKES ACTORS DIS/APPEAR

Like with other technologies, wielding STS as a sensitising device also had performative effects on myself and others, impacting what could (not) be included into the written account of the case studies (cf. Decuypere, 2019a). Or, to recall the words of Law and Lin (2022) from the general introduction, STS provided both sensibilities and in-sensibilities that influence what could and could not be taken into account: "to look well is to look selectively. It is to learn, implicitly or otherwise, what can and should be ignored" (p. 10). There are inevitably exclusions and omissions occurring in research projects and it is the responsibility of the researcher to recognise and reflect on those. The combination of methods I practiced, the vignettes and visualisations I made about different phenomena, they, too, made certain actors appear, disappear, and reappear. Therefore, I dedicate this section to the disentangling of my own positionality in the networks I participated in and the dis/appearances I effectuated.

I will identify three of my insensibilities and unravel how these posed problems and limitations in my research. A first insensibility during my research trajectory involved the way I made the *affective dimension* disappear, meaning the bodily sensations, experiences, and perceptions that stem from encountering certain materials. It is a dimension that has become a focal point in many researchers' inquiries (Rose, 2016). STS researchers, myself and other researchers in education included (e.g., Alirezabeigi et al., 2020; Martinez Lunde, 2021), tend to muster the almost forensic-like attention to tracing actors in everyday situations, allowing them to empirically disentangle how particular things (re)order reality (Latour, 2005; J. Law, 1994). This level of attention affords detailed and accurate accounts, however, it also commonly excludes "the affective capabilities of objects, spaces or bodies" from those accounts (McCormack, 2019, p. 182). There have been STS- and ANT-inspired cases that address emotions as a relational effect, such as the

work of Lee and Brown (2002) on the complexities of childhood trauma. Here, affective states such as fear are brought into view as both a reality and an imaginary. More recently, some have drawn on Latour's notion of 'attachments' to incorporate the affective dimension in STS research (de Laet et al., 2021; Decuypere & Simons, 2019), a notion I employed during my trajectory as doctoral student but not in this dissertation (see van de Oudeweetering et al., 2022).

The limited appearance of affects in this dissertation was made possible through the work of Hannah Knox (2017a, 2017b), in which affect is framed as the outcome of infrastructures specifically, and sociotechnical relations more generally. For instance, during my ethnographic fieldwork in the open and distance university (see Part 2), one of the Learniversity dashboard users, Timothy, voiced and showed disbelief and worry regarding the way the visualisations expected him to act on certain – in his eyes redundant – deadlines. The affective dimension was left out of my research except for a couple of mentions. For example, one participant narrated and expressed some negative emotions regarding his participation in technology-intensive open education practices. Christian could be considered a 'non-user' and had been studying at the university for over thirty years, participating in various courses, ranging from politics and statistics to economics and management. As a self-declared autodidact, he read the tangible course materials but never made online assignments, nor did he attend practical sessions or examinations. Christian stated fiercely, almost angerly, he did this out of protest in the aftermath of some racist incidents in that happened about three decades ago. He explained that his absence and non-usage were negative repercussions of being "dark skinned". Although he keeps officially enrolling in university courses, and misses contact with peers, his past had made him reluctant to engage in future activities organised by the pedagogical staff and more recent video conferencing technologies. This is an example of the way my (STS) research goals and sensitising device made me prioritise some dimensions (e.g., usage) over others (e.g., affect), causing some actors to appear (e.g., users) and others to disappear (e.g., non-users). Perhaps recognising someone as a 'non-user', a term and focal point that has been suggested in established STS research (Oudshoorn & Pinch, 2003), would have created an opening to see and attend to some participants' accounts more fully. This is especially important when human and non-human entanglements engender issues of race, ethnicity, and inequality in platformised education practices (see, for instance, Öztok, 2020).

A second insensibility concerns the ways I made some *identities* disappear from the research trajectory and account, an inevitable result of having to (re)focus the (auto)ethnographic fieldwork on those aspects that correspond to the research goals, dimensions, and methods. When discussing identities in the scope of this dissertation, I have relied on a particular dimension, the platform's usage, and repeatedly drawn on the notion of 'the user'. Following Bratton (2015), the User – he

capitalises the word – is the effect of sociomaterial relations and only an approximation of the actual entities being identified by this word. The User is always an aggregated subject or identity that cannot be reduced to a single entity. For him, "the User is not a type of creature but a category of agents; it is a position within a system without which it has no role or essential identity" (p. 406). Simply put, anyone and anything depending on some kind of technology in a network of relations could become a 'user'. In prior research on open education, for instance, Jeremy Knox's (2016a) investigation of MOOCs, the sort of human subject produced in these intensely technology-mediated education practices is the main focus. He argues MOOCs presume and produce a universal understanding of what it means to be a human, capable of rational and autonomous learning with various digital devices. That is to say, the identity MOOCs presume is based on:

> the nurturing and refinement of a particular kind of human being: one that thinks in a reasoned way; has a natural capacity for independence; and which shares these exclusive traits with all others assumed to be of the same species. (J. Knox, 2016a, p. 2)

Focussing on usage in this dissertation certainly made some identities appear across the different chapters, including the future learner (Chapter 1), open learner (chapter 2), educator (chapter 3), and student (chapter 4), but never really made identifying identities a key concern. The (changes in the) research design, moving from Part 1 to Part 2 of the inquiry, also impacted how and what identities were allowed to appear in the written account.

