Integrating FATE/Critical Data Studies into Data Science Curricula: Where are we going and how do we get there?

Jo Bates[1], David Cameron[1], Alessandro Checco[1], Paul Clough[1, 2], Frank Hopfgartner[1], Suvodeep Mazumdar[1], Laura Sbaffi[1], Peter Stordy[1], and Antonio de la Vega de León[1]
[1] University of Sheffield
Sheffield, UK
[2] Peak Indicators
Chesterfield, UK

ABSTRACT

There have been multiple calls for integrating topics related to fairness, accountability, transparency, ethics (FATE) and social justice into Data Science curricula, but little exploration of how this might work in practice. This paper presents the findings of a collaborative auto-ethnography (CAE) engaged in by a MSc Data Science teaching team based at University of Sheffield (UK) Information School where FATE/Critical Data Studies (CDS) topics have been a core part of the curriculum since 2015/16. In this paper, we adopt the CAE approach to reflect on our experiences of working at the intersection of disciplines, and our progress and future plans for integrating FATE/CDS into the curriculum. We identify a series of challenges for deeper FATE/CDS integration related to our own competencies and the wider socio-material context of Higher Education in the UK. We conclude with recommendations for ourselves and the wider FATE/CDS orientated Data Science community.

CCS CONCEPTS

• **Social and professional topics → Computing education**.

KEYWORDS

data science, FATE, critical data studies, higher education

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1 INTRODUCTION

The number of Data Science degrees has expanded significantly in the last five years (e.g., [9]), largely in response to growing demand from employers for data literate graduates. Despite disciplinary differences, in general terms Data Science is understood to be "the computational and quantitative analysis of large datasets to create information and knowledge" (p. 3) using scientifically rigorous methodologies, frameworks and tools [21].

Alongside this expansion in Data Science degrees, there have been increasing calls for Data Science curricula to embed training in topics related to Fairness, Accountability, Transparency and Ethics (FATE) e.g., [10, 18], as well as to develop students' critical awareness of the power dynamics and potential social consequences of applied Data Science as examined in Critical Data Studies (CDS) [3, 19]. Such calls echo growing concerns among academics, developers, policy makers and the public about the individual and societal consequences of existing and emergent forms of applied Data Science.

Since 2015/16, the authors of this paper (the MSc Data Science programme team based at the University of Sheffield, UK) have been actively engaged in a multi-disciplinary collaboration that works to embed FATE/CDS topics into the delivery of a Data Science Masters programme. In this paper, we report the findings of a collaborative auto-ethnography [5] that our teaching team engaged in with the aim of taking stock of our efforts so far, reflecting on our approach to working at the intersection of disciplines and how this influences how FATE/CDS are integrated into our curriculum, and what challenges and opportunities there are for deepening this integration in future years.

This paper is structured as follows. In Section 2, we first provide a literature review to set our work into context. In Section 3, we outline the research methodology of our work and present our main findings in Section 4. Section 5 concludes this work.

2 BACKGROUND

2.1 The Growth of Data Science Degrees

The process of datafication that can be observed in many sectors over the last decade has led to an, as yet unsatisfied, demand for skilled data specialists across industry and the public sector. Within the domain of higher education, rapid curriculum change aimed at addressing these workforce needs can be observed within a number of specialisms, including Information Schools and Computer Science [21, 27]. DeVeaux et al.'s 2017 paper [9, p. 2] reports 530 programmes in Data Science and related fields taught at over 200 universities worldwide, and the ACM Data Science Task Force [10, p. 11] predicts the number of programmes and the number of students wanting to study them will increase.

Song and Zhu's [26] analysis of 42 undergraduate and postgraduate Data Science programmes in the US observed more Masters

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than Bachelors degrees, and that Information Science departments offered the largest number of programmes, followed by departments of Computer Science and Statistics. During 2015–17, the 65 iSchools that made up the iSchool consortium offered a total of 87 data-related degrees, and 26 of these were data specific degrees offered at Masters level, half of which were Data Science degrees [21, p. 5]. As Ortiz-Repiso et al. [21] observe, that Information Schools have moved in this space is unsurprising given "core processes of information science (collecting, organising, managing, accessing and supporting the use and manipulation of information) are acutely relevant to data-driven disciplinary areas such as data science" (p. 1).

Within the emerging literature on Data Science curricula, there is a clear distinction between Information Science and Computer Science driven approaches to the subject: "Computer Science teaches computing with more emphasis on fundamental elements such as data structures, algorithms, computational theory, and computing models. On the other hand, information computing in iSchools should emphasize users, tools, and applications" (p. 6)[27, p. 6]. This difference maps well onto the distinction Tierney [30] makes between Type 1 (technical experts) and Type 2 data scientists who have some knowledge of a variety of Data Science techniques, but are more orientated towards user needs, acting as a translator "between the business problem and the technical environment necessary to deliver what is needed".

The multi-disciplinary nature of iSchools — and their emphasis on the interrelations between information, people and technology — Song and Zhu [27] argue makes them well placed to "educate successful data scientists equipped with diverse skills with broad perspectives... probably the most ideal institutions for teaching user-based and application-focused data science education" (p. 6); a perspective echoed by Ortiz-Repiso et al. [21].

2.2 FATE/CDS in Data Science Curricula

Despite these potential strengths of the iSchools in delivering a FATE/CDS oriented Data Science curriculum, there is little engagement with these issues within the existing research literature. In the discipline's educational literature on Data Science, FATE/CDS topics tend to receive little more than a mention in a list of relevant topics:

> "Most iSchool curricula emphasize concepts such as... social aspects of information such as ethics of big data and data science, security and privacy issues" [27, p. 8]
>
> "Data science has greater variety than big data analytics, with courses such as the semantic web, metadata, data curation, cognitive science and data management, and ethics" [21, p. 12].

