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## Professional Paradigms and Revolutionary Relationships

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### ABSTRACT

The impact of algorithms on the way knowledge is created and shared has been seen as a revolutionary shift in the knowledge apparatus of society. Using the concept of paradigm shifts, this study explores how librarians providing information literacy programs and services described the programs they offer in information and digital literacies, their understandings of algorithms and how they might see future services. Using an information practices approach, data were collected from 30 librarians from university libraries across NSW. The analysis identified a range of paradigms that could have implications for changes in professional practices. Significant was the paradigm of the algorithm as 'black box', indicating a lack of technical knowledge about algorithms. Also important was the emphasis on the transactional paradigm in the literacy programs provided, with descriptions focussing on the behavioural aspects of the skills of students. Given the situation in universities post-pandemic, there was little optimism that significant changes would be made to the programs and services currently offered, although a small number of participants had implemented their own micro revolutionary changes. As paradigm shifts occur through changes in knowledge, and revolutionary changes require a supportive environment, the study concludes that only piecemeal evolutionary changes can be made currently.

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## Introduction

As we began the project that underpins this paper, we were challenged by a colleague to state the outcome of our findings as an intervention, something that the librarians could put into practice. Without any deep thought, we were clear that this was not our aim. Rather, we wanted to know how librarians providing information literacy programs and services understood algorithms, in particular, whether they considered their impact on information service provision as an evolutionary or revolutionary shift and how they might see future services. Our project, we asserted, was a reflection of a societal concern with algorithms and their potential for impacts of which people might be largely unaware (Jarvis, 2022).

The challenge from our colleague caused us to reflect. We confirmed that we were not aiming to propose any intervention. This was not an action research project. It did not

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pose a problem to be solved. We did not claim any relationship with potential participants, other than that created through a shared professional orientation. We were not planning to engage in co-design of products and services that can bring together a range of stake holders to explore a problem and propose a solution that is usually conceptualised as an improvement to existing products or services, effecting some kind of evolutionary change. Against this background, this reflection, however, did show us that based on the data we had collected, the question of how librarians involved in programs of information literacy might consider the technological changes brought about by algorithms in access to authoritative information. This reading of the data was not a focus of our larger project, but we recognised that these changes are seen by some theorists (e.g. Haider & Sundin, 2019; Lloyd, 2019; Striphas, 2015) as revolutionary, marking a shift in the knowledge apparatuses of society (Beer, 2017).

Such changes are paradigm shifts. The phrase, cognitive frame, might be more common in information studies (see e.g. Cheng & Chen, 2022; Kunene & Mapulanga, 2021), however here we adopt the term paradigm. We start from Kuhn's paradigm theory, where paradigms are 'universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners' (1996, p. x). Writing originally in 1962, Kuhn claimed that when a paradigm shift occurred, reality, that is the world, changes. We suggest that changes such as those foreseen by Beer (2017) and others are evidence of a paradigm shift. Kuhn argued that the ideas that bring about these changes are not to be found in the everyday processes of research; those that disrupt accepted thinking arise outside the mundane. This approach to a change in reality reflects the grand narrative approach of modernism, prevailing at the time of Kuhn's development of the ideas. In contemporary times, scholars acknowledge the co-existence of several paradigms, each framework containing its own assumptions, ways of thinking and exploring knowledge.

Paradigms, as ways of understanding a reality, can be seen as ways to make sense of the world of work, to identify potential anomalies and propose solutions. Although paradigms are influenced by external factors, such as education and training and societal norms and expectations, they are also influenced by individual experiences. From this perspective, many paradigms or ways of thinking can be identified. Paradigms are also found in the values statements of professional associations, and in the mission statements and strategic plans of organisations. In organisations with a professional focus, such as libraries, strong links can be anticipated between the paradigms of individuals and the organisational paradigms. Given that paradigms include ways of identifying problems and proposing solutions, a paradigm shift leads to organisational change, and while this change may involve changes in behaviours, it must involve changes in thinking (Armenakis et al., 2000, p. 631). The changes in the role of university libraries have required significant shifts in paradigms in librarianship and related fields in recent times, including accommodating the shift from an instruction-based approach in education to a learning-based approach. This shift required the adoption of 'non-traditional functions' such as information literacy (Gunapala et al., 2020, p. 203). Traditional approaches to offering programs of information literacy can limit their effectiveness and relevance to students (Donovan & O'Donnell, 2013).

These reflections have led us to ask what paradigms librarians employed in universities in NSW with responsibilities for providing programs and services in information

and digital literacies use when thinking about algorithms and to consider the extent to which these are paradigms that can bring about change, either evolutionary or revolutionary. There is relatively little consideration in the literature of the paradigms within which librarians practise, either in the research or professional literature, yet these influence the ways librarians think about the work they do and they provide avenues to consider solutions to current problems. In other words, inherent in a way of thinking are the seeds for changes in professional practice in the future, as Kuhn posited (1996, p. x).