I will elucidate the impact of my insensibility by revisiting two related problems. The first problem concerned when and where the *researcher's* identities were permitted to appear in the vignettes and figures, knowing that any research puts some things in the foreground and others in the background or simply leaves them out altogether (J. Law, 2004). Some of the identities that were made visible in the written account were those of myself: me as an (auto)ethnographer (e.g., 'I', 'Lanze') and me as a user (e.g., a 'future learner', an 'open learner'). Much of that dynamic (self-)identification resulted from methodological choices. For example, the first chapter and case greatly emphasised the researcher in the network because of the autoethnographic inquiry which, according to Adams and colleagues (2021), is particularly well-suited to explore novel practices and identities as well as to gain firsthand knowledge. The method allowed me, like other researchers (Lange, 2021), "to use personal experience (*auto*); illuminate and interrogate [...] practices, and identities (*ethno*); and take the craft of representation seriously (*graphy*)" (Adams et al., 2021, p. 11). An 'I' appeared in the vignettes, and 'the user' was shown on the visualisations due to the methodological decision. This decision sparked a critical question: On what grounds can the researcher call him/herself – or any other entity – an 'actor' in the network if no participants are present? This points to a typical STS problem, Law (1992) explains, the somewhat fragile process

of punctualisation, how an entity (temporarily) becomes stabilised and self-evident, i.e., an actor with a particular function in its network (see also Akrich, 1992).

The second problem emerged precisely due to the absence of human participants other than myself (in Part 1), a kind of predetermining that happens when only the researcher is involved in shaping and identifying *user/learner identities*. Focussing on myself as learner was done with the best intentions, trying to include a researcher's/learner's identity in an accessible and evocative account while explicitly refusing any generalised or universal representation (Ravitch & Mittenfelner Carl, 2021). Adams and colleagues (2021) state that autoethnographers "recognise and embrace the reality that the person and the personal are always present in social life as well as in the processes of research and representation" (p. 1). The autoethnographic inquiry conducted in this dissertation allowed both the researcher and the researched to appear in the account, which is logically consistent with the "principle of generalised symmetry" maintained throughout the trajectory (see Callon, 1984, p. 200). For me, it makes no sense to avoid speaking about myself in the first person as long as 'I' remain the effect of sociomaterial relations just like any other actor. That being said, the appearance of other human actors (i.e., participants) during the ethnographic fieldwork in the second part remediated many 'self-identification problems' (i.e., *making* someone or something appear) while still adhering to the principle of generalised symmetry.

A final insensibility discussed here concerns the employment of *digital and visual technologies* (e.g., Gephi, Inkscape) in my own STS research practices. I have arguably drawn and included two kinds of visualisations across this dissertation: network diagrams, showing the sociomaterial and relational composition of various practices (e.g., Figures 1, 2, 8, 17), and interface images, showing the aesthetic look of graphic user interfaces (e.g., Figures 11, 14, 16, 20). The use of technologies deserves more elucidation and reflection because my own data visualisations, too, are no neutral representations of education and have performative effects (Burri & Dumit, 2008; Mikhaylova & Pettersson, 2024; H. F. Ratner, 2024). Data visualisations, Edwards (2015a) argues in the context of open and online education, both include and exclude particular aspects of reality, and what is shown can have persuasive and semiotic power. For him, data visualisations raise questions about what is made visible or not:

> When utilising digital visualisations of data in educational contexts, this raises questions about the quality and reliability of what is drawn upon and what is coded out as well as what is coded in to make the data visible. (R. Edwards, 2015a, p. 271)

The first problem regarding the use of digital and visualising technologies for methodological purposes was deciding which actors needed to be visualised in the figures of this dissertation,

especially the diagrams presented in Part 1, and on what grounds. Indeed, the problem directly relates to wat was just said about performing fieldwork without participants in which the researcher must determine what does (not) make a difference in the practices under investigation. Law (2004) reminds researchers that practicing methods always entails "enactments of relations that make some things (representations, objects, apprehensions) present 'in-here', whilst making others absent 'out-there'" (p. 14). As a researcher making use of digital-visual methods (see H. Knox, 2017a; Pink, 2021), I have made particular actors of platformised open education practices *appear on* and *disappear from* the diagrams, causing some to be more detailed than others and impacting how they can be known.

The final problem arose when some participants voiced having difficulty with accessing and using the communication platform via which interviews and observations were organised (Microsoft Teams). Unsurprisingly, my reliance on digital technologies has "digitally shaped ethnographic relations" before, during, and after the fieldwork (Kim et al., 2021, p. 1). Sending instructions and a user manual before the session did not always suffice to start the activities at the designated time and place. At times, additional emails or messages had to be send to the participant to make sure he/she could download, install, access, and use Microsoft Teams (the standard platform used at both our universities). On some occasions, I had to turn to an alternative platform, Skype, because the participant could or did not want to participate via Microsoft Teams. The struggles and negotiations surrounding the platformised fieldwork, being quite inevitable given the ongoing pandemic at the time, suggest the digital technologies for data collection should not be taken for granted by the researcher. Despite being an STS researcher in education, I have – perhaps somewhat ironically – made both platform *access and in-access* for my participants. If possible, I would have dedicated a fifth chapter on this problem and elucidated how the specific combination of research methods and platforms has resulted in foreseen and unforeseen consequences for actors that agreed to participate in this doctoral research trajectory.