Further, some in the field have observed that while Library and Information Science has much to offer, too often as iSchools have shifted towards offering Data Science and related programmes their social orientation "has been steadily eroded in favor of the same harvesting, hoarding, mining and manipulation that were once the exclusive domain of computer science programs" [15].

A similar level of engagement with FATE/CDS topics is observed in the wider non-LIS research on Data Science curricula e.g., Wilder and Ozgur [32] and Anderson et al. [2]. Whereas in some accounts FATE/CDS topics are noticeably absent e.g. Baumer's [4] description of an experimental Data Science curriculum at a US institution.

This body of research reflects the results of a recent ACM [10] international academic survey about Data Science curricula which discovered only 54% of Data Science programmes required content on ethics, with no other socially orientated topics identified, and only 65.5% had a Data Science in context requirement (a component in which ethical considerations may have been necessary).

As the number of Data Science programmes offered by universities has increased, there have been various efforts to establish model curricula and a set of common competencies at undergraduate and postgraduate levels (e.g., [6, 9, 10, 18]). In this paper, we will not elaborate on the technical aspects of these competency frameworks, only to observe a difference in the depth of computational and mathematical knowledge expected within proposals emerging from different disciplines. Our interest in this paper is the emphasis on competencies relating to FATE/CDS within these frameworks and proposed curricula.

With a specific focus on iSchool Data Science curriculum development, Song and Zhu [26, 27] argue that iSchools should take advantage of their existing emphasis on social aspects of information. However, despite their acknowledgement of the iSchools' strengths in this area, there is no mention of FATE/CDS topics in their paper "Big Data and Data Science: what should we teach?" [26].

The European EDISON Data Science Model Curriculum published in 2017 (release 2), on the other hand, does include consideration of "ethical issues" across a range of different competencies, and also more specifically the importance of "responsible data use, data privacy, ethical principles, legal issues" [6, p. 61]. However, there is no mention of bias, transparency, fairness, justice or the potential social implications of some forms of Data Science practice.

Similarly, the US-based Business Higher Education Forum argued that Data Governance and Ethics, framed as "Identifying data governance obligations and challenges and emerging legal and ethical data privacy and security best practices and uncertainties within a given context" [11, p. 5], should be a core competency for Data Science graduates.

Around the same time, faculty participants in the US-based Park City initiative observed that given the new ethical challenges posed by Data Science capabilities, curricula should "feature exposure to and ethical training in areas such as citation and data ownership, security and sensitivity of data, consequences and privacy concerns of data analysis, and the professionalism of transparency and reproducibility" [9, p. 9]. Nonetheless, while such challenges are recognised these topics are absent from the proposed course structure.

More recently, the US-based National Academies of Sciences, Engineering, and Medicine (NASEM)'s [18, p. 3] work on "envisioning" an undergraduate Data Science curricula, recommends that:

> "A key goal is to give all students the ability to make good judgments, use tools responsibly and effectively, and ultimately make good decisions using data... Ethics is a topic that, given the nature of data science, students should learn and practice throughout their education. Academic institutions should ensure that

> ethics is woven into the data science curriculum from the beginning and throughout."

Building upon these various efforts to map out competencies for Data Science students, the ACM Data Science Task Force's 2019 draft guidance [10] goes further, addressing a number of FATE-relevant topics that graduates ought to be able to demonstrate competency in. These include: privacy and confidentiality, legality, intellectual property, transparency and accountability in algorithms, and techniques for establishing whether a dataset or algorithm is biased. The report also observes:

> "Students of Data Science need to be imbued with the 'joy of data', seeing data as the 'currency or fuel of our time'. They also need to be imbued with a strong sense of professional and ethical responsibility. Data Science courses ought to reflect such sentiments; likewise the education of data scientists" [10, p. 14].

It is evident that there is a growing recognition of the necessity to embed FATE/CDS related topics into Data Science curricula. However, as Leonelli [16] observes, research on integrating ethical safeguards into Data Science practice is relatively limited in scope, noting a particular focus on issues of consent. This observation is somewhat echoed in the frameworks outlined above, with recommendations tending to focus on compliance with ethical and legal frameworks, and notions of transparency and accountability. Leonelli stresses that while these concerns are important the focus "sidesteps two crucial ethical issues": (1) the "implications of large-scale data integration on social groups and communities whose characteristics and identity are sometimes easily retrievable", and (2) how Data Scientists "could and/or should be made accountable for the decisions they take in their work" [16, p. 2-3].

Leonelli's concerns begin to touch upon wider trends within Critical Data Studies and cognate fields, which have tended to emphasise the power dynamics of emergent data practices through concepts such as 'Data Justice' [7, 28], 'Data Power' [13], 'Algorithms of Oppression' [20], and 'Data Feminism' [8]. These understandings have been advanced by scholars in the social sciences and humanities who have argued that the societal implications of applied Data Science are better addressed through frameworks centred upon understandings of power, justice, oppression, rather than the more technically 'resolvable' issues of ethics, bias, transparency etc. It is such an approach that scholars such as Bates et al. [3] and Neff et al. [19] have called for in their arguments for embedding Critical Data Studies within Data Science curricula.

While the above literature evidence a range of calls for embedding FATE/CDS into Data Science curricula, as yet there is a lack of literature on what this might mean in practice, and what the challenges are of building multi-disciplinary teams capable of delivering high-quality teaching that integrates both the technical and social justice dimensions of Data Science. The following sections will go on to describe how our team, based at the Sheffield Information School, have approached this issue since launching our Data Science programme in academic year 2014/15.