### **Paradigms in Information Literacy**

Since the idea of information literacy was first introduced, it has seen a number of paradigms, from the earliest focussing on a transactional approach to bibliographic instruction, that is, identifying a number of steps to be carried out in order to achieve a successful search, to the notion of a socio-technical practice, bringing together use of technology with impacts on societal functions. Whetstone demonstrated the multiple strands in the literature on information literacy, identifying four key themes: information literacy frameworks; improvements in learning and instruction; the impact and role of technology; and socio-political issues (2022, p. 109), and showed that associated paradigm changes were very gradual. As examples, according to Lloyd (2005), information literacy emphasised ‘the importance of connecting with textual information’, and at one level, little has changed. For Martzoukou (2013), information literacy reflects new paradigms of online information-seeking and sharing that librarians must adapt to, and here, too, little has changed.

According to Hicks and Lloyd (2021), there is an apparent dichotomy in any theoretical understanding of information literacy, one that is skills based, and the other, socially-based, focussing on a practice theoretical approach. This approach is recognised by many scholars in the field; DeVito (2021, p. 4) for example states that information literacy is ‘the capacity and opportunity to be aware of both the presence and impact of algorithmically driven systems ... and the capacity and opportunity to crystalize this understanding into a strategic use of these systems to accomplish said goals’. The JISC framework (JISC, n.d.), often referred to by participants in this study as the framework within which programs of information and digital literacies are conceptualised, uses the phrase ‘digital capability’ and similarly, includes this dichotomous approach, with its focus on helping staff understand why digital capability matters and working with students to develop digital skills that will prepare them for the workplace of the future (Johnston, 2020). This dichotomy indicates the existence of at least two paradigms in information literacy.

### **Algorithms and Algorithmic Literacy**

Definitions of algorithms are dependent on a person’s experience of them, in many cases from an emic or insider point of view (Dourish, 2016; Lloyd, 2019). Algorithms may have been the purview of mathematicians and software engineers, as automated databases were developed and then online searching through the Internet became possible. In that context, put simply in a definition cited more than 67,000 times, algorithms are ‘a

sequence of computational steps that transform the input into the output' (Cormen et al., 2009, p. 5). The need for socially-based definitions soon emerged. According to Kitchin, algorithms 'can be conceived in a number of ways – technically, computationally, mathematically, politically, culturally, economically, contextually, materially, philosophically, ethically' (Kitchin, 2017, p. 14) but they 'need to be understood as relational, contingent, [and] contextual' (p. 18), and, in reality, bring together these many conceptualisations embedded in wider socio-technical field. Striphas's influential work (2015, p. 398) suggests an algorithmic culture emerging through 'the enfolding of human thought, conduct, organization and expression into the logic of big data and large-scale computation, a move that alters how the category culture has long been practiced, experienced and understood'. Willson (2017, p. 140) describes them as 'central to the ways communication and information (including the relational) are located, retrieved, filtered, presented and/or prevented' yet, as the product of commercial companies, their workings have become less transparent or open to scrutiny (p. 145), even as users delegate more responsibility to them, for example through Google. Thus, it is not surprising that for many in the general public, they are 'a black box' (Rainie & Anderson, 2017).

Within the broad spectrum of information literacies relevant to this study is digital literacy and its subset, algorithmic literacy. Since the advent of the Internet, skills were 'digital', and digital literacy evolved with a transactional focus from how to send emails, to guarding one's privacy, to seeking help in using a search engine, to attaining visibility of one's content (Hargittai & Micheli, 2019). Efforts to define algorithmic literacy have struggled with the dichotomy identified by Hicks and Lloyd (2021), seeking ways to produce definitions that clearly signal the paradigm within which the concept sits. Finn favours 'one that builds from a basic understanding of computational systems. . . to offer us intellectual tools for interpreting the algorithms shaping and producing knowledge' (Finn, 2017, p. 25); whereas Head et al. define algorithmic literacy as 'a critical awareness of what algorithms are, how they interact with human behavioral data in information systems, and an understanding of the social and ethical issues related to their use' (Head et al., 2020, p. 49). In the context of algorithmic literacy and the role of libraries, the technical and operational aspects of algorithms are important to understand and use, but they must be situated within socio-technical systems that are fundamentally cultural (Ridley & Pawlick-Potts, 2021, p. 2).

## **Paradigms for Algorithms**

There are four paradigms concerning algorithms relevant to this study and the understandings of algorithms in the context of information literacy. They are the technical paradigm, the socio-technical paradigm, the socio-cultural paradigm and what we have referred to as the black box paradigm. Each is outlined briefly below.