Despite the limitations present in the cases of this dissertation, my trajectory as *doctoral researcher* has showcased how one can add *movement* to the existing sensibilities that STS affords; how someone may go from one point to another, from somewhere they can see and be seen to somewhere they cannot. Ethnographic inquiry has been suggested as possible method in the methodological toolbox for investigating platforms and other data-driven technologies in practice (Decuypere, 2021), and builds on a long tradition of STS research that is inflected by techniques from the field of anthropology (Latour, 2005; J. Law, 2004; Pink et al., 2016). The way I practiced ethnographic STS was not only a matter of investigating the interface, design, usage, and ecology, as the toolbox suggests (see also van de Oudeweetering & Decuypere, 2019). It was also a matter

of going back-and-forth between different places, making myself and certain worlds dis/appear repeatedly as I tried to grasp the relations with, on, behind, and beyond the platform. Platforms remain self-evident surfaces unless the researcher crosses their relational field attentively, equipped with one or more protocols to direct the sense-making (e.g., seeing, listening, touching) towards the heterogeneous actors encountered (see Appendices A and B), and theoretical resources to (re)educate that sense-making (J. Law & Lin, 2022). Disentangling (some) of those relations and presenting them to the reader as a critical account is a key aspect of what this doctoral trajectory accomplished.

Moreover, this dissertation equally showed the trajectory of a doctoral *student,* exemplifying and contributing to a movement from one identity to another, that is, crossing different sociomaterial networks attentively has re-shaped the way the student relates to the world (see also Nespor, 1994). The persistent attention to science and technology over the years is more than merely a research project: it is a course of actions with educational implications for my own identities. STS educators stress that besides "the process of making science and technology, people also make and remake themselves, their bodies and identities, their societies, and their material surroundings" (Felt et al., 2017, p. 1). The way I disentangled how open education platforms (re)order access to education resources changed throughout the trajectory, from the first to the last case, but also reordered how *I* think and act upon different actors along the way. Indeed, (STS) research and education are often intertwined in a double sense: science and technology studies imply both operating *in* and *as* education simultaneously (Decuypere, 2019a).While describing and visualising the trajectories of other actors crossing digital platforms, the STS student/researcher, too, was being pushed and pulled in various directions. The account presented in this dissertation, including the representation of myself in the four chapters, are concrete materialisations of that movement: the way I made myself and others appear and disappear has transformed throughout the chapters.

Perhaps the STS researcher/student's attentive trajectory across platforms can be understood as a third *mode of dis/appearing*, a movement of the researcher amongst some encountered actors that define, shape, and understand each other. In order to make sense of the sociotechnical practices and modalities of open education platforms, one needs to trace and retrace how these entities recurrently shift between a seemingly visible and invisible state by crossing attentively. Crossing platforms means paying attention to their infrastructural/ecological qualities and the curvatures that are made, i.e., the trajectories over the designed surfaces and across the wider relational landscape. To put it differently, crossing platforms implies the researcher ventures

into strange lands and back; recognising the appearing and disappearing of what lies in front and behind him/her.

FUTURE RESEARCH TRAJECTORIES

As appearance and disappearance depend on one another to make education practices possible, an ambivalent and ongoing process of *dis/appearing*, platformising education should not be equated to democratising education. The education shaped by OpenLearn and FutureLearn expected users to become 'open learners' and 'future learners' respectively, thereby visualising a highly specific identity that invites one to consolidate continued relations between the user and the platform (see also Decuypere, 2019c). To some extent, the platforms also made resources appear that were produced by actors within the same public-private ecosystem, the access ecology in which the Open University played different roles (e.g., owner, co-owner, producer). Within the Open University's ecosystem, the university moved resources that were produced by its educators to both the OpenLearn and FutureLearn platform. Regardless of the legal question whether these resources are also allowed to appear elsewhere given their licencing (e.g., a creative common versus proprietary licence), an extensive auxiliary digital education ecology comprised of organisations and architectures is making *their* curated and licenced knowledge resources dis/appear.

What some digital platforms give learners access to and the sort of education they bring into existence today is, perhaps, neither a traditional curriculum nor a massive open online course anymore (Thomas & Nedeva, 2018; van Dijck et al., 2018). Curricula are organised by educational institutions for a particular purpose, such as introducing students to an academic discipline (e.g., computer science) and/or a specific vocation (e.g., computer scientist) (Cliff et al., 2022; Eisner & Vallance, 1974). MOOCs, in turn, are primarily organised by universities and colleges as an instrument for the democratisation of education, a way of introducing students to low-cost or even entirely free education in the format of a single course (Brons, 2017; Zawacki-Richter et al., 2020). MOOCs (provided via platforms) have proven to be a popular strategy for tackling the issue of crowdification in higher education, bringing education to 'the masses' or 'a crowd' of students (de Andrade et al., 2023) as well as a marketing strategy to popularise the brand of old and new education organisations (Thomas & Nedeva, 2018). The platform-centric cases in this dissertation revealed that and how students were introduced to something more than an education format and brand: a sort of education that can tentatively be called a *platform ecology of dis/appearances,* meaning an extensive heterogeneous field of relations (comprised of numerous interacting architectures and organisations) that produces, selects, promotes, and disseminates resources under their specific sociotechnical preconditions.