2.3 Sheffield Information School's Data Science Programme

The Data Science programme delivered by the Information School at University of Sheffield is a one-year full time Master of Science degree, which can also be studied part time over two years. The Information School, and therefore the Data Science programme, are based in the Faculty of Social Sciences. The programme explicitly aims to train "Type 2" Data Scientists; that is data scientists who have some knowledge of a variety of data science techniques, but are more orientated towards the user needs, acting as a translator "between the business problem and the technical environment necessary to deliver what is needed" [30]. The programme was launched in 2014/15, and has experienced significant growth in student numbers since its inception. As shown in Table 1, this growth in student numbers is based on increased recruitment of international students, particularly Chinese students.

Year	Number	Fee status
2014/15	20	7 UK; 2 EU; 11 INT
2015/16	42	10 UK; 2 EU; 30 INT
2016/17	47	20 UK; 4 EU; 23 INT
2017/18	59	10 UK; 2 EU; 47 INT
2018/19	110	9 UK; 4 EU; 97 INT

Table 1: Numbers and fee status of registered students

The course is 180 credits, made up of 15 credit 'modules' and a 45-credit dissertation. Some of these modules are compulsory (core) and others are optional (electives). The initial and current module structure is presented in Table 2. The 'Data and Society' module is the most FATE/CDS relevant module. It is a core module that runs in the 1st semester. It is taught from a Critical Data Studies perspective, and adopts a constructivist pedagogy to explore issues relating to:

- Conceptualisations of power, structure and agency and how they relate to Data Science and the production of knowledge;
- Philosophical debates related to production of knowledge from data;
- Politics of data visualisation and algorithmic processing (e.g. bias, transparency, surveillance etc);
- Data citizenship and agency;
- Legal aspects of processing personal data (GDPR);
- Ethical reasoning for data science practice applying insights from the above topics.

The growth in student numbers has also meant an increase and diversification of academic staff teaching on the programme since 2014/15. As seen in Table 3, the composition of the teaching team is diverse in disciplinary background.

2.4 Working at the intersection of disciplines

The literature points to significant advantages for students in being exposed to ideas and knowledge from differing disciplinary and cultural perspectives. Learning is understood to be "trigger[ed]" in the 'third-spaces' at the boundaries of disciplines, cultures and

2014/15 (first year)	2019/20
Introduction to Data Science (15 credits)	Introduction to Data Science (15 credits)
Data Analysis (15 credits)	Data Analysis (15 credits)
Information Retrieval: Search Engines and Digital Libraries (15 credits)	Data Visualisation (15 credits) – core from 2019/20
Data Mining and Visualisation (15 credits)	Data Mining (15 credits)
Database Design (15 credits)	Database Design (15 credits)
Research Methods and Dissertation Preparation (15 credits)	Data and Society (15 credits) – core from 2016/17
Dissertation (45 credits)	Research Methods and Dissertation Preparation (15 credits)
	Dissertation (45 credits)
Plus 3 from:	**Plus 2 from:**
Researching Social Media	Researching Social Media
Information Governance	Information Governance and Ethics
Business Intelligence	Business Intelligence
Information Systems in Organisations	Digital Advocacy (option from 2016/17)
Research Data Management	Big Data Analytics (option from 2016/17)
Information Systems Modelling	User-Centred Design and Human-Computer Interaction (option from 2018/19)

Table 2: Core and elective modules in 2014/15 & 2019/20

Name	Year joined	Academic background
Jo Bates (Deputy Programme Co-ordinator)	15/16	Social Science/ Humanities, Critical Data Studies
Dave Cameron	18/19	Psychology, Human-Computer Interaction
Alessandro Checco	16/17	Mathematics, Computer Science, Machine learning
Paul Clough (Former Programme Co-ordinator)	14/15	Computer Science, Information Retrieval
Val Gillet	17/18	Chemoinformatics Data Mining
Frank Hopfgartner (Programme Co-ordinator)	17/18	Computer Science, Information Retrieval
Suvodeep Mazumdar	18/19	Computer Science, Human Computer Interaction/ Data Visualisation
Laura Sbaffi	16/17	Information Behaviour, Applied Statistics
Peter Stordy	14/15	Education and Computer Science
Antonio de la Vega de León	18/19	Biology, Chemistry, Computer Science, Chemoinformatics

Table 3: Academic background of team members

social groups [1, 14]. The Information School's Data Science programme with its multi-disciplinary team and curriculum, and international cohort of students and staff, is therefore well situated in relation to opportunities for activating such forms of learning among our students. Further, a significant amount of the literature on researching and teaching at the intersection of disciplines emphasises institutional barriers related to the administrative challenges, departmental organisation, physical space etc [17]. Again, our programme is well positioned in relation to such challenges given the multi-disciplinary team are co-located within a single department. Nonetheless, as MacLeod [17] observes such institutional challenges are only part of what makes working at the intersection of disciplines difficult, and more understanding is needed about the "likely cognitive difficulties that pervade, constrain and even block collaborative interdisciplinary work" (p. 698). As Pederson [23] similarly observes, while something of a consensus has emerged in the literature around the necessity for integrating knowledge from different disciplines, the differing "ontological and epistemological regimes" of disciplines means that integration can become the 'Achilles' heel" of a project. Such barriers to researching and teaching at the intersection of disciplines are observed in the literature, with multiple concerns raised that when Social Science and Humanities (SSH) are brought into 'interdisciplinary' teams it is often as "an 'add on', or as an independent project within the overall project architecture", risking that SSH "becomes merely an appendix to the techno-scientific disciplines" [23].