### ***The Technical Paradigm***

The origins of the word that appears in English as an algorithm indicate that there will always be two paradigms associated with it, according to Striphas (2015, pp. 404–405). One is a technical paradigm, reflecting the approach that as a set of mathematical procedures, an algorithm reveals something; it is a way of making something happen. On

the other hand, algorithms were equally likely to conceal meaning or at least to obfuscate. To clarify how the two paradigms can exist, seemingly enmeshed in each other, Striphas explicates Shannon's Mathematical Theory of Communication, a model that will be familiar to many librarians, and that he refers to as one of the first 'algorithmic theories of information' (2015, p. 405). Humans delegate aspects of their work to the 'data intensive computational processes' that algorithms are (Striphas, 2015, p. 396). However, '[a]lgorithms will most benefit ... those who are sufficiently technically savvy to understand and manipulate them' according to Tom Vest (Rainie & Anderson, 2017, p. 63).

### ***The Socio-technical and Socio-cultural Paradigms***

The second is a socio-technical paradigm. Here, an algorithm is a coding system that is likely to conceal something, to have an impact in the real world that may not be desirable. The challenge for working in the socio-technical paradigm is that it requires a sophisticated technical understanding as well as a strong grasp of and concern for the impacts of algorithms in society (Rainie & Anderson, 2017, p. 64, 75). There is strong support in the literature for the socio-technical paradigm, as an assemblage of technical knowledge and processes and social (human) actors (see eg Gillespie, 2014; Kitchin, 2017).

There is equally strong support, in the literature of information literacy, to consider algorithms through a socio-cultural paradigm. Rosenbaum (2020, p. 2) emphasises that algorithms are 'pervasive in social, cultural, economic, political, and cultural domains, or, stated more succinctly, as embedded in everyday life' – the lifeworld – since they are always 'in play'. Beer notes that algorithms have 'the capacity to shape social and cultural formations and impact directly on individual lives' (2009, p. 994). Lloyd constructs the distinction between a socio-technical approach and a socio-cultural approach. She notes that algorithms, which are essentially computational processes, 'cannot be separated from the social world'; however, taking this socio-technical approach might lead to an acceptance of the black box paradigm. She favours a socio-cultural paradigm; she adopts an Actor Network Theory approach that focuses on the social relations that exist between humans and algorithms as non-human actants, and that allows her to focus on the values inherent in social cultural production (2019, pp. 1476–1478).

### ***The Black box Paradigm***

A fourth paradigm emerges in the literature of information literacies, the 'black box' paradigm. The notion of the black box begins in the second definition of algorithm, evoking its capacity to conceal. Algorithms lack transparency and are often proprietary, enigmatic technologies; as Hargittai et al. (2020, p. 765) note 'there is no established ground truth given the secrecy that shrouds how algorithms actually operate'. In Pasquale's black box society, an information infrastructure dominated by commercial platforms, 'authority is increasingly expressed algorithmically' (Pasquale, 2015, p. 8) and has led to a social world where 'most people who use them [algorithms] daily are in the dark about how they work and why they can be a threat' (Rainie & Anderson, 2017, p. 74). Furthermore, especially in online media content, Min Kyung Lee (2018) has suggested that people form diverse mental models about how they operate, regardless of the

reality, and other academic scholars use terms such as ‘algorithmic imaginaries’ (Bucher, 2017), ‘folk theories’ (DeVito, 2021; Ytre-Arne & Moe, 2021) or ‘intuitive theories’ (Rader & Gray, 2015) when online users do not have a technical understanding of algorithms. Algorithms have the capacity to ‘shape the lifeworld in ways that are hidden and deeply entangled in people’s social and work lives and in their routine information and decision-making practices’ (Rosenbaum, 2020, p. 5).

This black box paradigm of algorithms demonstrates that a high level of algorithmic literacy is required to interact with algorithms and to be aware of the impact of their workings. From a socio-technical perspective, ‘Internet users are not mere receivers of algorithmic decisions, but they are interwoven with the process itself’ (Dogruel, 2021, p. 69). Thus, in our information literacy practices, we need to be aware of the relationship between humans and technology in our online work (Lloyd, 2019, p. 1481).

## Methodology

This study is part of a larger project which has been examining the practices of academic librarians who are responsible for developing and/or delivering information literacy programmes and services. Here, we reflect on the data gathered in the larger project, to explore the question of how participants express their understanding of algorithms, with a particular focus on technical knowledge and skills. Our research paradigm was interpretivist, with an emphasis on understanding the context and practices of our participants, rather than on making recommendations for change. However, as we reflect, we acknowledge the influence of other paradigms.