Future research may look into the different ways this platform ecosystem entices users, learners, or students to relate to the resources (e.g., course materials, university educators, company experts, and platform peers) that are made available. The type of education that is appearing and brought into existence introduces students/learners into a collection of actors that inevitably foregrounds and democratises only some aspects of reality for (crowds of) people whose identity is ready to be shaped. Nowadays, researchers are striving not only towards more openness but also to open *ecosystems* in which knowledge materials become visible and networked thanks to the affordances of the latest technologies (e.g., artificial intelligence, blockchain) (Otto & Kerres, 2022; Yuan et al., 2013). The call for and believe in open ecosystems for more accessible education and knowledge is exemplified in the article of Bozkurt et al. (2023):

> Openness serves as an indispensable ingredient in the rich recipe of human learning, development, and progress. It is a truth universally acknowledged that human beings naturally inhabit an open ecosystem, engaging in complex, multifaceted interactions with their environment. Hence, one can make a persuasive argument that openness acts as a potent catalyst, facilitating and invigorating the process of learning. (Ibid., 2023, p. 77)

There is a growing and widespread trend to think in terms of 'ecosystems' across academic disciplines, to the extent that almost anything is being conceived in this way, and the term loses its conceptual-analytical clarity (Audretsch et al., 2019). Since the 2000s, the term has been proliferating in many academic disciplines beyond biology and ecology (e.g., economics, policy, business, education), where it has undergone several specifications (e.g., 'economic ecosystems,' 'entrepreneurial ecosystems,' 'digital education ecosystems'). The term ecosystem is cited more than 1000 times annually, typically as a predefined set of actors in a particular sector. It has been argued that reasoning about the increasingly specified forms of ecosystems not only risks bordering on conceptual vagueness but also severs the link to their holistic, natural dimension (Hörl, 2017). Given the spread, proliferation, and normative use of the term, ecosystems require more in-depth conceptualisations and empirical understanding (Gu et al., 2021; Nguyen & Tuamsuk, 2022).

Research about edtech ecosystems, also called smart learning environments or digital education ecosystems, is becoming increasingly prevalent but lacks that conceptual-empirical clarity (Nguyen & Tuamsuk, 2022). "Despite the overwhelming use of the metaphor 'ecosystem' in academia, industry, policy, and management, exact definitions of what 'ecosystems' really comprise are scarce and often inconsistent" (Audretsch et al., 2019). Chapter 1 revealed how public-private relations between companies, digital platforms, and universities are not neutral but generate socio-technical effects: FutureLearn's access ecology both provided and hindered the learner's way to education and knowledge. Chapter 2 showed some of the Open University's ecosystem and how

OpenLearn primarily flexibilised access to resources, courses, and programs within and for the benefit of its own ecosystem. Chapter 3 identified how private companies (e.g., Brightspace) pressure and replace the Learniversity ecosystem, understood as an infrastructure with open-source technologies, which had organisational and pedagogical implications. Chapter 4, shed some light on how a private company collaborates with a university, together creating a learning analytics dashboard that was only temporarily plugged into the ecosystem. This dissertation did not investigate ecologies or ecosystems as such but has hinted at the value of having a clearer conceptual and empirical understanding in the context of (open) education. Future research trajectories are encouraged to move in the direction of so-called (open) learning ecologies and edtech ecosystems that are more and more taking the form of intricate networks (Zawacki-Richter et al., 2020). STS researchers, now working from diverse places across the world (Felt et al., 2017), may scrutinise the heterogeneities of these ecosystems and the sorts of openings and closings they configure.

In the end, as argued by past and recent scholarship (Amiel, 2023; R. Edwards, 2015a, 2015b), researchers will still face open education platforms and ecosystems in need of critical scrutiny. STS researchers have been urging their peers in the field of science and technology studies to consider non-western words and methods to enrich their investigations of technoscientific practices and effects in certain regions of the world (J. Law & Lin, 2020; J. Law & Mol, 2020). Critical scholarship on digital education, too, has argued that the field is in need of accounts about and originating from places that are still under-represented in this sort of inquiry (Williamson et al., 2024). This dissertation has showed that and how some digital platforms and knowledge resources dis/appear from the eyes of various actors in open education practices – an issue that remains wide open for future academic and public debate across the world.

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APPENDICES

APPENDIX A: RESEARCH PROTOCOLS OF PART 1

The protocols have been translated and modified to fit the language and style format of the dissertation. Each protocol was accompanied by the synopsis and the research questions of the project at that time. The core concepts in the research protocols have changed throughout the research process as the research approach became more refined.

Observation protocol FutureLearn

Date and time:

Location:

Title of the session:

Exploring the platform ecology

The researcher visits the platform to scrutinise and identify the home page, about page, and/or about section of the selected course(s) and get a general understanding of its position in a wider ecosystem.

- What actors can be distinguished on the platform?
- What do these actors do?
- What types of actors can be distinguished on the platform?
- What other contextual information needs to be taken into account to understand these actors?

Using the platform

The aim of the researcher is to identify material-semiotic actors by distinguishing and relating to them on the graphic user interface. The researcher first uses the platform by taking on the role of the learner and reflects on this usage afterwards by taking (additional) screenshots and notes.

Activities	Actors	Relations	Context for further interpretation
What pathway did the user take?	Through whom and what is access possible?	What does the actor do?	When and where does the activity take place?

What kind of activities take place when accessing the platform?	Who or what is involved in the activity?	What does the actor make the user do?	What are the consequences (benefits) for the actors involved? (Reminder: Take screenshots.)

Observation protocol OpenLearn

Exploring the platform's described curriculum

The researcher visits the platform to scrutinise and identify the platform's described curriculum and get a general understanding of its position in a wider ecosystem.

- What actors can be distinguished on the platform?
- What do these actors say about the course to be run?
- What other contextual information needs to be taken into account to understand these actors?

The platform's prescribed and enacted curriculum

The aim of the researcher is to identify material-semiotic actors by distinguishing and relating to them on the graphic user interface. The researcher first uses the platform by taking on the role of the learner through multiple accounts and reflects on this usage by taking screenshots and notes.