Building upon such insights, we became interested in opening up a conversation amongst academics teaching on the Data Science programme about how our Data Science team had evolved its approach to working at the intersection of disciplines, what this means for how topics related to FATE/CDS are integrated into the curriculum, and what this might mean for our graduates' understanding and appreciation of such challenges.

3 METHODOLOGY

We adopted a methodological approach that assumes a different ontological and epistemological position than the dominant perspective in Data Science: collaborative auto-ethnography (CAE) [5] combined with 'provocation' as method [22]. This approach was selected not only because of its strengths in getting under the surface of our own practice, but also its potential for fostering the kinds of open communication and reflection needed within multi-disciplinary teams. Building on the research methodology of "auto-ethnography", the CAE approach has been defined as "a qualitative research method in which researchers work in community to

collect their autobiographical materials and to analyse and interpret their data collectively to gain a meaningful understanding of sociocultural phenomena reflected in their autobiographical data" [5, p. 23-24]. The approach has previously been used in similar context to our own to explore working at the intersections of science, technology, engineering and mathematics (STEM) and Arts [12, 25]. The aims of CAE are to develop the group's understanding of self in socio-cultural context, community building among participants, and empowerment/transformation. Common challenges include the logistics of contributing, power dynamics in the group, and participants willingness to open up [5]. With these challenges in mind, principles of participation were discussed and agreed between all participants prior to the first data collection meeting, and ethical approval for the research project was gained from University of Sheffield Information School.

All except one academic staff member on the Data Science team were actively engaged on the project. The one staff member that was not engaged was supportive, but did not have the time available due to undertaking a senior administrative role within the School. Data collection was undertaken in three stages.

(1) Three articles on teaching, researching and communicating at the intersection of disciplines were selected, and key quotations were selected as 'provocations' [22] for the team.
(2) A 'provocations' document and list of questions for individual reflection were circulated to all team members. Team members were given a week to reflect on the provocations and write an individual response to the questions, prior to sharing with the group.
(3) Two 2-hour group discussion meetings. The first focused on the evolution of the degree and how it sits at the intersection of disciplines, the implications of this for our integration of FATE/CDS, and the opportunities, risks and challenges of deepening disciplinary integration. The second meeting focused on our ideal approach to FATE/CDS integration, pros and cons of such an approach, different stakeholders' perspectives and practicalities. These meetings were recorded and transcribed.

Due to time constraints, the development of the 'provocations' and questions for individual reflection and group discussion was led by one person who had familiarity FATE/CDS, Social Science/Humanities methods and some of the literature and debates around interdisciplinarity, with input from other team members on an opt-in basis.

We adopted an 'analytical', rather than 'evocative', approach [5] to our CAE data analysis and write up, and a writing style and structure more familiar to ACM conference participants than some traditional CAE approaches. Given tight time constraints and lack of availability of some participants during the data analysis and write-up period, this stage was also led by a single group member with experience in qualitative methods with input on drafts from other participants.

Data collected through individual reflections and group discussions were thematically analysed [24]. Identified themes were: (1) Challenges of disciplinary integration; (2) Evolution of the programme; (3) FATE and Critical Data Studies; (4) People – staff and students; (5) Data Science Curricula; (6) Overcoming challenges. Each theme had a range of underlying codes related to the overall thematic concept. Codes and themes were developed through a combination of data-driven and literature-driven methods.

4 FINDINGS

The following section presents some of our key findings from the collaborative-autoethnography process.

4.1 Moving Towards Values-Driven Development

At the time of the programme's initiation in 2014/15, programme leaders were driven by a need to develop a postgraduate level degree that would successfully diversify the Information School's taught programmes offer and attract new students to the School,

> "it sort of started out probably, just, we just had to create something… we were quite successful as a department, [we] attracted students who didn't want to do that Computer Science type of course… that's the sort of target that we were looking at... what we called then the 'type two' data scientist".

The programme developers were bound by tight constraints in terms of staffing and the creation of new modules:

> "we weren't given free reign... we couldn't create loads of new modules, so there's practical constraints as well, I think we were allowed to create three or four new modules".

We acknowledged how these conditions shaped the initial design of the programme, recognising that the drivers, constraints and the techno-scientific backgrounds of those involved meant, understandably, that curriculum concerns initially emphasised practical skill development, rather than more social concerns:

> "Thinking about the social aspects wouldn't have been my first worry, my first worry would have been the actual practical output, so what skills can we provide students with".

Perhaps unsurprisingly given the heavy marketisation of UK Higher Education in recent years [31], beyond the need to define and teach core Data Science skills, the main drivers of the programme's early development were largely financial and market-led. Primarily, the programme design aimed to attract students (and their fees) in a subject area that was reported by industry to have a skills shortage, and was constrained by the amount of institutional investment provided for staffing and module development.

We reflected how since 2014/15 the programme had undergone a "fairly fast... transformation" with Critical Data Studies perspectives being embedded in the core of the programme as new people joined the team. As a previous programme leader pointed out:

> "I don't think at the outset we probably thought about it as we're thinking about it now... and particularly having Jo's input, that's how things have I think evolved, kind of over time."

This shifting perspective represents not only changes in the people involved and the content taught, but also the opening of a space for fostering values-driven curriculum design. Despite differing levels of experience and confidence, all programme team members

were keen to engage with a values-driven approach to teaching Data Science that emphasised concerns around FATE and CDS.