In the first quarter of 2023, we interviewed 30 academic librarians from universities in New South Wales, Australia, who had responsibility for providing both information and digital literacy services to both students and academic staff, to ascertain their knowledge and understanding of algorithms. The participants were men and women with professional experience ranging from 7 to over 20 years, and who work face to face with students as well as team managers and senior managers.

The interview schedule had three parts. Part One asked the participants to describe the services and programmes that they developed and offered to develop digital literacies, a term which was not defined. Part Two draws heavily on the work done by Leyla Dogruel et al. (2022) to develop a question bank in order to ascertain internet users’ awareness of and knowledge about algorithms. Part Three sought the participants’ understanding of the connection between digital literacy and democratic practices.

Each interview lasted between 45 and 60 min, and the audio recordings were transcribed verbatim and then analysed first using the concept of practice architectures, followed by a thematic analysis to identify key features of their literacy practices. We had used a practice theory approach (Mahon et al., 2017), in conducting the interviews. The three practice architectures: cultural-discursive, material-economic, and socio-political arrangements, were useful as a ‘lens for exploring [the] learning’ (Mahon et al., 2017, p. 18) of academic librarians. Cultural-discursive arrangements are the ways people talk about what they do; material-economic arrangements include aspects of the physical environment, financial resources and funding arrangements, human and non-human actants and other factors that influence what people do; and socio-political arrangements include those resources and relationships that influence how people

interact with each other and with non-human actants. Approval for the study was given through the Human Research Ethics Committee of the University of Technology Sydney, with the condition that participants and the universities where they work were to be anonymised. In the findings, although we interviewed men and women, all participants are referred to as female.

## Findings

The findings presented here will highlight the paradigms that emerged from the interview responses of participants to questions on information and digital literacies and algorithms and their perceptions of changes to information literacy programs. They will begin with a consideration of the information literacy themes apparent across the interviews. The second section will set out the paradigms that appeared in the ways participants discussed their information literacy practices. The third section will describe the paradigms underpinning participants' understandings of algorithms. The fourth section will document observations on implications that participants saw for information and digital literacy programs.

### *Information Literacy and its Themes*

All four of the themes identified by Whetstone (2022, p. 109) from the literature on information literacy were apparent in the responses of participants. Information Literacy frameworks were openly discussed by relatively few participants. Some, like participant 001, noted that in the past 'many people equated [information literacy] with how to search catalogues and how to search a database and I always thought that was very simplistic'. She went on to describe the significance of the 'JISC Model', to the conceptualisation of 'information literacy'. Similarly, participant 022 stated that in the university library where she works, they have 'adopted and adapted' the JISC Digital Capabilities Framework. She explained that 'The adoption of the JISC elements into the staff framework provides what I guess is a more harmonised approach to thinking about how digital literacies are defined and applied and enabled at this institution.'

Those whose practices actively encompassed the JISC model had a way of bringing together different forms of literacy under a heading of information literacy, giving them a sense of common ground. There was a sense of collaborative effort either within the university or across universities, for example through 'an information literacy, digital literacy project [undertaken] a couple of years ago' (participant 003), or through 'lots of discussions about the shifting nature of digital literacy' (participant 014).

Another framework was found in the graduate attributes of the individual universities, the specific features that a graduate from that university was expected to be able to demonstrate. These existed under a number of names, including the generic graduate attributes, Graduate Learning Outcomes and graduate capabilities. Participants were keen to point out the contribution of staff in the library to this important acknowledgement of the generic knowledge and skills of a graduate. 'We've developed the framework. And then we've divided it up into competencies, and what students can be expected to know at foundational, proficient and advanced level' (participant 026); 'The library was instrumental in, in fact, writing the rubric' (participant 021); 'When it comes to



the graduate attributes then you know the library is the contributor, but it's the university that the student is graduating from' (participant 024). The librarians focussed on graduate attributes acknowledged the importance of 'designing learning outcomes and assessments that ... build student digital capability as part of their learning and progress the graduate capability that [marks] their employability into the future' (participant 022) as well as the allocation of responsibilities for the development of knowledge and skills related to digital literacies across the university.

Given that all participants had several years' experience in offering information and digital literacy programs, it was not surprising to hear participants reflecting on aspects of learning and instruction that had changed. LibGuides seem always to have been part of this approach to information literacy. Participant 028 explains how their current digital capabilities guide

also links out to the framework itself, and it links out to LinkedIn learning, which we were able to get a university wide license for a couple of years ago. Just so that we're not just saying to students, these are all the capabilities you should have. We're also telling them 'and this is where you can upskill'.

Several participants commented on the move away from running programs with general groups of students: 'a couple of years ago we did actually have student groups coming into the library and run workshops with them' (participant 008).