Curricular practices	**Actors**	**Relations**	**Context for further interpretation**	**Reverse engineering**
What kind of activity takes place on or beyond the platform?	Who or what is involved in the activity?	What does the actor do? What does the actor make the user do? How does the user depend on written prescriptions?	How does the activity relate to other aspects on the platform? What are the consequences for the actors involved?	What differences appear in these activities when given a different input via another user account? (Reminder: Take screenshots.)

APPENDIX B: RESEARCH PROTOCOLS OF PART 2

The protocols have been translated and adjusted to fit the language and style format of the dissertation. Each protocol was accompanied by the synopsis and the research questions of the project at that time. Depending on the situation, adjustments were made to each of the protocols. For instance, interview protocols were adapted depending on the role a participant fulfilled (e.g., student, educator, coordinator). All participants had received an information sheet and an informed consent form before agreeing to give an interview or join an observation session.

Observation protocol

Date and time:

Location:

Title of the session:

Pseudonyms of the participant(s):

Activities	Actors	Data (exchanges)	Context for further interpretation
What kind of activity takes place on, with, behind, or beyond the platform?	Who or what is involved in the activity?	What is the role of data in the activity?	How does the activity relate to other aspects at the university? How is a data standard established in the activity? What are the consequences for the actors involved?

Interview protocol for educators

Date and time:

Location:

Title of the session:

Pseudonyms of the participant(s):

Before the interview (10 minutes)

- Check the two recording devices, the second screen, and the headphones.

- Welcome and thank the participant.
- Introducing myself, the research, and the objectives of the interview (cf. information sheet).
- Sketch the flow of a semi-structured interview (length, video recording, screen sharing).
- Discuss informed consent form and pseudonyms.
- Check whether the participant has any questions and whether it is okay to start the video recording.

Part 1. Interview questions about the organisation and program (30 + 5 minutes break)

1. Would you like to introduce yourself and your role within the program?

2. Could you briefly explain what your research is about?

3. How does your research relate to the course(s) you teach?

4. What tasks do you fulfil in your role as educator?

5. What are some current developments within the program that concern you?

6. What do you think characterizes the university compared to a regular university?

Part 2. Interview questions about technology in training (40 minutes)

7. Which software, apps, programs, or platforms should you use in your role as an educator? (I.e., without this technology you cannot do your tasks). [For example: Teams, MS Office, …]

a. When and in what situations should you use this technology?

b. What do you do with that technology?

8. Which software, apps, programs or platforms do you use without obligation in your role as an educator? (I.e., you can do your tasks without this technology).

a. When and in what situations do you use this technology?

b. What do you do with that technology?

9. Given your duties and role as an educator, what other people (positions) at the university do you need to collaborate with? (i.e. without them you cannot fulfil your duties.)

a. When and in what situations should you work with these people?

b. What topics do you discuss with these people (positions)?

10. Given your duties and role as an educator, which other people (positions) at the university do you choose to collaborate with?

a. When and in what situations do you work with these people?

b. What topics do you discuss with these people (positions)?

11. Given your role as educator, what does the organisational chart of your faculty look like? (How is it administratively organised?)

a. How is the faculty divided (e.g. according to departments)?

b. What is the role of the program leader / department leader / ...? (Who is that?)

c. Can you describe the different types of faculty meetings you participate in?

Closing interview questions and general additional questions (5 minutes)

12. Given the topics we've discussed; are there any other people you think would be interesting to interview? Earlier in our conversation you mentioned [person X], would it be possible to interview that person?

13. What other (digital) places or things do you think would be useful for me to see? Earlier in our conversation you mentioned [technology X], is it possible to see that?

14. Are there any other things you think are important to say? Earlier in our interview you talked about [topic X], what exactly does that mean?

After the interview (5 minutes)

- Indicate what the next steps in the research are.
- Ask if the participant wants to be kept informed.
- Thank the participant.

- Stop recording and backup recording, save the files and notes.
- Complete logbook and contact details.

Interview protocol for staff members

Date and time:

Location:

Title of the session:

Pseudonyms of the participant(s):

Before the interview (10 minutes)

- Check the two recording devices, the second screen, and the headphones.
- Welcome and thank the participant.
- Introducing myself, the research, and the objectives of the interview (cf. information sheet).
- Sketch the flow of a semi-structured interview (length, video recording, screen sharing).
- Discuss informed consent form and pseudonyms.
- Check whether the participant has any questions and whether it is okay to start the video recording.

Part 1. interview questions about the organisation (20 minutes)

1. Would you like to introduce yourself and your role within the university?

2. What tasks do you fulfil in your role as an employee?

3. What would you say are some current developments at the university that concern you?

4. How do you view the change from Learniversity to Brightspace?

a. How were you involved in this change?

b. What consequences does this change have for your tasks at the university?

c. What does the phasing out of Learniversity mean for education/staff at the university?

d. What role does the fact that Brightspace is a private platform play at the university?

7. What do you think characterises this university compared to a regular university?

Part 2. Interview questions about technology in the organisation (25 minutes)

8. What professional software, apps, programs, or platforms do you need to fulfil your duties as an employee? (I.e., without this technology you cannot do your tasks.).

a. When and in what situations should you use this technology?

b. For what purposes do you use this technology?

9. What other people (professions) do you need to work with to fulfil your duties?

a. When and in what situations should you work with these people?

b. For what purposes do you have contact with these people (professions)?

After the interview (5 minutes)

- Indicate what the next steps in the research are.
- Ask if the participant wants to be kept informed.
- Thank the participant.
- Stop recording and backup recording, save the files and notes.
- Complete logbook and contact details.