We also observed that our engagement with a values-driven approach extended beyond the integration of FATE/CDS into the broader culture of the team, including our reflections on pedagogical issues, internationalisation and a shared commitment to work together across disciplinary boundaries despite the various communicative and philosophical barriers we surfaced.

While the Data and Society module has been core to the programme since 2016/17, a previous programme leader reflected on how topics relating to FATE and CDS had been integrated into the programme design:

> "I think one of the comments [in the provocations document] that resonated with me... was... maybe the social sciences being a bit of a bolt on, and it was never really intended to be that, but I do wonder whether that's possibly how it did start out. And as we kind of evolved over time I think, you know, a classic example of this is that, Jo, you gave I think one lecture on the introduction to data science, which was data and society, and over time that evolved then to be a whole module, to then evolve to you now being a deputy programme coordinator where you can shape the programme".

Team members had different perspectives on the extent to which FATE/CDS topics were currently integrated into the curriculum. While some perceived a deepening integration, one new team member observed:

> "I mean I got the impression from the outside that a lot of our modules are technical, and then we basically expect Jo to deal with the social part in the Data and Society module [all laugh]".

Despite this observation, there was evidence that elements of FATE were slowly emerging in one or two practical modules. One module leader reported being

> "more mindful every year... I started, just last year... to introduce little elements of, you know, be mindful of how you use the data, and give little example of misuse and what is not appropriate"
>
> "In my teaching, I introduce various examples that illustrate the need for transparency".

Others, however, were less confident:

> "In relation to my Database Design module, I struggle to understand how these concepts [FATE] are related. Hence, there's a huge 'gap' [in knowledge]".

Despite significant changes in recent years, some weaknesses were perceived in our current approach to integrating FATE/CDS into the programme design and assessment:

> "Perhaps we are missing an element — which is putting those [Data and Society] concepts, ideas, debates, arguments into practice... in relation to different technical skills that are being learnt"
>
> "To what degree are those aspects, the sort of social science aspects covered in the coursework? Because the students, they're very coursework driven. Is it only Jo's coursework that really explores that? The rest of us are getting them to crunch numbers, produce visualisations and so on. Do we get them, for example, to create a visualisation thinking about the social aspects, the effect that they might have? Probably not, and that's fine, so therefore maybe it's our failing, not the students that we haven't got their attention by getting it embedded in the coursework".

Our reflections around these challenges were inspired by the idea of a "third space" discussed by Klaassen in the 'provocations'. Advocates argue that learning is "trigger[ed]" in the 'third-spaces' at the boundaries of disciplines, cultures and social groups [14]. This concept resonated strongly, and in different ways, for team members. As our discussions evolved, our emergent understanding was that while our current programme design did, under certain conditions, have the capacity to generate a 'third space' there was more we could do to design a curriculum and modes of assessment that actively fostered the development of a 'third space', thus enhancing students (and academics) capacity to be "fluent" in FATE/CDS driven Data Science.

Various practical suggestions for a programme level approach to FATE/CDS that would activate such a third-space were explored. For example, rather than conceptualising the curriculum as a series of complementary modules, the team saw potential for better FATE/CDS integration and attainment of the programme learning outcomes by merging core modules into one coherent and integrated block taught and assessed by the Data Science team members. The team will explore these ideas further in the coming months alongside the various administrative and assessment related challenges that we identified such approaches would undoubtedly raise, including how to ensure an adapted programme design still meets the requirements of our existing – or a replacement – external accreditation body.

4.2 What do we want...?

While at the surface level there was a clear commitment to the deeper integration of FATE/CDS into the Data Science degree, as our discussions evolved, we began to become more aware of the complexities and challenges about what this may mean in practice. Two key issues emerged: (1) What do we mean by FATE/CDS? Do we have a shared and coherent understanding? (2) What is the meaning of FATE/CDS in an international classroom and in the context of decolonising the curriculum and maintaining academic freedom?

These definitional issues were recognised as a challenge when collaborating at the intersection of disciplines:

> "What we mean by these concepts as well... all the constructs are debated; people disagree about what they mean. You could spend your entire academic career just trying to define what justice is for example, and I think that adds an extra layer of complexity probably, not just in terms of the relationship between us and the students... but also probably within the team as well. We all have a different understanding about what all of these different concepts mean... I'm

> not even sure I know what some of these concepts mean for myself".

In our discussions about the struggles of working in a multi-disciplinary context it was expressed by many team members that they struggled with the philosophical nature of SSH approaches that underpin many of these conceptual debates, and which contrasted with the often unexplored philosophical norms of disciplines they were more familiar with:

> "Coming from Data/Computer Science into the Social Sciences/Humanities field, I always found it strange the importance (maybe fixation) with the research setting, and all of the different fields and frameworks present."
>
> "Working in Data/Computer Science the positivist research philosophy seems invisible in its ordinariness".

There was also a feeling that philosophical flexibility ought to go both ways:

> "So, I see a bit of asymmetry... So, the direction is only — it seems only — one way... so the other way would be: okay, I'm a social scientist, and I want maybe... to do something that can be more reproductive, or viable... so the integration from let's say 'technical'... So, if we have an idea of justice or fairness, how can we put it in a technical way?"

This philosophical framing and uncertainty about different theoretical approaches and concepts tended to dominate cross-disciplinary perspectives, and some expressed a strong emotional reaction to encountering SSH approaches for the first time:

> "It was a shock in the beginning and it still partly is"
>
> "The first encounter was traumatic".

Similarly, from the Social Science perspective one team member spoke of becoming "disillusioned with Stats" at undergraduate level. Many of us reported having dismissive attitudes towards other approaches at some point, but over time shifting perspective — often as a result of working in collaboration with others.