All participants referred to the impact and role of technology. A strong message emerging from this theme was: 'The principles of those remain relatively similar over time but are nuanced depending on the technology that you're using' (004) or 'Now we do the same thing, except the tools have changed. So, you know, things like Menti' (participant 001). A few participants acknowledged that the current discussions around the use of ChatGPT 'made me recognise that we have been teaching [information and digital literacies] at a very rudimentary level' (participant 021): 'this is a complete game changer' (participant 015).

Content related to the final theme of socio-political issues was prompted in part by the questions relating information and digital literacies to democracy. Participants referred to 'the safety aspect' (participant 001), the need 'to engage ethically' (participant 021); 'the importance of critical thinking' (participant 025) and the significance of 'free and open information'. A frequently expressed aspect of concern was with threats to privacy: 'I'm basically always assuming that my privacy has been breached at every point' (participant 006), 'protecting reputation' (participant 028) and threats from 'data breaches' (participant 009).

### ***Institutional Paradigms***

Paradigms underpin the professional practices of librarians and are embedded in the policies and processes of individual universities and their libraries as organisations. From an organisational perspective, the most frequently occurring paradigm as participants discussed their information literacy practices was the transactional, the focus on a series of steps that constitute an effective approach to identifying and evaluating information. There was significant emphasis on students and their information behaviours such as 'Looking for journal articles, databases and advanced searching' (participant 026); how

to come up with keywords (participant 011); being able to evaluate information (participant 005). Several participants referred to the CRAP/CARP test as

a way of assessing the validity of information that you find online, including social media. Social media particularly can be a minefield of misinformation or questionable information. So, we try to teach students how to navigate that landscape, using that that mnemonic CRAP. (participant 003)

Recognising the limitations of this approach to evaluating information, one participant noted: 'So at the moment ... that's the criteria we run with' (participant 025).

Every participant presented descriptions of this transactional approach to what information literacy involves. From the cognitive perspective, there was little emphasis on knowledge as power, or on ways of thinking, although a number of participants stressed the power of algorithms to gather and process data, an idea expressed by (participant 008) as 'this huge power in having all that data about people that's being used both for us and against us at the moment'. Course outcomes, expressed as graduate attributes, were seen as important expressions of the knowledge inherent in information and digital literacies. Participant 023 spoke with pride about how

the library managed to get an information literacy glo [graduate learning outcome], so it's embedded across the university that students have to ... or when you're designing a course for a unit, you need to demonstrate that the students are engaging with information literacy as a graduate attribute.

The responsibilities of universities in working towards the development of informed citizens, as a question of 'knowledge and education', was raised by participant 025 for whom this was 'absolutely pivotal'. Collaboration, taken as evidence of a social paradigm, ran through responses from most of the participants. One participant referred to a collaborative initiative undertaken by a colleague in a university in a different state to share information on information and digital literacies broadly defined as follows:

she's tapped into the knowledge of the network of all these other librarians and [is] beginning to form this group to share information about what the university is doing and different approaches we can take and different ways of thinking about things.

## **Algorithms and Their Paradigms**

### ***The Black Box Paradigm***

The paradigms through which participants understood algorithms are clearly expressed in the definitions they gave when asked how they would explain what an algorithm is to a student. The most frequently expressed paradigm was the one referred to above as the black box. For the largest group of participants, the black box symbolised their ignorance. They used phrases like 'I don't know' (participant 013); 'I've never had to do this' (participant 020); 'This is a stab in the dark' (participant 027). Reflecting on the low level of understanding of the students, participant 028 noted that she 'would try not to get too technical'. Responses from others can be seen as examples of the black box paradigm as they emphasise the 'hidden' workings of search engines such as Google or Google Scholar (participant 017); or how algorithms 'create an information bubble' (participant 009) or refer to the 'darker side of algorithms, the black box' (participant 002), something

that ‘can be put to nefarious uses’ (participant 026). Two participants gave answers that could be understood as fitting in the technical paradigm. (Participant 003) gave a standard definition: ‘An algorithm is essentially a sequence of instructions that tell computers or networks or systems to process a certain task.’ She then gave a series of examples from the practices of librarianship including relevance ranking. Participant 022 expressed her understanding as ‘It’s a sophisticated use of metadata and analytics to track and monitor search behaviour or other types of online engagement behaviour’. Among the responses expressing a transactional paradigm, a participant explained it and its workings as ‘the suggestions on the side, the right-hand panel’ in some journal searches (participant 016). Some participants anthropomorphised algorithms, giving them agency: ‘so the algorithm relies on the human to know what is the best result. And ... they keep replaying it until the accuracy is really good’ (participant 018). One participant, (012), was concerned at the way Google Scholar could influence search results for scholarly articles, casting Google Scholar as ‘my teacher [because] you’re being taught by the values that Google Scholar preferences rather than trying to get a more objective view’.