Interview protocol for students

Date and time:

Location:

Title of the session:

Pseudonyms of the participant(s):

Before the interview (10 minutes)

- Check the two recording devices, the second screen, and the headphones.
- Welcome and thank the participant.
- Introducing myself, the research, and the objectives of the interview (cf. information sheet).
- Sketch the flow of a semi-structured interview (length, video recording, screen sharing).
- Discuss informed consent form and pseudonyms.
- Check whether the participant has any questions and whether it is okay to start the video recording.

Part 1. Interview questions about the program (20 minutes)

1. Can you introduce yourself?

2. How did find your way to this university?

3. Can you tell me what your study path looks like?

a. Which courses have you taken?

b. What courses are you currently taking?

c. Which courses will you take?

4. What do you think characterises this university compared to other universities?

5. What would you say are some of the things that are currently on your mind as a student?

Part 2. Interview questions about studying within the program (25 minutes)

6. Can you describe for me what technologies you use during a normal study activity? (I.e. without this technology you cannot study/learn.)

a. How do you use this piece of technology?

7. What preparations do you need to make so you are able to study?

a. What things do you need?

b. Who supports you so that you can study?

8. Can you guide me across your Dashboard in the electronic learning environment? (or provide screenshots)

9. Are there anything else you think is important to tell me?

After the interview (5 minutes)

- Indicate what the next steps in the research are.
- Ask if the participant wants to be kept informed.
- Thank the participant.
- Stop recording and backup recording, save the files and notes.
- Complete logbook and contact details.

APPENDIX C: LIST OF PARTICIPANTS

Number	Pseudonym	Role	Organisation/curriculum
1	Elias	Coordinator (platforms)	Coordination Centre
2	Elly	Coordinator (quality)	Coordination Centre
3	Wyatt	Coordinator (LAD project leader)	Coordination Centre
4	Jackson	Senior developer (platforms)	Coordination Centre
5	Hunter	Designer (platforms)	Coordination Centre
6	Michael	Educator, Program leader	Bachelor Management
7	Rose	Student advisor	Bachelor Management
8	Inez	Educator	Bachelor Psychology
9	Stefan	Educator	Bachelor Psychology
10	Jon	Educator, Program leader	Bachelor Psychology
11	Timothy	Student	Bachelor Management
12	Amber	Student	Bachelor Psychology
13	Jane	Student	Bachelor Psychology
14	Christiano	Student	Bachelor Management

APPENDIX D: MATERIALS OF THE WORKSHOP ABOUT LEARNING ANALYTICS

Time: 1:00 PM – 4:00 PM

Location: Online, MS Teams

Target audience: Researchers and practitioners at the open and distance university

Number of participants: 11

Rationale

Open educational practices have long been characterised by their pursuit of broader, more inclusive access to (higher) education as well as by special attention to people who find it more difficult to connect with regular education (Blessinger & Bliss, 2016). Offering "engaging online education... for those who cannot (or do not want to) study at another ... university" is one of the central objectives of the university (University website, 2021). That is not an easy task. The university is therefore continuously committed to "developing, innovating and offering open higher education" (University website, 2021). For example, there are no admission requirements to join the bachelor programs and students have the option to study part-time. The use of digital and data-driven technology, such as the learning management system Learniversity to realise distance learning, is also an important element of the commitment to open practices. The stored student data from Learniversity is increasingly analysed using: learning analytics (LA).

Learning analytics can be understood as a collection of practices in which data about students is generated, measured, collected, analysed, and reported in order to identify patterns in learning and subsequently gain insight for so-called optimized educational practices (learning, teaching, the learning environment (Gašević et al., 2015). However, the high expectations regarding such technological innovations are not often met in practice and this raises questions about how learning analytics can be integrated in a meaningful way (Reich, 2020). What the possibilities and limitations of learning analytics are for open educational practices, and what this means for learning and teaching in particular, is an issue that is currently inconclusive (Zawacki-Richter et al., 2020). The open and distance university also faces the question of how they can relate to this emerging technology and what role it can play in the context of their central objective.

To tackle such challenges, the importance of interdisciplinary collaboration and enabling cross-fertilisation between the diverse research and practice approaches that exist in the university landscape today is increasingly being emphasised. Both researchers with quantitative and qualitative approaches, from practice-oriented organisations and academically-oriented faculties, have an interest in such collaboration. After all, it allows to highlight the complexity of contemporary

challenges in open education in different ways, to raise new questions and to seek appropriate answers (Ramirez-Montoya, 2020). This workshop seeks to bring together individuals from different disciplines and organisations around a common issue: the possibilities and limitations of learning analytics for open and distance university education. What kind of research is currently being conducted at the university into student learning? How is learning analytics important to researchers today? And how can they work together, despite possible different motivations and approaches?

Goals

The aim of this workshop is to map how people at the open and distance university, from their various research and practice approaches, study learning with Learniversity (via learning analytics). We start from the assumption that there is no one correct approach, but that exploring the different approaches offers added value for research and practice. The initiators of the workshop want to make a social and scientific contribution for and by people from the open education landscape. The social contribution consists of creating and strengthening relationships between various actors working within the university (12 people), both researchers and practitioners. This concerns people affiliated with the open and distance university, in particular the Coordination Centre, Faculty X, and organisation X, and a researcher from the Faculty of Educational Sciences of KU Leuven. Students were no longer invited due to: corona measures and the online format. The scientific contribution includes exchanging insights from recent research through a presentation and offering time/space for reflection with others in order to open up new possibilities. It is precisely because some problems are persistent and complex that insights from different research and practice approaches are needed.