Despite most of us emphasising philosophical differences as a key challenge, some team members observed that on reflection many of the issues at stake were political — rather than strictly philosophical — in nature:

> "I started to notice more the political ideologies embedded in self-professed completely impartial hard science work…I am more careful in trying to understand the underlying ideological assumptions that are often embedded in computational work, and I try to expose the ideology driving my research questions before diving in into them"
>
> "It's not just a philosophical issue, it's a political ideology issue, and I think we need to sort of stay mindful of that, that it's not just being awkward about philosophy, but that there's a reason for that, that's political in nature, that people would want to cling onto a certain way of thinking about a concept".

This emphasis on the political nature of FATE/CDS is currently reflected in the Data and Society module, with its emphasis on power and agency, as well as philosophical and ethical concerns. However, there was limited time in this project for capturing a deeper understanding of our diverse perspectives on the power dynamics and politics surrounding how we define concepts such as FATE/CDS, and some things were, for now, left unexplored. This is evident in a brief aside in a discussion about the potential for external accreditation of any new FATE/CDS oriented developments we implemented:

> "Speaker 1: Does Microsoft do anything, because I know they got their new centre for FATE, Fairness Accountability Transparency and Ethics, I don't know if they do anything, you know, or Google for example, someone like that, I know they have whole teams now, and centres set up where they do some kind of—,
>
> Speaker 2: Well would it be better that we become the authority that puts stars on to the people?"

The meaning we give to FATE/CDS as a programme team, and the politics of who is given the authority to define meaning and shape practice are crucial. For our team this remains a key issue to explore as we deepen the integration of FATE/CDS into the Data Science curriculum.

A similar concern arose in relation to our role as educators within international classrooms. As seen in Table 1, the majority of students (88% in 2018/19) registered on our Data Science programme are international (i.e., not UK or EU). While there is some diversity in nationality among international students, the vast majority are Chinese. How to address issues around FATE/CDS in this context, including in relation to broader efforts to decolonise the curriculum, arose on a number of occasions in our discussions:

> "it is very Western, so these concepts of ethics, fairness, accountability, transparency, a lot of them are very liberal concepts, particularly fairness, accountability and transparency, I'd say"
>
> "I mean... data justice, so we would already be biased in there because we would look at it from a UK, European perspective... Now someone from another country, a different culture might have a different perspective. Now you might say, "Well okay, but it's a British degree," but then a counter argument to that would be, "Well, this is colonialism, you're putting on your world view, teaching your world view"
>
> "Yeah, but can you possibly be objective, I mean this is our culture, so we teach what we know best, and they decided to come here to learn what we can teach, so we cannot accommodate for everyone"
>
> "I mean I think we should stick, but we should have a broader understanding of where they are coming from, in order to understand how far they need to come"
>
> "I think this could be what the 'third space' is talking about, it's just saying, just discussing about, you know, 'in my culture this is not a concept', 'but this is not even applicable from where I come from', so having that space and kind of protected space where there

> is more of a collaborative feeling, where you know, everyone can share what they feel like, is going to be quite interesting".

Through consideration of being mindful of the different cultural assumptions we and our students might be bringing to the classroom, we also recognised that by deepening FATE/CDS integration we would likely introduce more potentially contentious topics into the classroom. Our discussions highlighted the need to be more confident of our own boundaries about what was acceptable:

> "Speaker 1: Would there ever come a point where you would actually put your foot down and say, "No, that's unacceptable," what someone was saying, because it just jarred so much with your beliefs? Just say if someone says something particularly sexist or racist and they genuinely meant it, how does that work out?"
>
> Speaker 2: "I think there comes a point where people are stepping over a line, you know, where what they're actually doing is sort of like inciting hate or something, which is illegal... Yeah, I think there are boundaries... I think they need to be very sensitively handled within the classroom context. But yeah, I think generally the idea is to open up to discussion, not to enforce an agenda. I can have my views but I'm never going to say to a student, "You need to think like me" - that'd be authoritarian. But yeah, so I think we do need to reflect on that and make it clear–, because it would destroy the teaching environment as well if students perceived that they had to think in a particular way, or they had to think in a particular way in order to pass the assessment".

While some members of the team had some experience of addressing somewhat contentious topics in their teaching, including with students who may face repercussions in their home country for voicing particular opinions, others expressed worry about their confidence in being able to handle such issues.

> "You're dealing continually with tricky situations, and I've suddenly got cold feet, thinking, oh dear, have I got the skills to facilitate a discussion that allows me to know what the boundaries are and things. I probably will be [ok]. It's all about confidence, isn't it, and I've been teaching for a very long time and I still find it a bit scary".

This is clearly an important concern if the team were to deepen the integration of FATE/CDS across the curriculum. Team members initially considered whether one way to mitigate such issues might be to limit the "topics we allow [students] to work on" or avoid particular topics in classroom materials. However, on reflection we acknowledged this would be a form of "self-censorship" and raised concerns in relation to academic freedom. While we were not able to fully resolve the concern, there was a sense that we would likely need to have an approach that would enable free and open discussion on contentious issues "so long as it's not illegal and it's not outside the university allowed policy" (i.e., in relation to Dignity at Work, Equality & Diversity and Harassment).

4.3 What do the students want?

Through our discussions we slowly moved towards a vision of how we might integrate more FATE/CDS topics into our Data Science curriculum; however, uncertainties were raised about what students want from a Data Science degree. Given the time constraints and sensitivity of discussions, we were not able to engage students in this study; however, we plan to do so in follow up work.

While the societal aspect of the current degree design does attract some (particularly UK) students to the programme, and the Data and Society module receives positive feedback from many students, many also have a tendency to perceive technical modules to be more relevant to their programme:

> "I mean this is one of the issues on the Data and Society module, is that it gets good marks for everything, apart from the one that it comes out [a bit] weaker on tends to be seeing the relevance of the module to the programme"

Further discussions with students and student evaluations revealed a potential difference in perception between home and international students' understanding of the programme.

> "I think we have the problem that, I think our marketing is important for the home students, in that they do understand the difference in the Masters [that we cover societal aspects], but I don't think it's all that obvious for international students"
>
> "I think a lot of times it's potentially because they are coming here with the expectation of gaining technical skills... when they see the name Data Science, it immediately captures their technical kind of interest"
>
> "I think there's also quite a number of students who possibly don't choose us on the grounds of content. So, I think the idea would be that they choose the course because they want that Social Science perspective on Data Science, but I do think actually it's probably not quite that. It might be that now we're listed in the top, whatever, 100 universities, we're a well-known School, Data Science is kind of what we want to do, that's what they want to do... which could be where this mismatching kind of 'oh it isn't quite what I expected', because they kind of didn't really look at [the marketing]".

This challenge is clearly a significant issue. In the context of the UK's heavily marketized Higher Education sector, the survival of the programme is dependent upon the continued recruitment of students, and as educators we would chose to teach students that are engaged with our approach to Data Science and have chosen to study with us on that basis.

This means that further FATE/CDS integration will require a careful balancing act of developing new marketing materials aimed at attracting students, potentially in new 'markets', who favour our approach, while maintaining recruitment to the programme at close to current levels. Nonetheless, despite the challenge there was some optimism that such an approach could work:

> "I could imagine that being quite successful, because it's in the news all the time, these issues, and people

> are picking up on it, and we're saying, "Well, that's what this degree's about." It would really knit things together well."

4.4 Fostering our capacity

A further challenge raised was our own capacity to deepen the integration of FATE/CDS across the Data Science curriculum. Capacity issues were raised in relation to our existing workloads which were stretched due to a rise in student numbers, and our current areas of expertise and confidence in delivering effective teaching and assessment in this area. All team members highlighted knowledge gaps on topics relevant to FATE/CDS, including in areas such as:

> "theoretical frameworks in which to consider the topic, such as notions of fairness and bias";
>
> "I feel ill-equipped around legal issues within the area";
>
> "often I have problems in following some arguments because I don't have the philosophical background that is often taken for granted in some papers";
>
> "the theoretical, ontological context of research and how to integrate that into my teaching of fundamental statistics!";
>
> "putting those [FATE/CDS] concepts, ideas, debates, arguments into practice in relation to different technical skills that are being learnt – I don't feel that I've got the skills to be able to do that";
>
> "how these issues can be integrated into the day-to-day life of a data scientist is also where I feel I have a gap – how can you put these issues and theories into practice and operation within businesses?"

As individuals we clearly felt we had significant gaps in the knowledge required to deliver a state-of-the-art FATE/CDS orientated Data Science curriculum. However, upon reflection it became clearer that collectively we have a lot of knowledge and experience to share within the team. It was agreed that, although support and accreditation from external organisations with relevant expertise might be valuable, we could also to a great extent "help ourselves".

A variety of practical suggestions to empower team members to share knowledge were proposed, including 101 sessions, reading materials, auditing modules across the programme, discussion sessions on contentious topics, simulating the classroom environment, and targeted seminars on communicating across disciplines – some of which we will be exploring this academic year. Core to any developments in this domain will be to ensure that these knowledge sharing spaces we produce will foster learning:

> "it needs to be a space where you feel secure, it's an informal space where you don't feel embarrassed to say I don't know, please can you help me learn that, so it's quite interesting how you create that space and make it a space where people are willing to kind of, you know, learn and share and so on".

Looking further in to the future, recruitment of new staff members was also recognised as important. While the programme team was perceived to be somewhat diverse in gender and nationality, it was acknowledged that

> "if we want to go all the way through with it being unbiased and so on, [we need] to actually find the right candidates from all populations, which could be a challenge as well".

5 DISCUSSION AND CONCLUSION

Through engaging in this research project, we confirmed our commitment to FATE/CDS integration in principle and recognised the insights we had gained teaching FATE/CDS as a core part of the curriculum since 2016/17. However, deeper reflection raised questions about the meaning and application of FATE/CDS concepts, and the practicalities and politics of how to integrate them.

We noted that our current approach towards integrating FATE/CDS into the curriculum was situated somewhere between a multi- and interdisciplinary approach [14], with FATE/CDS teaching and assessment largely, albeit not entirely, siloed in the Data and Society module. We observed that relevant topics were beginning to filter into some more practical modules and some dissertation projects, and that strong students were able to build their own links – creating a 'third space' [1, 14] – between modules. Nonetheless, we agreed that a fully interdisciplinary approach would require a much deeper integration of FATE/CDS into the curriculum, potentially through combining all core learning and assessment into a single unified module. Extending this logic further, we recognised that a transdisciplinary approach [14] would further require increased engagement with non-academic knowledge, and that this may need to extend beyond our current industry links if the programme is to deepen its FATE/CDS ethos.