### ***The Socio-technical and Socio-cultural Paradigms***

Participant 006 provided an elaborate explanation of how an algorithm works using a socio-technical paradigm. She used the analogy of

lots of little robots ... all of them are competing against each other to deliver whatever is defined as the correct result. ... if you click on one of them, the Big Boss robot is gonna go ‘Right, you’re a good employee, let’s replicate you a million times and let’s use you in the future ones’ (participant 006).

This presentation of how to explain an algorithm to students gave a glimpse into a world of creativity where an experienced librarian used her understanding of the interests of students to communicate a complex technical concept in a memorable way.

Expressions of a socio-cultural paradigm were relatively common, mostly as participants expressed their concerns and fears of the impact of algorithms on society. The presence of algorithms, seen by participant 015 as having a parallel in the existence of oxygen in the air, is deemed ‘scary’. For participant 018, it was important to see [algorithms] as ‘a tool to learn from, rather than being afraid’. The disquiet that underpinned the socio-cultural paradigm was based on threats to privacy and to wellbeing, mentioned by almost half the participants, as noted above. As participant 022 observed, ‘limitations in digital fluency in terms of how to manage your own personal profile, how you secure your digital identity’ are threats to your privacy, a sentiment echoed by participant 016.

### ***Reflections on Implications for Change***

The final section of the Findings presents ways that some participants reflected on implications for change to their practices – either change that had happened or obstacles to change in the ways programs of information and digital literacies were presented or to the content of programs. At the outset, it must be stated that the Covid pandemic had some significant influences on these programs, as university funding and operations were significantly affected by the pandemic and the steps taken by governments to curb the spread of the disease.

Participants from several different universities spoke of the changes brought about by the impact of Covid on staffing in Australian universities. It is not clear how many staff in universities lost their jobs as a direct or indirect outcome of Covid; the estimate for 2020 and 2021, documented at 17,300, has been claimed to be as high as 37,000, with NSW sustaining 40% of the documented losses (Larkins, 2022). Libraries have not been quarantined from these losses. Participants reported that some elements of literacy programs ‘died with Covid’ (participant 001). Others were changed significantly, because of the move to the use of video-conferencing software when universities were physically closed. ‘Prior to Covid, ... we did mostly face to face, we would be using things like Google Docs, Google forms ...’ (participant 001). A senior librarian from a different university made a similar point about the benefits of moving from face to face meetings with students to having to use other means to engage their attention:

I’ve developed a number of different resources, ... and this is where COVID has actually had a big impact, because using Zoom is a really, really easy way to ... create a video doing a demonstration of a search and ... you can talk it through, that actually has been a really powerful tool that they [the students] have a look at. (participant 017)

Another suggested from her tone that some return to previously offered programs was needed:

We did have a big data literacy time. We need to go back to building those skills again ... I think we were **going** [emphasis in the voice] to move into that space more, but it sort of got taken, ... it moved more to the Research Office because it really looked at research data, whereas we were looking at data literacy, as in knowing how to sort your files and stuff like that. Who’s teaching the students to do that? I have no idea. (participant 018)

The final statement shows that Covid and its impact caused soul-searching and the making of hard decisions for many managers and team leaders:

We were using social media as a way to put out communication to our audience. We pulled back from that because of our Facebook page was taken down. We called it ‘sustainable futures’ in the COVID era when we had to ... review everything we were doing to ensure that we could continue on with the staff cuts we had, and social media was something we decided that was not a valuable, good use of our time. (participant 026)

Some participants had maintained a sense of what changes to programs and practices in information literacy might be appropriate. One librarian mused on what would be needed to turn her dream scenario for information and digital literacies programs into a reality: ‘It would be easy enough to say some more capacity and staff to help do that. It’s getting more difficult as we progress. The team is shrinking, obviously with restructures and things, so it’s having a capacity to ...’ (participant 014). The sentence was left unfinished, as the fleeting thought of innovation hung in the air. Another librarian was less pessimistic in expressing a possibility for changing the implementation of information and digital literacies: ‘I think if we have a digital literacies road map that is published on the landing page of every university in Australia, I think that would make life so much easier for students’ (participant 028).

Four participants indicated that they or others had made changes to their practices. As described above, one participant was excited to use the video recording functions of Zoom to take a different approach to explaining the use of certain search functions. A

second participant referred to the establishment of a collaborative group of which she was now a part. A third participant indicated that 'I've been learning SQL this year ... that was joyous in learning how to make things [happen]' (participant 018). The fourth participant contacted us after the interview to report that she had emailed a major overseas practitioner and researcher in the field of digital literacies and was in the process of setting up a targeted discussion among team members.