Methods

The participants of the workshop will have the opportunity to discover research results and approaches in a workshop with four parts: (1) an introduction and introduction, (2) pitch of some research and text discussion, (3) a presentation and discussion, (4) a review and explanation (see below).

Part 1. Introduction and introduction (15 minutes)

We start the workshop with a brief introduction that outlines the planning and purpose of the meeting. Lanze briefly speaks to indicate how this workshop is situated in his research and asks for informed consent. Then all participants briefly introduce themselves and we start to identify similarities/differences between different studies. In preparation, participants have written a short text (20-50 words) and sent it to the organisers in the week before the workshop (no later than

09/12) explaining what they do with learning analytics. Before and during the workshop, Lanze visualises the key words of the written preparations using digital technology. This "map" can be further adapted and expanded throughout the various workshop components and should lead to a material outcome of the meeting.

Chairman & moderator part 1: Elias*

Part 2. Pitch and text discussion (90 minutes)

Pitch (45 minutes) – During the second part of the workshop, participants will have the opportunity to give a short pitch of their research project regarding learning analytics (5-7 minutes per person, see table below) and relate to a scientific article that was read in preparation. During the pitch, participants reflect on their own work and its implications for the use of learning analytics within the open and distance education. Lanze further adds important insights to the map: What type of research has been conducted so far? What do such results yield for the university's education? Lanze tries to summarise the results and provide feedback to the other participants. This gives the participants the opportunity to further supplement the summary where necessary.

Text discussion (30+15 minutes) - Based on the differences in research (approaches), we then use a common text to look for what we mean by 'learning analytics' and what its possibilities/limitations are for the open and distance university? A text seminar or text discussion is the ideal place and time to jointly study a text and issue that challenges the participants. Although the text may be complex, the format of a seminar is simple: there is a pre-selected text on the table that all participants read in advance and discuss together during the workshop under the guidance of a moderator. A reading seminar usually goes through three phases. It is 'crucial to temporarily suspend judgement' and first pay attention to 'what the text/author says (active listening), then look for recognisability, illustrations as a test for the way in which you understand the text and only then - as a third and separate step - the question of judgment: What do I think? Do I agree? Why/why not?' (Kelchtermans, 2020, p. 49). It should allow us to start talking about learning analytics from a somewhat "shared language" and to specify what we, as researchers/practitioners, are confronted with today.

The participants are split into two groups (2 breakout rooms in Teams), each led by a moderator who further stimulates the discussion with guiding questions (see table). After approximately 30 minutes we return to the common room to share the main findings with each other. In this way, the workshop not only brings together people with a shared interest, but it also becomes clearer what the limits/possibilities of types of research are, and what interests are at stake. After the discussion in the breakout rooms, Lanze and Elly* provide feedback on what the main

concerns/discussion points were in their groups. Lanze then further adds the main insights to "the map."

Text: Gašević, Dawson & Siemens (2015). Let's not forget: Learning analytics are about learning.

Moderator part 2: Lanze

Part 3. Presentation and discussion (60 minutes)

In the third part of the workshop, Lanze Vanermen (faculty of educational sciences, KU Leuven) presents preliminary findings from his ongoing ethnographic research. The aim of the presentation is to show how students really study at the university and to provide workshop participants with the opportunity to discuss the implications of these findings. The research draws theoretical and methodological inspiration from the broad field of science and technology studies (STS) (Law, 2004) and has a distinct interest in studying practices. The presentation zooms in on descriptions of study practices and how, in addition to the students themselves, digital platforms do not play a role in studying. In this way, Lanze wants to open a discussion about how qualitative research results relate to data processed via learning analytics. The discussion is sparked by the question: in what way can qualitative data supplement the (Learniversity) data for learning analytics, and vice versa?

Moderator part 3: Elly

Part 4. Review and explanation (30 minutes)

The participants take the time to look back on the workshop (what worked well/didn't work well). Lanze clarifies the final phase of his research and indicates what the next steps will be. We end by finalising the map and a brief reflection on how these insights can be further used in the future. It must become clear what the next steps are for the university with regard to learning analytics. Why is it important/not important for open and distance education? And what do researchers/practitioners within the university need to continue working with learning analytics?

• Chairman and moderator part 4: Elias

Possible outcomes of the workshop

The workshop allows people to meet each other (and each other's research) based on a shared concern for learning analytics and thus express interests, approaches and opportunities for collaboration. The material outcome of the workshop is a map on which these elements are presented (this is created throughout the different activities). On the other hand, the workshop provides an opportunity to validate preliminary findings from Lanze's ethnographic research. The

workshop makes it possible to further incorporate insights from the discussions into the analysis and refine results. It is therefore important to emphasise that the general insights and working methods of the workshop are still part of the ethnography and can be regarded as results of the research. It is therefore possible that there will be a later report on how the workshop was organised and what topics were discussed.

Insights are pseudonymised and converted into observation notes, a logbook, and/or diagrams that serve for scientific research. They can therefore be used for multiple printed and online scientific publications (e.g. journals, books, and conference papers), for public activities (e.g. lectures and presentations), as well as for educational purposes (e.g. lectures). The workshop will not be recorded to ensure confidentiality of participants and no results will be shown during the presentation that could relate to participants present.