Overall, our programme appears to have a relatively advanced and well-resourced approach to FATE/CDS integration compared with other programmes reported in the literature e.g., [10, 15, 21, 26, 27]. Further, we work well together as a multi-disciplinary team – communication is open and respectful, there is an appreciation for one another's knowledge and insights – and we envisage this should make for a solid foundation for discussion around more contentious topics around the 'politics of FATE/CDS' that will need to be addressed if we decide to further integrate the degree. While there were instances of cross-disciplinary unfamiliarity, there was little evidence of the team being greatly hampered by the related "cognitive difficulties that pervade, constrain and even block collaborative interdisciplinary work" described by MacLeod [17, p. 698]. Nonetheless, we identified clear limits to our current level of integration, and challenges and potential barriers to further integration.

Despite various calls in the literature for FATE/CDS integration into Data Science Curricula, there has so far been little examination of these practical and political challenges of enabling this to happen. Through our reflections and group discussions, we observed that the challenge of FATE/CDS integration is not only a question of what and how we should teach and how we as educators gain that knowledge, but how this can be achieved in practice within the complex socio-material conditions our work takes place within. For example, the challenges of working in a highly marketized higher education sector mean that not only do changes that may impact student recruitment hold significant risks, but that as academics we are also working in highly pressurised environments with little time

for personal study to address gaps in understanding and re-thinking existing teaching materials and assessments. Further, values-driven curriculum development raises a series of complex challenges in a programme that attracts students who may have very different cultural values and assumptions to the academics teaching the course. How this is handled sensitively and mindfully with regard to decolonisation efforts is still to be fully explored.

This suggests that alongside the numerous calls for more FATE/CDS to be embedded into the curriculum, the community also needs to work together to address the practical challenges of implementing this in practice. Failure to address these practicalities may lead to a situation where Data Science programmes become FATE-washed. That is, they have a veneer of FATE, but fail to equip students with the desire and ability to embed their critical insights into their future data practice. With this in mind, we conclude by making a number of suggestions:

- **Creating learning spaces.** Our discussions illuminated the need for Data Science teams to work collaboratively across sub-disciplines to share knowledge and insights that would help team members to deepen the high-quality integration of FATE/CDS across teaching and assessment. It is important to recognise that everyone does not need to be an expert in all areas of the curriculum, however team members can support one another to deepen collective understanding and synthesise insights. The importance of such space being informal and supportive, creating an environment in which colleagues can acknowledge they don't understand something is crucial. As is ensuring learning is accessible in relation to already heavy workloads, and recognising the need for learning in all directions – 'social' ↔ 'technical'. Such space could also be extended beyond individual academic institutions, to foster the development of online and offline cross-disciplinary learning spaces in the wider community
- **The politics of FATE.** Our discussions began to surface differences beyond the philosophical assumptions of disciplines that are emphasised in the literature on interdisciplinarity that were more political in nature. Such differences began to emerge in discussions around who gets to define best practice in FATE, and are likely to surface again as discussions around integration unfold. This mirrors wider discussions beginning to take place in the FATE/CDS community, for example in relation to the decision to embed a program on Critiquing and Re-thinking Accountability, Fairness and Transparency (CRAFT) in the 2020 FAT* Conference[1] and Taylor and Purtova's [29] recent paper. Acknowledging and understanding this political dimension to FATE/CDS integration will be important for Data Science degree teams such as ours that aim to deepen integration of FATE/CDS into the curriculum. As a community we can help teams better understand these issues through the sharing of short, accessible and engaging materials that illuminate the power dynamics at play in such efforts, and which can be used in reading and discussion groups.
- **Collaborate across borders.** In advancing an agenda around FATE/CDS integration in Data Science we need to deepen our understanding of the cultural shaping of FATE discourse, and work with international students and collaborators, and experts in curriculum decolonisation efforts, to address these issues. In our team's case, this particularly means enhancing our understanding of Chinese perspectives on issues of ethics and social justice. Existing networks and organisations such as the iSchools' Consortium and ACM FAT* may be well placed to help foster such collaboration.
- **The image of Data Science.** Many prospective students – and many curriculum designers – perceive Data Science solely as a technical discipline with good earning potential. Deeper integration of FATE/CDS into Data Science curricula could be hindered due to student resistance and reluctance to engage with the non-technical parts of programmes. We need to think about how Data Scientists might move away from this image towards a more socio-technical identity that positions ethical and political considerations at the core of Data Science.
- **Data Science competency frameworks.** There are increasing mentions of FATE relevant topics in published competency frameworks, however there is still a need to consider FATE/CDS related competencies at a deeper level. Without creating too many restrictions on teaching practice and innovation – what should a well-designed FATE/CDS-driven Data Science curricula address? What should curriculum designers be thinking about, and what should students understand and be able to do at the end of their studies? How might educators go about teaching key and emerging topics? Existing networks and academic fields such as ACM FAT*, ACM Data Science Task force, iSchools Consortia, as well as some non-academic partners, could be well positioned to collaborate on articulating such competencies, and encouraging the development of open learning resources.

While the challenges identified in our research relating to deepening FATE/CDS integration in Data Science curricula are significant, and our possible responses to them are constrained by the socio-material contexts we find ourselves embedded within, they are not wholly insurmountable. Our struggles to overcome these challenges should also help us remain mindful of the challenges that FATE/CDS-aware Data Science graduates are likely to face as they enter their own workplaces. Enhancing Data Science students' critical and ethical thinking is clearly not a cure-all; unethical and socially irresponsible data practice will continue as long as it goes rewarded and poorly regulated. However, with these caveats in mind, we conclude by arguing that in order to foster the development and spread of more socially aware and responsible data practice, it remains important to work together to overcome these challenges and empower the development of interdisciplinary teams that can integrate and deliver high quality FATE/CDS teaching in Data Science curricula.

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