This presentation of the Findings has shown the paradigms used by participants as they discussed the programs of information and digital literacies that they are responsible for, as well as their reflections on changes in their practices in providing programs of information and digital literacy. The picture presented suggests that a variety of circumstances would make changes to organisational or professional paradigms challenging, and that individually held paradigms are subordinate to these.

## Discussion

Paradigms offer an insight into the thinking behind action. In the development of research projects, the researcher's paradigm – their ontological and epistemological positioning – is acknowledged as having a significant impact on the development and conduct of the research, as well as on its outcomes (Baker, 2022). As researchers, we have identified the paradigm within which we work, the interpretivist paradigm with its emphasis on 'finding out' and acknowledging diversity, with no intervention foreseen. Yet, as Armenakis et al. (2000, p. 631) noted, those concerned with cultural change bring their own biases to its consideration. Thus, it is important to recognise that we work with other paradigms and here we acknowledge their influence on our reflections, in particular the emphasis that we might place on a need for action. We have been academics, and therefore teachers, for a long time. In analysing the interview data, the teachers in us saw ways to present some of the complex ideas about algorithms using approaches that would be comprehensible to people taking a socio-cultural perspective. These were about changing the knowledge-base of practitioners, not about changing individual or organisational practice. The activists in us, however, had a different reaction. This was one based in part on emotion, the absolute need for action, to bring about a change in understandings of algorithms and of their place in information and digital literacies, especially in the context of democratic practices. As activists, our concern is with the enormity of the changes being brought in the creation and use of knowledge by algorithms and the consequent shifts in the workings of democratic society, and the importance of information and digital literacies in strengthening the capacity of people to interact with algorithms. We have been very aware of the strength of these ways of thinking in our presentation of the findings and the discussion section that follows, and have not sought to downplay the aspects of our activist paradigm that call for changes to thinking and practices.

The findings provide a picture of how these librarians think about information and digital literacies and about algorithms, and about the possibilities for changes in their practices and the implications of these. They show that a variety of paradigms exist within the information literacy practices of participants. This is not unexpected, given the findings of previous studies (e.g. Haider & Sundin, 2021; Hicks & Lloyd, 2021) on the paradigms within which librarians engaged in information and digital literacies work.

The themes of information literacy that we identified are what we might have expected, given the analyses in the literature (e.g. Whetstone, 2022). Unsurprisingly, there is little variation in the paradigms related to the theme of learning. As Gunapala et al. acknowledge (2020, p. 193), one of the biggest shifts in paradigms in universities has been that from instruction to student-based learning. We identified two clear paradigms related to shifts in technology. One acknowledges current shifts in technology as ‘a complete game changer’, whereas the other considered that ‘the principles ... remain relatively similar over time’. These can be seen to reflect the socio-technical and socio-cultural paradigms. There were also differences in the paradigms related to socio-political issues; these were elicited in part by the questions relating information and digital literacies to democracy; these data have formed part of another paper (Henninger & Yerbury, 2024) and therefore are not considered here.

The frameworks for information literacy practices are a key theme in the literature and the two frameworks – JISC Digital Capability framework and a Graduate Attributes framework – were important to participants in this study. These are distinct paradigms, the one a professional paradigm, shared with the librarians throughout the world who also use this framework, and the other very much a locally held paradigm, relating to the specific context of employment and the university. These differences, in spite of their potential for common ground, demonstrate distinct ways of thinking about information literacy, and thus limit the possibilities for change.

From a professional, organisational perspective, the transactional paradigm – the focus on the skills people who are informationally and digitally literate will have, on what they will be able to do – is very clearly expressed. Participants talked in terms of ‘knowing how’ rather than ‘knowing what’, so that the findings of this study mirror the dichotomy identified by Hicks and Lloyd (2021). Secondly, there is a strong emphasis on collaboration, both within a particular university or across the profession. These two shared paradigms suggest a strong basis from which change might emerge. However, the cautions noted by Armenakis et al. (2000) about the need for change in thinking, rather than in behaviours, would suggest that possibilities for change are limited here too.

Turning to the paradigms held about algorithms, the place held by the ‘black box’ paradigm is significant, and will be discussed in greater detail below. The use of a socio-cultural paradigm is not unexpected. This paradigm has been espoused by influential scholars in information studies, such as Lloyd (2019), and it is in line with the socially oriented practice theoretical approach being quite widely adopted in research in the field. The literature from the social sciences on the impact of algorithms on everyday life also, mostly, is presented in a socio-cultural paradigm, as the work of scholars such as Beer (2017), and Ridley and Pawlick-Potts (2021) attest. The data showed only a few instances of a socio-technical paradigm; this was not surprising, given the number of participants expressing very limited technical knowledge of the workings of algorithms, and little curiosity about it. This is disappointing in the light of the call made by Tuominen et al. (2005) nearly twenty years ago.

Thus, the use of the ‘black box’ paradigm by participants is important in this study of the use of paradigms and implications for change (cf Lloyd, 2019). For a very small number of participants, the ‘black box’ paradigm was used to refer to the hidden facets of algorithms and their working – that algorithms are proprietary, so that the details of their workings are deliberately obscured in order to maintain a commercial

advantage of some kind over any competitors in the so-called ‘attention economy’ (Gibbons, 2021). Most participants who used the ‘black box’ paradigm saw algorithms as something to be feared, something unknown and potentially monstrous, mirroring the picture painted by Lloyd (2019). This, in turn, made it difficult for participants to consider engaging with algorithms in the context of online activities, other than to consider ways for students to protect their privacy and their wellbeing.

These paradigms used to express understandings of algorithms present a picture of lack of technical knowledge. Taken together with the emphasis given to the transactional paradigm, with its focus on behaviours rather than the development of knowledge, and the distinctions made between the frameworks of information and digital literacies, a pessimistic view of the possibility for changes to programs of information and digital literacies emerges. This pessimistic view is reinforced by the situation in which universities found themselves during and after the pandemic, with significant cuts to staff and to funding, factors which can have a profound effect on organisational change (Gunapala et al., 2020, p. 202).

A shift in paradigm demands a shift in knowledge and understanding towards a common ground as Gunapala et al. (2020, p. 203) note. They identified ‘a paradigm shift in the context of university libraries during the past few decades’ but proposed the need for further change. Their assertion of the need for staff ‘with essential new knowledge, skills and capabilities’ (p. 205) would apply to any model for significant organisational change, especially a change that requires a paradigm shift and is relevant to this study.

A change in knowledge is essential for a shift in the ways that algorithms and their workings might be introduced more directly into programs of information and digital literacies. Since this project began, in late 2022, participants have notified us of a number of initiatives intended to develop professional knowledge and understanding about algorithms and artificial intelligence. Some of these are specific to a particular library, others to a particular university, and some have been aimed at librarians in general. These initiatives mark a step towards a profession-wide change and may provide some hope that paradigmatic change is possible.

The findings also show that several individuals have described changes in their practices. While these personal changes may not seem to hold much significance in achieving the kind of paradigm shift that would lead to engagement with a new knowledge apparatus (Beer, 2017), they are examples of revolutionary change. Kuhn himself acknowledged (1970, p. 249, fn.3) that shifts in knowledge could come about through micro revolutions, small community-based changes, an idea tested out through bibliometrics by Small (2003). The concept of micro revolutions is now used more loosely in the literature of organisational change as a Google search will demonstrate. In this context, it focuses on individual learning and initiative. Taking that approach, the Findings indicate that several participants have engaged in a micro revolution, from taking a course to learn SQL to establishing an ongoing professional discussion with a scholar-practitioner overseas.

Micro revolutionary changes, by themselves, may not lead to a paradigm shift on algorithms for librarians engaged in programs of information and digital literacies. However, they are evidence of changes in ways of thinking. Taken together with recent initiatives to change the knowledge-base of librarians, increased societal

discussions of the need to develop knowledge and skills to enable people to exercise agency in their interactions with algorithms and the potential for an accumulation of evolutionary changes, there is some small scope for optimism.

## Conclusion

We conclude without proposing a specific intervention, but, as activists, acknowledging our paradigmatic position of the need for librarians to develop a greater understanding of the socio-technical. Algorithms may be seen to herald a revolutionary change in the knowledge apparatus of society. Such a change would signal the need for changes to programs in information and digital literacies, the avenues through which an understanding of the dominant knowledge apparatus of society is communicated or taught. This study of the paradigms used by librarians involved in the provision of information and digital literacy programs has shown that the paradigms they hold, with their emphasis on behaviours and on local contexts, are most likely to lead to evolutionary change. These are ones concerned with behaviours rather than with ways of thinking. Institutional change is more commonly achieved through evolutionary change, which is easier to conceptualise than the radical change that would require new practice principles. At this level, the kind of revolutionary change in approaches to information and digital literacies that would be needed to integrate a socio-technical paradigm of algorithms and algorithmic literacy appears out of reach.

However, the micro revolutions, individually based changes in behaviours and knowledge, reported by some participants indicate possibilities for significant change. Any change to services requires change in the level of knowledge and technical competence of librarians. Involvement in a research study such as this, pondering the answers to probing questions, and engaging in a different discourse, made possible by professional development sessions, may be the start of developing the necessary expertise for revolutionary change, incorporating technical knowledge of algorithms into programs of information and digital literacy.

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No potential conflict of interest was reported by the author(s).

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