Schedule

Part	When?	What?	Who?	Where?
Part 1	13.00 – 13.15	Welcome and introduction Lanze asks informed consent	Elias	Main room
Part 2	13.15 – 14.45	Pitch and seminar	Lanze	Main room
	13.15 – 14.00	Pitch	Lanze	Main room
	14.00 – 14.30	Discussion	Lanze	Breakout room 1
		Groups 1 and 2 [Names participants.]	Elly	Breakout room 2
	14.30 – 14.45	Feedback	Lanze & Ally	Main room
Break	14.45 – 15.00			
Part 3	15.00 – 16.00	Presentation Lanze	Elly	Main room
Part 4	16.00 – 16.30	Reflection and conclusion	Elias	Main room

APPENDIX F: EXAMPLE OF THE USED INFORMED CONSENT FORMS

Information about the research and its team

Methodology of Educational Sciences Research Group (KU Leuven)
Mr. Lanze Vanermen, Prof. Dr. Mathias Decuypere, and Prof. Dr. Joris Vlieghe

Participate in research about the open and distance university's curriculum

It is important to read the information below carefully before deciding to participate in this study. This information and consent form clarifies the objectives of this research, the nature of your contribution, and how the research team will treat your data confidentially. You can indicate at the bottom of the form which parts you agree with and confirm this with a signature. Please return this form digitally and completed to Lanze Vanermen before the start of the interview (see email address at the end of this document).

Purpose of the research

In this education research, the team is interested in the role of digital technologies in the curriculum of your open and distance university. We would like to understand and describe how data-driven technologies are present in the daily lives of students. Consider, for example, the operation of Learniversity, a Facebook group, a serious game, and so on. How are data-driven technologies integrated at the university? What do you do with those technologies? How is data exchanged between people and technologies? And, what kind of curriculum makes such data and technology use (im)possible? These are some of the questions that are key to this investigation.

This study is part of a larger and independent doctoral research at KU Leuven on the role of digital technologies in the curriculum of open education. The research was *not* requested by the open and distance university and examiners/employees have no insight into who participates. The research team consults the Coordination Centre and your faculty to ensure that everything proceeds correctly.

Your contribution

You are invited to participate in online semi-structured interviews and/or observations. The focus is always on everyday situations during your studies, and you are free to choose which of these activities you wish to show the research team. You are also free to decide when and where these moments take place.

First, the interview allows the researcher to maps how, where and when you study with digital technologies. During the conversation we focus on your role and place in the curriculum as well as the course you are currently following (or may have recently completed). You can, but don't

have to, share a screen during the interview to clarify something. Please be careful not to accidentally share more than you intend, since both the audio and video of the interview are being recorded. The researcher will assist you in using Microsoft Teams, including screen sharing if/when desired. Sending screenshots or documents related to topics that were discussed is much appreciated. During the conversation you will also receive more information about further steps in the investigation.

Second, an observation will take place at a time and place when you are actually studying. You notify Lanze by email when you have scheduled a study session and allow him to observe for about 60 minutes. Longer sessions are fine, but not obligated. The observation also takes place via Microsoft Teams, which means that you share your screen, camera, and microphone with the researcher during the entire observation. The observations are not being recorded by the researcher. It is of course possible to pause for a while or not to show certain things. We will discuss any possible sensitive aspects of doing such an observation before the start.

This time investment allows self-reflection about the role of technologies within your studies and can, therefore, help you to use them more consciously. Your contributions will ultimately be turned into interview transcripts, observation notes, a diary, images and/or diagrams for scientific and educational purposes. The contributions can be used for multiple printed and online scientific publications (e.g. journals, books, and conference papers), for public activities (e.g. lectures and presentations), as well as for educational purposes (e.g. lectures, workshops).

Confidentiality and privacy

The data we collect throughout the entire study remains strictly confidential. This means that your personal data (such as name, gender, or age) will not be shared with people outside the research team. Your details and the name of the open and distance university are pseudonymised by default in any scientific or educational output (e.g., articles, lecture notes). This means that names are replaced by alternatives and information that could identify you is included as little as possible and/or equally pseudonymised. It is possible to indicate you do *not* want to use a pseudonym and/or to make your position at the university public. You can express your wish to make your name and/or position known below. However, the researcher ensures that your data, and that of people around you, remain confidential. It is possible you will still receive a pseudonym in order not to harm the privacy of other participants. The research team is and remains responsible for reporting and storing your data.

Finally, you have the right to *withdraw from the study* at any time without any consequences. You can do this in the first place by informing the researcher (Lanze Vanermen). Please note that

even though you can withdraw from the research after your contribution has been printed in a publication, the publication itself cannot be changed. In that case, your contributions will be excluded from future publications and activities. Please also note that the design of the study is susceptible to changes. There are no risks associated with this study, though you may feel nervous, watched, and/or questioned while participating. We will guide you through the different phases and there are no right or wrong answers. Do you have serious complaints about the course of the research that you cannot report to the researcher himself? In that case, you can contact the promoter of this research personally [contact details] or anonymously at the Center for Scientific Integrity of KU Leuven.

Consent form (please check the applicable boxes)

☐ I voluntarily agree to participate and that my contributions are used for scientific, public, and educational purposes. I know that I can withdraw my consent at any time (except for works already published) by contacting the researcher;

☐ I do *not* want a pseudonym and want my name to be openly mentioned in publications, as long as this is relevant and appropriate for the research;

☐ I do want my role at the university to be openly mentioned in publications, as long as this is relevant and appropriate for the research;

☐ I would like to be kept informed of relevant research results by email.

Information about the participant

First and last name:
Course(s) you are following:
Role at the university:
E-mail address:
Date:
Signature:

Information about the resercher

First and last name:
Course(s) you are following:
E-mail address:
Date:
Signature:

