THE IMPACT OF DIGITAL TECHNOLOGIES, INCLUDING ARTIFICIAL INTELLIGENCE ON TEACHING ROLES IN FURTHER EDUCATION COLLEGES AND SKILLS SECTOR IN THE UK

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DISSERTATION

Presented to the Swiss School of Business and Management Geneva

In Partial Fulfilment

Of the Requirements

For the Degree

DOCTOR OF BUSINESS ADMINISTRATION

SWISS SCHOOL OF BUSINESS AND MANAGEMENT GENEVA

Dec, 2025

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ABSTRACT

Artificial intelligence (AI) and digital learning technologies are becoming increasingly embedded within the UK Further Education (FE) sector, reshaping teaching, learning and institutional practice. As FE colleges respond to government expectations for a digitally skilled workforce and a "modern Britain," they face growing pressure to integrate AI in ways that improve learning while also navigating significant cultural, pedagogical and ethical challenges. This research explores the impact of AI on FE students' learning experiences and examines the complexity of FE teachers' viewpoints regarding digital and AI-enabled teaching technologies.

This study aims to critically examine how artificial intelligence is viewed and experienced by teaching staff within the UK's FE college sector. The study explores how AI is influencing teaching pedagogy and workforce readiness in a sector already facing many financial challenges and tasked with delivering the UK's skills for industry. The study is grounded in a critical realist philosophy and employs Q methodology to systematically capture and analyse the subjective viewpoints of FE practitioners. Q methodology enabled the identification of shared perspectives across trainers and trainee trainers, highlighting points of consensus and divergence on the benefits, risks, and long-term implications of AI for vocational education. The research combined Q-sorts with semi-structured interviews and surveys to triangulate findings, ensuring robustness and validity. Ethical implications emerged strongly, with participants expressing concerns around privacy, data protection, transparency, accountability and fairness. These ethical issues can significantly influence learning quality, student wellbeing, autonomy and equity, highlighting the need for thoughtful and responsible AI implementation.

The results reveal distinct clusters of perspectives. One group of practitioners emphasised AI's potential to personalise learning, streamline administrative tasks, and support inclusivity. Another group voiced concerns over digital illiteracy, loss of human connection, and ethical issues such as bias and data privacy. A third viewpoint recognised AI as a catalyst for redefining the professional role of FE teachers from content deliverers to facilitators and mentors requiring continuous professional development (CPD) and new pedagogical approaches.

Overall, the findings indicate that while AI offers significant potential benefits for FE colleges, its positive impact depends on effective governance, targeted investment in staff training, and curriculum reform that embeds both digital literacy and irreplaceable human skills. This research contributes to the limited evidence base on AI in UK FE by demonstrating how trainers conceptualise its impact and by offering insights to guide institutional strategy, policy development, and teacher education in the sector.

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Acknowledgements

Thank you to all participants from the colleges who agreed to be involved and participate in this research, and to the senior management of the colleges and colleagues who have supported my journey.

I gratefully acknowledge the guidance and encouragement of SWISS SCHOOL OF BUSINESS AND MANAGEMENT GENEVA Team for their continuous support of my professional doctoral study.

CHAPTER 1: INTRODUCTION

1 Chapter Overview

This chapter clearly sets out the aim, objective, research questions that needs to be addressed and justification underpinning the study. It further provides the contextual background of the study and outlines contribution this study makes to the existing literature. The closing section of the introduction presents the overall structure of the study.

1.1 Introduction to context & background of the study

Artificial Intelligence (AI) has undergone significant conceptual and technical evolution since its early formulation when it was broadly defined and studied largely in isolation. The development of Machine Learning (ML) and, later, Deep Learning (DL) between the 1980s and 2010s reshaped both the theoretical framing and practical application of AI (Nil & Aras, 2019). After 2010, DL emerged as a dominant subfield of ML, drawing inspiration from the structure, and functioning of the human brain (Marsland, 2014). While these advances demonstrate the increasing sophistication of AI, they also raise critical questions about its definition and scope. Popenici and Kerr (2017), for example, describe AI as a computational system capable of human-like processes such as learning, adaptation, synthesis, self-correction, and the use of data for complex tasks. Yet, other scholars caution that such anthropomorphic framings risk overstating AI's autonomy, obscuring its reliance on human-designed algorithms and data inputs. This debate is particularly relevant in the FE and skills education sector, where tensions arise between viewing AI as a supportive tool to enhance teaching and learning and framing it as a potentially autonomous agent capable of reshaping pedagogical relationships.

In the context of Further Education (FE), this distinction is critical, as it influences how colleges, educators, and policymakers conceptualise AI's role whether as an efficiency-driven instrument to support existing practices or as a transformative force challenging the very nature of teaching, learning, and assessment and ultimately the operations of FE colleges. Artificial Intelligence (AI) has been reshaping education systems for several decades, moving from experimental applications to a position of increasing necessity in institutional strategy.

Early debates in education centred on the appropriateness of even basic assistive technologies such as calculators or spell-check software for learners with disabilities (Lazarus et al., 2008). Today, however, the debate in the Further Education (FE) sector concerns how AI can be embedded sustainably to enhance learning, teaching, and institutional effectiveness (Aldosari, 2020). Popenici and Kerr (2017) emphasise that AI has become integral to augmenting student learning and interaction, while Chen, Xie, and Hwang (2020) highlight that advance in data processing and computational techniques have enabled wider adoption across education systems.

In the FE context, where responsiveness to labour-market demands is paramount, the challenge lies in harnessing AI's benefits without exacerbating inequalities or undermining professional practice. AI adaption in FE colleges is framed both as a pedagogical enabler and as a tool for organisational efficiency, Stanley (2018) notes that AI can provide institutions with competitive advantage through cost reduction, process optimisation, and enhanced student experience and are all priorities in a sector shaped by funding constraints and accountability measures.

Specific applications with relevance to FE include teacherbots and chatbots, which deliver personalised feedback and real-time support to large cohorts (Fahimirad & Kotamjani, 2018; Vázquez et al., 2018), as well as Intelligent Tutoring Systems **(ITS)** that have been adapted to vocational and technical subjects such as mathematics, science, and languages (Ocana-Fernandez et al., 2019). Automatic Speech Recognition **(ASR)** and natural language processing systems are increasingly embedded in digital platforms (e.g., Duolingo, Carnegie Speech), supporting the acquisition of language and employability skills (Defrancq & Fantinouli, 2021).

Adaptive learning platforms such as Smart Sparrow and cloud-based systems like Desire2Learn (D2L) demonstrate how AI-driven analytics can personalise content and generate actionable insights for both learners and teachers (Zhao & Liu, 2019).

The UK's FE colleges serve a highly diverse cohorts, use of such adaptive capabilities are particularly valuable for widening participation and meeting varied learner needs, and despite these opportunities, critical concerns emerge in the FE literature. Selwyn (2019) warns against overly deterministic narratives of AI as a transformative solution, stressing that its application is deeply shaped by institutional, cultural, and political contexts.

Williamson and Hogan (2020) highlight the growing role of 'datafication' in education, where learner data is commodified and used for performance monitoring, raising ethical questions about surveillance and control. Similarly, Luckin (2018) argues that while AI has potential to support teachers by reducing administrative burdens, it risks narrowing educational practice if adopted uncritically.

These issues in FE sector are acute given the sector's emphasis on employability, accountability metrics, and often underfunded digital infrastructures. Evidence from Jisc (2020) indicates that FE institutions are experimenting with AI-enabled tools such as predictive analytics for learner retention, but adoption remains fragmented, with concerns about data governance, algorithmic bias, and the professional development of staff.

A notable gap in current research lies in the lack of systematic studies exploring the impact of AI on student learning specifically within UK FE colleges, its impact on the entirety of college operations and future landscape. Existing evidence tends to be drawn from higher education or international case studies, leaving questions about transferability to the FE sector unresolved. Furthermore, limited research has examined the ethical implications of AI in FE colleges, particularly around equity of access, inclusivity, and the safeguarding of learner data (Remian, 2019; Paddick, 2018).

Addressing these gaps is vital if AI is to move beyond piecemeal adoption towards sustainable, sector-wide integration. The following sections therefore examine the benefits, challenges, ethical considerations, and future trajectories of AI in the FE sector. By situating FE colleges within both UK and international debates, this review underscores AI's dual character: as a technology with transformative potential for pedagogy and institutional practice, and as a source of profound ethical and professional challenges requiring careful governance and critical engagement.

1.2 The study setting

The study setting is based on the participation of two FE colleges in England, offering 1-18 vocational provisions, adult education, apprenticeships and community provisions. The colleges were chosen carefully to ensure all aspects that could influence the success and use of AI within the sector can be looked at and studied in details. There are known digital divides within the local community the colleges serve. Majority of the 16-18 years old school leavers joining the colleges are from deprived areas due to the college's location in a high economic and social deprivation. This will mean that majority of the students will have very limited access and exposure to AI technology and hardware at home.

1.3 Targeted research participants

The study was designed to include two contrasting participant groups within the further education college sector in England. One of the participating groups consisted of advanced teachers and teacher training (TED) students. These two groups were intentionally selected to explore whether experienced college practitioners and those new to the profession hold similar or divergent views regarding AI-enabled teaching and learning.

Advanced teachers were identified by the participating colleges as practitioners with more a number of years of teaching experience. In addition to their substantive teaching duties, they also undertake coaching and mentoring responsibilities, supporting colleagues to enhance pedagogical practice across their colleges. This cohort of participants hold an informed and embedded understanding of the teaching workforce and are positioned to influence change in digital and pedagogical development. Their inclusion allowed the study to capture the perspectives of those who operate with a high level of professional confidence and college awareness. The second participant group consisted of eight volunteer TED students at the beginning of their professional teaching career and were expected to offer fresh, and potentially more nuanced, perspectives on digital and AI pedagogy and the evolving teaching role.

Unlike the advanced teachers, this group did not yet possess extensive experience of classroom practice or assessment, making it possible to investigate how early-career teachers conceptualise their responsibilities, the teacher–student relationship, and their own digital confidence.

1.4 Benefits of AI in Further Education Sector

The purpose of AI education in FE colleges is not to transform all students into an artificial intelligence specialist, but rather to equip them and staff with the capacity to understand, apply and critically evaluate emerging technologies. Developing these capabilities has become essential for both students and staff. Learners must not only know how to use AI responsibly and ethically, but also develop a practical awareness of how different AI tools can function and vary across contexts. Embedding AI core competencies within FE sector provides students with the foundational AI awareness now expected in most sectors of the labour market.

For staff, the imperative is twofold: to appreciate how AI can enhance teaching, learning and assessment, and to guide students in its effective and appropriate use. Without a clear understanding of AI developments and pedagogical applications, academic staff may find it difficult to embed AI skills within the curriculum and may be unable to recognise when students are using AI inappropriately or uncritically. Therefore, building AI capability among teaching professionals is a prerequisite for meaningful integration of AI within educational practice. Some FE tutors will smoothly adapt to the new technology, using AI to enhance their teaching and provide their students personalised engaging experience.

Whilst some will struggle, particularly those with limited access to continuous professional development or lacking the confidence in using new technologies. The fear is that this could potentially cause a two-tier workforce with one using AI to enhance students' experience and one failing to meet students' needs and ensure their readiness for the competitive world of work. Artificial intelligence has the potential to transform the vocational sector and ensuring students have access to high quality resources and training; however, this can only be achieved if those working in the sector are well equipped to use the technology.

The literature highlights a range of benefits associated with the application of Artificial Intelligence (AI) in education, many of which are increasingly relevant to the Further Education (FE) sector. Owoc et al. (2021) observe that AI systems support learners through automated exam and assignment marking, providing faster feedback cycles and personalised recommendations based on the analysis of students' responses. Such rapid, tailored feedback is particularly valuable in FE contexts, where diverse learner cohorts often require differentiated support. Zawacki-Richter et al. (2019) similarly note that AI applications employing machine learning and natural language processing can deliver continuous evaluations and guidance during the learning process, enhancing both formative and summative assessment practices.

One of the most frequently cited benefits of AI is the immediacy of support it offers. For example, IBM's Watson cognitive computing system has been used to deliver real-time responses to student queries via chat functions (Gliozzo et al., 2017). In FE, where students may balance study with employment or face-to-face contact hours are limited, such on-demand responsiveness can help to sustain learner engagement and retention.

Dhawan (2021) further argues that exposure to AI technologies during education not only improves students' immediate learning experiences but also equips them with digital skills that are increasingly valued in the workplace. This is directly aligned with the labour-market orientation of FE provision, where employability and industry relevance are central outcomes. AI also offers benefits beyond assessment and skills acquisition. Tools such as chatbots have been found to support learner wellbeing by answering routine queries, reducing anxiety, and directing students to appropriate services (Jisc, 2020). In addition, AI has expanded opportunities for collaborative and cross-cultural learning, connecting students across geographical and linguistic boundaries in ways previously unattainable (Luckin, 2018).

For FE learners, who may have fewer opportunities for international mobility than their higher education counterparts, AI-mediated collaboration provides an alternative route to globalised learning experiences. The role of AI in supporting research and innovation is another noted advantage. Prokhorov and Safronov (2019) emphasise that AI tools can process large datasets, generate hypotheses, and assist in tackling complex research problems.

While this is most visible in higher education, parallels exist in FE through the use of AI-driven analytics to identify at-risk learners, personalise interventions, and inform curriculum design (Williamson & Hogan, 2020). Such data-driven approaches have the potential to improve outcomes at scale and to inform institutional decision-making. Overall, the literature demonstrates that AI offers a broad spectrum of benefits for FE, spanning teaching, assessment, learner support, wellbeing, and employability.

However, as with higher education, the adoption of these technologies requires careful consideration of sector-specific needs and constraints. The following section therefore explores the challenges associated with implementing AI in FE institutions, with particular attention to equity, ethics, and professional practice.

1.5 Challenges of Artificial Intelligence in Further Education

While the benefits of Artificial Intelligence (AI) in education are well-documented, the literature also identifies significant challenges that are particularly relevant to the Further Education (FE) sector. One of the most pressing concerns relates to issues of equity and access. Although AI promises to personalise learning, it risks exacerbating digital divides by privileging students who already have access to reliable technology and digital literacy skills. Jisc (2020) highlights that many FE learners continue to face barriers to connectivity and device availability, raising concerns that AI-enhanced provision could inadvertently widen attainment gaps rather than close them.

Another recurring challenge involves data privacy, surveillance, and algorithmic bias. Williamson and Hogan (2020) argue that AI is part of a broader process of "datafication" in education, where learner data is continuously collected, analysed, and used to drive institutional decision-making. In the FE context, predictive analytics are increasingly used to monitor attendance, forecast student outcomes, and target interventions.

While these systems can support retention, critics argue that they may also reproduce existing biases, categorise learners reductively, and reduce student agency (Selwyn, 2019). This raises questions about the governance of learner data, informed consent, and the ethical use of predictive models. The impact on teaching professionals is another area of concern. Luckin (2018) warns that, although AI can reduce administrative workload, it risks narrowing professional practice if positioned as a substitute rather than a complement to human expertise.

FE teachers already operate under significant pressures related to funding constraints, accountability measures, and workload intensification. The introduction of AI without adequate professional development could increase stress, reduce autonomy, and potentially deskill educators. Jisc (2020) similarly notes that AI adoption must be accompanied by substantial investment in staff training to ensure teachers have the confidence and competence to use such tools effectively.

Ethical considerations also extend to student wellbeing and trust. While chatbots and teacherbots can provide instant support, they may lack the emotional intelligence and pastoral sensitivity required in FE, where many learners need personalised guidance and safeguarding support. Over-reliance on automated systems could diminish meaningful human interaction, undermining the relational aspects of teaching and learning that are central to FE provision (Selwyn, 2019).

Finally, the literature points to the challenge of systemic readiness and sustainability. Many FE institutions face financial pressures, outdated infrastructures, and competing priorities. Implementing AI at scale requires not only financial investment but also strategic vision and robust policy frameworks. Remian (2019) and Paddick (2018) both highlight the lack of comprehensive research into the long-term implications of AI adoption in UK FE, particularly regarding its ethical and societal impacts.

Without careful planning, AI may be adopted in a piecemeal manner that fails to deliver sustainable benefits. In summary, the challenges of AI in FE are multifaceted, encompassing equity, ethics, professional practice, and institutional capacity. These concerns suggest that while AI has transformative potential, its implementation must be critically managed to avoid reinforcing existing inequalities or undermining the professional and social dimensions of FE education. The next section therefore considers the ethical implications of AI more directly, situating them within wider debates about technology, governance, and the role of education in society.

1.6 The Hidden Cost of Dependency on AI

It is well known that FE teachers are respected for their adaptability, problem solving, and ability to meet students' needs from different backgrounds and learning needs. This new technology brings a lot of potential benefits to the teaching and learning profession and taking over a lot of the day-to-day tasks that are currently done by teachers such as content generation, assessment, and many other tasks. However, these wonderful benefits could potentially if not managed properly could have unseen hidden costs such as the

erosion of key valuable teaching skills. FE teachers may begin to be over reliant on AI tools to such an extent that their own capabilities diminish. In time, the inherent skills that underpins effective teaching and learning, differentiation and adaptability may erode away. The potential lose will not impact teachers, but the whole sector and the ability of FE colleges' ability to respond to future challenges.

The sector needs to be ready and able to respond to when the new technology fails, will teachers be able to adapt when they become so dependent on AI, will they still have the confidence and capacity to innovate independently and creatively. FE college leadership must ensure effective use of AI and well-defined safeguards are in place to preserve the unique strengths of FE teaching.

This uniqueness also applies to the students, often young students pursue vocational learning because they need a different kind of education. A kind of education that is personal, flexible, and engaging. The sector needs to ensure AI does not make teaching less human and less connect, the risk is alienating the students in this case their main customers.

1.7 Ethical Implications of Artificial Intelligence in Further Education

The ethical implications of Artificial Intelligence (AI) in education have become a growing area of concern, particularly in the Further Education (FE) sector where diverse learner groups and complex social contexts heighten the risks of unintended consequences. Remian (2019) and Paddick (2018) both note that research on the ethics of AI in education remains limited, especially within the UK FE context, yet emerging literature identifies several critical themes. A key issue relates to data privacy and surveillance. AI systems rely on the large-scale collection and processing of learner data, from academic performance to behavioural metrics. Williamson and Hogan (2020) argue that this process of "datafication" can transform students into data points to be monitored, analysed, and categorised.

In further education (FE) colleges, predictive analytics are increasingly used to identify learners who may be at risk of dropping out. While this can offer valuable early support, it also raises important ethical questions around consent, transparency, and the use of sensitive personal data. Many learners may not fully understand how their data is collected or analysed, and institutions can face difficult decisions about how to use predictive insights without undermining student autonomy.

Another significant concern relates to bias and fairness. AI systems depend on the data they are trained on, and where that data reflects existing inequalities, those biases can be reinforced or even amplified (Selwyn, 2019). This is particularly troubling in the FE sector, which has a strong commitment to widening participation and supporting learners from disadvantaged backgrounds. If predictive tools consistently label certain groups as "at risk", they may unintentionally reinforce structural inequalities rather than help to address them.

The growing use of AI also prompts ethical questions about automation in teaching and learning. Tools such as chatbots and teacherbots can improve efficiency and scalability, but they cannot replicate the empathy, understanding, and contextual judgement that human educators provide. This is especially important in FE settings, where many learners rely on pastoral support. As Luckin (2018) cautions, an over-reliance on automated systems risks weakening the relational and human-centred aspects of education.

This leads to broader ethical concerns about whether the efficiencies gained through AI come at the expense of meaningful teacher–student relationships. Questions of accountability further complicate the debate. When AI is used to inform high-stakes decisions, such as assessment, progression, or access to support, it becomes unclear who is responsible if those systems make errors or cause harm. Jisc (2020) emphasises the importance of governance frameworks that ensure AI systems are transparent, open to scrutiny, and supported by human oversight. In the FE sector, where accountability pressures are already intense, institutions must carefully balance the benefits of automation with the need to protect both learners and educators.

Finally, there is a broader ethical discussion about the purpose of AI in education. Selwyn (2019) suggests that much of the rhetoric around AI reflects a commercial agenda, with technology companies driving adoption in ways that may not align with educational values or learner needs. For the FE sector, which serves as a bridge between education, employment, and community, the ethical question is not simply whether AI can improve efficiency, but whether it enhances equity, inclusivity, and the broader social mission of education.

In summary, the ethical implications of AI in FE revolve around privacy, bias, fairness, automation, and accountability. Addressing these issues requires sector-wide dialogue and policy development that centres the interests of learners and educators rather than technological determinism. The following section considers the future trajectories of AI in FE, focusing on how institutions might integrate these technologies responsibly and sustainably.

1.8 Future Trajectories of Artificial Intelligence in Further Colleges

The future of artificial intelligence (AI) in further education (FE) colleges will be shaped by a mix of technological developments, policy priorities, and the specific needs of the sector. Although the adoption of AI across FE remains uneven, there is growing agreement in the literature that its influence will continue to increase. This is particularly likely as colleges look for new ways to align courses with labour-market demands, improve operational efficiency, and support better learner outcomes (Jisc, 2020).

One key direction is the growing use of adaptive and personalised learning systems. Building on earlier work in intelligent tutoring and learning analytics, AI has the potential to offer more tailored learning pathways at scale, adjusting support in real time as

learners progress. For FE colleges, which work with highly diverse and often non-traditional learners, this approach could help address persistent challenges around retention, achievement, and widening participation (Luckin, 2018). However, its success will depend on sufficient investment, staff training, and careful attention to issues such as algorithmic bias and fairness.

A second area of development is the use of AI in curriculum design and assessment. Williamson and Hogan (2020) suggest that data-driven systems will increasingly shape curriculum planning by linking provision more closely to labour-market intelligence. This reflects FE's role in developing skills for local and national economies, particularly in priority areas such as health, digital industries, and green technologies. In addition, automated or semi-automated assessment tools could help reduce staff workload and speed up feedback for learners. However, their wider adoption will require clear guidance from awarding bodies and quality assurance agencies to ensure that assessment remains valid, fair, and trustworthy.

The professional development of educators will be crucial in determining how successfully AI is embedded in FE. As Selwyn (2019) argues, technology alone does not transform education; meaningful change depends on how it is integrated into teaching practice and institutional culture. Jisc (2020) highlights the need for ongoing staff development, not only to use AI tools effectively but also to question and evaluate them critically. This points to the importance of developing "AI literacy" among educators, enabling them to understand both the possibilities and the limitations of these systems. Without this, there is a risk that reliance on AI could erode professional judgement and autonomy.

Ethical and governance issues will also remain central. Remian (2019) notes that the rapid pace of technological change often outstrips the development of policies to regulate it. For FE colleges, this raises important questions about who drives the AI agenda—government, technology providers, or educators themselves—and how accountability, inclusivity, and learner welfare are safeguarded. Future developments will therefore need to balance innovation with responsible governance, ensuring that AI supports the public mission of FE rather than being driven purely by commercial or efficiency goals.

Finally, the future of AI in FE must be understood within the wider context of social change and evolving skills needs. AI is not only a tool for enhancing teaching and learning; it is also a subject that learners need to understand as they prepare for workplaces increasingly shaped by automation, data, and digital technologies. Embedding AI literacy and digital ethics into vocational curricula may become just as important as using AI within pedagogy itself. From this perspective, the future of AI in FE is not simply about adopting new technologies, but about equipping both staff and learners with the critical skills needed to understand, question, and shape the role of AI in society.

1.9 Research Justification

Artificial Intelligence (AI) has been described as one of the most profound innovations in human history. Audrey Azoulay, Director-General of UNESCO, emphasised its transformative significance when she stated that AI is "the biggest innovation in human history since the Palaeolithic time" during the opening keynote of Mobile Learning Week (Tuomi, 2020). Despite the rapid development of AI systems and their expanding application across education, the evidence base regarding their impact on learning remains limited and inconsistent.

As educational contexts vary significantly across institutions, countries, and even classrooms, findings are often fragmented and not easily generalisable (Remian, 2019). Much of the existing scholarship presents AI as a transformative force. Woolf et al. (2013) argue that AI could "be a game changer in education," enabling learners to achieve outcomes beyond those possible with a single human teacher. Similarly, Hwang et al. (2020) highlight AI's potential to reshape culture, cognition, and knowledge, positioning it as a central research theme in education and computing.

However, this optimism is counterbalanced by caution. Chaudhry and Kazim (2021) stress that the risks of AI in education particularly its psychological impact on learners and teachers are substantial, underscoring the need for robust safeguards, ethical frameworks, and reliable systems. Several gaps in the literature justify the focus of this study.

First, most research has concentrated on higher education or international contexts such as the USA, China, and India (Dhawan, 2021; Aldosari, 2020), with very limited evidence specific to the UK Further Education (FE) sector.

Second, existing studies tend to focus on general benefits and challenges of AI implementation (Owoc et al., 2021; Ocana-Fernandez et al., 2019; Rasheed et al., 2020), without exploring how these directly shape student learning experiences and outcomes in vocational and technical education.

Third, there is little research addressing which AI systems are most effective for particular modes of learning in FE, despite a growing diversity of tools such as chatbots, predictive analytics, and intelligent tutoring systems (Yu, 2019; Kabudi, Pappas & Olsen, 2021).

Fourth, while ethical concerns including bias, fairness, and data governance have been raised in secondary literature (Woolf et al., 2010; Whittlestone et al., 2019; Stahl & Wright, 2018), there is limited exploration of how these ethical challenges influence students' learning experiences specifically within FE.

This study addresses these gaps by examining the impact of AI on learning within the UK FE sector. Given the sector's distinctive context characterised by diverse learner cohorts, close alignment to labour-market needs, and often constrained resources there is a critical

need to understand both the opportunities and the risks of digital technologies including AI adoption in this space. By focusing on the lived experiences of FE students and educators, this research contributes to the literature by moving beyond generalised debates to provide evidence on how digital technologies including AI directly shapes teaching, learning, and learner outcomes in the UK FE context.

1.10 Research Context

The study was conducted at two Further Education colleges in England, one of the colleges was in Northwest of England and the second a smaller college in the Midlands, which serves students aged 14-19 in classroom settings (Learner Responsive – LR), along with post 19 adult learners and work-based (WB) apprentices. The first college employs 450 full-time (FTE) staff, including more than 250 FTE academic personnel, whilst the second smaller college employed 300 full-time (FTE) staff, including more than 150 FTE academic personnel.

The colleges operate within an inner-city locality characterised by significant digital divides due to economic needs and cultural divide, with a high percentage of their (LR) trainees from areas of high deprivation. The colleges are situated in regions of considerable economic and social disadvantage within their respective local authorities.

1.11 Research Questions

The following research questions will shed a light on the status of further education colleges and future challenges due to the role of digital technologies including AI in vocational education.

- How do Further education teachers and instructors understand and position themselves in relation to the future changes to their role brought about by digital teaching and learning technologies?
- How do FE teachers and practitioners see the impact of digital technologies on the relationship between themselves and their students?
- How confident do they feel about the inclusion and use of digital teaching and learning technologies withing their profession?

These questions should allow us to ascertain the implications of digital technologies on the further education & skills sector.

1.12 Factors impacting the research.

A significant impact on this research derives from varying levels of confidence and positions that FE college trainers adopt concerning digital technologies and particularly AI technology. The views of trainees provide a deeper understanding of the cultural and experiential factors shaping these perspectives. The trainers past experience s and exposure to new digital technologies shapes their adaptability, behaviour, and readiness to get out of their entrenched teaching practices.

Furthermore, throughout the study, I constantly reflected upon my own personal views and experiences, and it can affect the study. Gadamer (1975) reminds us that interpretation is shaped by our historical consciousness. My initial assumptions about the confidence of new trainers in using digital technologies have been challenged through this inquiry, revealing the complexities of their individual experiences. The study allowed me to examine my own held beliefs and opinions and have proven flawed at times.

1.13 Methodology

This study adopted a mixed-methods approach, combining qualitative and quantitative data within a critical realist philosophical framework. Critical realism distinguishes between ontology (what exists) and epistemology (how we know it), emphasising that the "real" world exists independently of human perception but can only be understood through social and theoretical constructions (Al-Ababneh, 2020).

This makes it particularly suitable for investigating Artificial Intelligence (AI) in the Further Education (FE) sector, where the material affordances of digital technologies intersect with the socially constructed practices of teaching, learning, and governance.

A mixed-methods design was selected to improve validity, reliability, and triangulation of the findings (Noble & Heale, 2019). The research combined three approaches: secondary desk-based research, semi-structured interviews and surveys, and Q methodology. This integration provided both breadth and depth, capturing empirical data on the impact of AI in FE sector while also uncovering the subjective viewpoints of key stakeholders.

1.14 Secondary Desk-based Research

The first phase involved desk-based research, which reviewed peer-reviewed journals, books, reports, and credible online resources. This phase mapped existing global scholarship on AI in education, with a particular focus on benefits, challenges, and ethical concerns. Studies from international contexts (e.g., China, India, USA, Saudi Arabia) were examined, but special attention was given to identifying gaps in UK-based research.

The findings were analysed using thematic analysis, which enabled the development of a structured set of codes and themes (Ando, Cousins & Young, 2014). These themes

informed the design of the semi-structured interview questions, survey items, and Q methodology statements.

1.15 Primary Field-based Research: Interviews, Survey, and Q Methodology

The second phase of the study consisted of primary data collection within two FE colleges in the UK. This included semi-structured interviews, survey distribution, and the use of Q methodology to capture trainee and trainer perspectives.

- Semi-structured interviews were conducted with eight trainee trainers and five trainers. These interviews explored experiences of digital technologies in teaching and learning, perceived benefits and challenges, and ethical concerns.
- Survey research was distributed more widely and completed by thirty-eight trainee trainers and nine trainers across the two FE colleges. This provided quantitative breadth and comparative insights into institutional and professional perspectives.
- Q methodology was employed to systematically capture subjective viewpoints. Participants were asked to rank-order a set of statements (developed from the thematic analysis of secondary research) covering digital technology benefits, challenges, ethical considerations, and impacts on teaching and learning. Factor analysis was then applied to identify clusters of shared perspectives (Watts & Stenner, 2012).

The addition of Q methodology allowed the research to go beyond descriptive accounts, revealing patterns of thought and discourses about digital technology and AI adoption in FE that would not have been visible through surveys or interviews alone.

1.16 Pilot Testing and Data Collection

Both the interview and survey instruments were pilot tested to ensure clarity, timing, and relevance to the FE context. The pilot also tested the Q methodology sorting exercise to check that statements were comprehensible and appropriately challenging.

Interviews were conducted online using Zoom, and surveys were distributed electronically. The participants were purposively sampled from trainee trainers (to capture the learner perspective of those preparing for teaching roles) and qualified trainers (to capture the practitioner perspective). This ensured a diversity of viewpoints while keeping the focus firmly within the FE sector.

1.17 Data Analysis

Three complementary analytical strategies were employed:

- Thematic analysis (Braun & Clarke, 2006) of interview transcripts to identify recurring patterns around digital technology and AI's role in teaching, learning, and ethics.
- Quantitative analysis of survey data using SPSS, with descriptive statistics and correlation analysis to identify relationships between demographics and attitudes.
- Q methodological factor analysis, which grouped participants' ranked responses into clusters of shared viewpoints, mapping the subjective structures of how trainee trainers and trainers perceive digital technology in FE.

1.18 Triangulation and Validity

To enhance validity, findings were triangulated across the three data sources (secondary research, interviews/surveys, and Q methodology). This integration provided a multi-layered understanding: the desk research identified existing knowledge and gaps, the interviews and surveys captured lived experiences and trends, and Q methodology revealed deeper subjective perspectives.

This triangulated, mixed-method design aligned with the critical realist stance, recognising both the material realities of AI systems and the social constructions through which trainee trainers and trainers interpret their impact. It also ensured that the findings were robust, sector-specific, and capable of addressing the research objectives in a comprehensive way.

1.19 Contributions of the study to Theory and Practice in FE College sector

- **Theoretical Contributions**

This study contributes to theory by extending existing debates on Artificial Intelligence (AI) in education, which have largely focused on higher education and international contexts, to the under-researched setting of the UK Further Education (FE) sector. The findings demonstrate that the impact of digital technology tools and systems on trainee trainers and trainers in FE colleges is generally more positive than negative.

While ethical implications were acknowledged, the evidence suggests that the educational benefits outweigh potential risks. Specifically, AI was shown to enhance learning and teaching by enabling greater accessibility, flexibility, and personalisation, as well as improving efficiency, speed of feedback, and overall learning quality.

Importantly, the study highlights digital technologies and AI's role in fostering learner independence, a central objective of vocational education and training. In doing so, this research strengthens the theoretical argument that AI can act as both a pedagogical

enabler and a driver of institutional effectiveness in FE, rather than being confined to the higher education discourse.

- **Practical Contributions**

The study also makes practical contributions to the FE sector by identifying concrete ways in which digital technology can support teaching and learning. For trainee trainers, AI provides additional scaffolding, responsive feedback, and personalised pathways that align with diverse learning needs. For trainers, AI technology offers opportunities to reduce administrative workload, streamline assessment processes, and provide more targeted support to learners.

The research further demonstrates how AI technologies such as chatbots, adaptive learning platforms, and predictive analytics can be applied in day-to-day FE practice, offering scalable solutions to enhance retention, engagement, and learner outcomes. These insights can inform curriculum planning, professional development, and institutional strategies for digital transformation.

- **Policy Contributions**

At the policy level, the findings address a gap in evidence about AI's impact in FE by providing sector-specific insights that can guide decision-making. In the UK, policy frameworks have often prioritised digital technology and AI adoption in higher education or in national skills strategies, with less emphasis on FE.

This research highlights the need for FE-specific policy approaches that support ethical adoption, ensure equitable access, and provide funding for infrastructure and staff development. By evidencing both the opportunities and the risks of AI in FE, this study underscores the importance of regulatory clarity, ethical safeguards, and sector-wide dialogue to ensure that AI enhances, rather than undermines, the social mission of FE.

1.20 Summary

Overall, the research findings contribute to theory, practice, and policy by demonstrating that AI adoption in FE has the potential to deliver meaningful educational benefits, provided that challenges are carefully managed. By situating digital technology within the context of UK FE, the study offers new insights into how these technologies are perceived and applied in vocational training environments, thus filling a significant gap in the literature. The following section therefore explains the rationale for focusing on the FE sector in the UK as the context for this research.

CHAPTER 2: Review of Literature

2 Chapter overview

The aim of this chapter is to delve into the literature that examines and reviews educational transformation resulting from the use of Artificial Intelligence in further education colleges and skills sectors in the UK. The chapter will try to examine the evolving further education colleges and how digital technology is beginning to be impeded in the sector.

Rather than just focusing on digital technology & AI technology, the paper will explore the changes that are happening and impacting the sector such as trainers, assessors, and their teaching approaches. Hopefully the perspective and significance presented in this review underscores the changes required by the sector to make best use of the great potential of digital technology particularly AI and alleviate many of the challenges faced by those working in the further education sector.

AI technology is advancing at a pace that challenges even the most prepared among us. New AI tools and applications appear almost daily, offering opportunities for teaching and learning while raising questions around assessment, safeguarding, and governance. No single college or individual can keep track of it all which is why communities are essential. In further education, AI technology brings an unusually wide range of stakeholders. Teachers want practical ways to save time and enhance learning.

Across the UK, different stakeholders within the further education (FE) ecosystem are navigating the challenges posed by rapid advances in artificial intelligence and digital technologies. Regulators and awarding bodies continue to grapple with issues of academic integrity and assessment validity, while FE colleges, training institutions and safeguarding teams work to assess emerging risks to learners and ensure their digital and IT policies maintain robust security and ethical standards. At a strategic level, college governors seek clarity on how institutions can offer responsible guidance to learners and remain aligned with evolving expectations around digital competence, employability, and technological readiness. Work-based learning providers and employers introduce yet another perspective, as they adapt to shifting workforce needs and consider how AI is transforming job roles, skill requirements and workplace practices. Each of these viewpoints is legitimate and grounded in professional responsibility; however, without structured opportunities for dialogue, there is a risk that the sector becomes fragmented, reactive, and prone to duplication of effort. Communities of Practice (CoP) offer a mechanism for bridging these divides.

By creating shared spaces where educators, leaders, technologists and industry partners can collaboratively examine their challenges, CoPs enable colleges to focus on what genuinely supports learners, teachers and support staff. Over the past year, Jisc's AI in FE Community has demonstrated the value of this approach. Staff from across the sector

have exchanged experiences, reflected on emerging concerns, and collectively worked through the practical realities of AI adoption.

Recently, a group of FE colleges collaborated to explore how AI is reshaping assessment design and quality assurance. Instead of beginning with predetermined answers, the process started with shared questions—centred on fairness, academic integrity, learner skills, and the evolving meaning of "authentic assessment" in an AI-rich environment. This collective inquiry highlights how CoPs can help the FE sector navigate uncertainty, build shared understanding, and respond in more coherent and evidence-informed ways.

The colleges worked for months, considering assessment from multiple angles that included design, learner literacy, and wellbeing. The outcomes culminated in a set of practical tips:

- **Before assessment:** set clear expectations, design for higher-order thinking, and create safe opportunities for learners to practise using AI.
- **After assessment:** treat suspected misuse with empathy, check understanding through varied methods, and reflect on what worked.

The participating colleges were clear that this guidance should not be seen as a rigid rulebook, but as flexible and adaptable support that FE colleges can shape to suit their own contexts. Its real strength lies in the fact that it has been developed collaboratively by practitioners from different roles and institutions. As a result, it reflects real-world concerns, builds trust, and feels relevant to everyday practice. Because the guidance is grounded in collaboration, it is designed to evolve over time, mirroring the changing nature of AI itself and our growing understanding of its implications.

The benefits of this approach extend beyond individual institutions. Shared communities reduce duplication by openly exchanging ideas, tools, and solutions. They give staff the confidence to respond more quickly to emerging challenges without feeling isolated, and they strengthen the sector's collective voice when engaging with policymakers and technology providers. Most importantly, these communities reinforce the idea that FE colleges are not navigating technological change alone. While AI can feel overwhelming, pooling knowledge and creativity allows the sector to move from simply reacting to change towards actively shaping how digital technologies and AI can best support learners.

Since the COVID-19 pandemic, artificial intelligence has increasingly been promoted as a way to enhance skills development within Technical and Vocational Education and Training (TVET). However, despite this rapid growth, the effectiveness and impact of AI on trainees, skills development, and FE colleges remain unclear. This study therefore aims to systematically review the academic literature on the use of AI in the UK vocational education and skills sector, with a particular focus on the changes required to ensure the sector is prepared to respond positively to the challenges and opportunities created by AI.

The UK further education and skills sector is still in a period of transition and is not yet fully equipped to meet the demands of widespread AI integration. Traditionally, many vocational educators are experienced industry practitioners with deep subject knowledge but limited exposure to digital technologies and AI. As a result, upskilling the workforce represents a significant challenge that should not be underestimated.

This research focuses on the anticipated and future changes that FE colleges and the wider skills sector will need to implement in order to realise the potential benefits of AI for vocational education and training in the UK. When used appropriately, digital technologies, including AI, have the potential to reduce administrative workload across FE colleges and training providers, freeing up time for trainers and assessors to focus on high-quality teaching, learning, and assessment.

There is strong evidence to suggest that developing a culture which meaningfully integrates digital teaching and learning technologies in FE colleges is far more complex than is often assumed by decision-makers. This study critically examines that assumption by exploring the challenges and intricacies involved in transforming teaching and learning through the use of AI. It aims to highlight the depth of change required and to provide a clearer understanding of the factors that influence successful integration, offering insights into how these complexities might be navigated in practice.

Importantly, AI should be understood as a tool that works best when used by skilled, committed, and passionate teachers and assessors. It is not a solution to all the challenges facing FE colleges and training providers, such as funding constraints, recruitment difficulties, or inadequate infrastructure. Nor can AI replace the essential human relationships at the heart of vocational education, including the trust, support, and professional judgement that underpin effective teaching and learning.

Finally, FE college leaders and staff must be supported to take ownership of the transformation required to narrow digital and knowledge gaps and to realise the benefits of AI. It is equally important to recognise the role of research in shaping the responsible use of AI and generative AI, particularly in the development of new pedagogical approaches and teaching frameworks that align with the values and mission of further education.

2.1 Artificial Intelligence

Artificial intelligence is a constellation of many different technologies working together to enable machines to sense, comprehend, act, and learn with human-like levels of intelligence. (Accenture, 2021a). The rapid advances in technology are having a significant impact on the skills sector and personalised learning. It is the science and engineering of making intelligent machines, especially intelligent computer programs. It is related to the similar task of using computers to understand human intelligence, but AI technology does not have to confine itself to methods that are biologically observable, John McCarthy (McCarthy, 2004).

A particular area of using digital technology such as Artificial Intelligence is becoming widely used in further education colleges and the skills sector is in personalised learning. The evidence shows that the AI technology can give students timely support and individualized learning plans utilizing machine learning and natural language processing techniques, according to research by Wang and Xu (2020).

Advances in AI/GAI algorithms is making the technology widely used by practitioners in content development and curriculum design. AI system can analyse learner data and suggest personalised and tailored learning resources and learning plans, Li and Ogata (2018). This feature ensures inclusion of all learners and enhancing the overall student experience and positive progression.

Recent research on the impact of AI conducted by Smith et al. (2020), highlights the power of AI technology in alleviating the effect of external factors on teaching and learning. The rapid emergence of AI technologies such as virtual classrooms, intelligent tutoring systems, and adaptive learning platforms, and the enormous implications for the sector can appear daunting, the key is not to panic, but to embrace the opportunities and for the sector to understand the challenges and capitalize on the innovative approaches AI offers to ensure continuous learning regardless of physical limitations or unforeseen circumstances.

The emergence of AI as a remedy for learning interruptions represents a milestone shift in the educational landscape in the UK and internationally. Trainers and institutions can proactively adapt to changing conditions and provide a seamless training path for students through the integration of AI. However, it is crucial to address all ethical concerns, privacy safeguards, and ensure all those engaged in the delivery and receiving training have equitable access to learning technology when implementing AI in education.

Achieving the full potential of AI will enable continuous learning and improve training outcomes requires ongoing research, investment, collaboration, and partnerships among all those engaged in the further education and skills sector in the UK.

2.2 Artificial Intelligence Classification

Quinn and Goldstraw -White (2020) classify artificial intelligence into three main categories: Artificial Narrow Intelligence (ANI), Artificial General Intelligence (AGI), and Artificial Superintelligence (ASI). ANI refers to systems with a limited scope of abilities, designed to perform specific tasks exceptionally well within a narrow context. AGI, by contrast, represents intelligence on par with human capabilities, enabling machines to think strategically, abstractly, and creatively across a broad range of functions. ASI, the most advanced theoretical stage, surpasses human intelligence in virtually every domain. To date, however, only ANI has been successfully realised in practice.

Agnihotri (2022) similarly highlights ANI also known as weak AI as the most successful and widely implemented form of artificial intelligence. Such systems excel at executing single, well-defined tasks but cannot generalise their functions beyond their specific design. In contrast, AGI aspires to replicate human cognitive abilities, though it remains largely theoretical and, as Accenture (2022) notes, has not yet progressed beyond conceptualisation and fictional portrayals.

This tripartite classification is further supported by Lateef (2022), who reinforces that ANI (weak AI) enables machines to carry out narrowly defined tasks, AGI (strong AI) would allow machines to think and make decisions in a manner comparable to humans, and ASI would involve machines advancing beyond human intelligence altogether. Another approach to classifying artificial intelligence is based on its similarity to the human mind. According to Joshi (2019), AI systems can be categorised into reactive machines, limited memory machines, theory of mind, and self-aware AI.

Reactive machines represent the earliest form of AI. These systems have no memory, extremely limited capabilities, and function solely by responding to stimuli. As Marr (2021) explains, reactive AI operates on predefined inputs and outputs, responding in the same way to identical situations without the ability to learn from past experiences or anticipate future ones. Limited memory machines, while sharing similarities with reactive AI, have the added capability of making decisions using historical data. Joshi (2019) notes that most of today's AI tools and systems are based on this category.

Betz (2022) highlights that limited memory AI can store and reuse knowledge for future tasks, while Johnson (2020) adds that these systems are more advanced than reactive AI because they leverage data to make more accurate predictions. Beyond these, two more advanced categories theory of mind AI and self-aware AI remain largely conceptual and are yet to be realised.

Theory of mind AI aims to understand the beliefs, emotions, needs, and thought processes of the entities it interacts with. Reynoso (2019) suggests that such systems would be capable of recognising emotional outputs and behaviours, remembering them, and adjusting their responses accordingly. Petterson (2021) further argues that this form

of AI could eventually provide personalised solutions by understanding human motives and reasoning.

Self-aware AI, the most advanced and currently hypothetical form, would involve machines not only recognising others' emotions, beliefs, and needs but also possessing their own sense of self, with independent desires and consciousness (Joshi, 2019). Lateef (2022) acknowledges that while this stage of AI often linked to superintelligence remains far from present capabilities, it may become achievable in the future. Similarly, Agnihotri (2022) identifies self-aware AI as the ultimate goal of AI development, where machines no longer "borrow consciousness from a model" but instead possess their own awareness and internal representation of the world.

2.3 Evolvement of Artificial Intelligence

Artificial intelligence (AI) has its origins in the 1950s and has developed over more than seventy years (Zhang & Lu, 2021). One of the earliest contributions came from Alan Turing, who posed the question of when a human-designed system could be considered "intelligent." He proposed what became known as the Turing Test, where a human would attempt to distinguish whether they were conversing with another person or a machine; if they could not, the machine could be regarded as intelligent (Popenici & Kerr, 2017).

Around the same time, Noam Chomsky introduced the concept of language as a formal and systematic structure, comparable to mathematics, thereby justifying the attribution of human-like capacities to machines and framing computer processing as a form of mechanical thinking (Ocana-Fernandez et al., 2019).

This led to two distinct interpretations of AI: weak AI, focused on using computers to study and replicate certain aspects of human cognition, and strong AI, which sought to directly connect artificial systems with human intelligence (Ramos, 2014). The Dartmouth Summer Research Project on AI in 1956, led by John McCarthy, Marvin Minsky, Nathaniel Rochester, and Claude Shannon, is widely recognised as the formal birth of AI (Dick, 2019).

The project proposed that intelligent human behaviour could be formalised and replicated in machines. Attendees Herbert Simon and Allen Newell further argued that computers and human minds could be seen as "species of the same genus," both processing data inputs through formal rules to solve problems and make decisions (Crowther-Heyck, 2008; Heyck, 2005). Following the workshop, AI research focused on reproducing human intelligence through computational means (Dick, 2019). However, while early AI was heavily tied to simulating human cognition, contemporary approaches emphasise building automated systems that perform effectively using available resources, not necessarily by mimicking human thought (Floridi, 2016).

2.4 First Wave of Artificial Intelligence: Internet AI

The first wave of digital technology such as AI, emerging in the 1960s, is often described as Internet AI. It relied on algorithmic systems trained on large amounts of user data to curate online content (Brown, 2018). Early systems were designed around expert knowledge and proved useful in addressing narrow-domain problems by identifying parameters and recommending the best course of action (Deng, 2018). Their main strength lay in transparency and interpretability, though they had limited logical reasoning capabilities.

By the 1970s and 1980s, expert systems advanced further, particularly in speech recognition. Yet, limitations persisted, especially in learning from data and managing uncertainty in reasoning. As Li (2018) highlights, Internet AI was fuelled by vast user-generated datasets, creating detailed behavioural profiles. Similarly, Rufenacht (2020) describes how algorithms of this era detected behavioural patterns and provided personalised content.

2.5 Second Wave of Artificial Intelligence: Business AI

The second wave, beginning in the 1980s, is referred to as Business AI and was driven by the rise of machine learning. These systems outperformed earlier knowledge-based models but still fell short of human-level intelligence (Deng, 2018). The main limitations were a lack of "deep" data representations (Murphy, 2012) and insufficient computing power to process large-scale datasets. Nonetheless, this wave marked a turning point. Li (2018) notes that algorithms were now trained on increasingly complex datasets, ranging from simple to advanced business processes. Diamandis (2018) observed that such systems often outperformed seasoned experts, while Luhar (2018) emphasised the use of structured data to optimise processes, generate value, and reshape the workplace.

2.6 Third Wave of Artificial Intelligence: Perception AI

The third and current wave of intelligent digital technology, known as Perception AI, began around 2010 and is characterised by deep learning. This paradigm overcame many of the limitations of earlier waves, becoming the driving force behind AI's exponential growth. Neural networks and deep learning significantly advanced real-world applications such as speech recognition, image captioning (Karpathy & Fei-Fei, 2015), web search (Huang et al., 2013), visual question answering (Yang et al., 2016), natural language processing (Deng & Liu, 2018), as well as robotics, medical imaging, customer relationship management, and digital advertising.

2.7 Fourth Wave of Artificial Intelligence: Autonomous AI

The fourth wave of digital technology and artificial intelligence, often referred to as Autonomous AI, represents a stage where machines are not only capable of perceiving their environment but also of acting productively and independently in response to it (Brown, 2018). According to Rufenacht (2020), this wave seeks to develop systems that function entirely without human intervention.

However, its advancement is particularly challenging to evaluate, as autonomous systems must demonstrate the ability to adapt dynamically, manage irregularities, and respond effectively to unexpected changes. Li (2018) highlights that Autonomous AI aspires to achieve human-like intuition in movement and object manipulation, bridging the gap between perception and purposeful action.

Similarly, Sikka (2018) conceptualises this stage as Purposeful AI, where technology not only automates routine and repetitive tasks but also liberates individuals to focus their energy on creativity, innovation, and larger opportunities. Rufenacht (2020) notes that Perception AI "gives machines senses," expanding their ability to interpret context. Zaraki (2020) adds that this wave not only enables machines to categorise and detect but also to explain the reasoning behind decisions, marking a significant leap toward contextual and human-like understanding.

2.8 Application of digital technology such as Artificial Intelligence in Education Institutions, Modes of Learning, and Theories of Learning

Artificial intelligence (AI) has been widely defined by scholars such as Nabiyev (2010), Velik (2012), Deng (2018), Gupta et al. (2021), and Crawford (2021), offering a broad conceptual understanding of the field. In the context of higher education, however, Popenici and Kerr (2017) define AI more specifically as "a computing system capable of engaging in human-like processes such as learning, adapting, synthesizing, self-correction, and using data for complex tasks. Huang et al. (2019) emphasise that AI has advanced rapidly in recent years, influencing lifestyles globally. Its role in higher education can be traced back several decades, with early applications in teaching and learning.

Today, however, AI extends beyond educational functions alone and is increasingly viewed as essential for universities seeking to evolve sustainably and remain integral to societal development (Aldosari, 2020). To keep pace with these technological transformations, higher education institutions (HEIs) must innovate teaching methods and learning models.

Ouyang and Jiao (2021) argue that AI offers both opportunities and challenges, reshaping educational practices by enabling new modes of delivery, assessment, and interaction. Limna et al. (2022) further highlight that adopting AI is a strategic priority for HEIs, critical to future-oriented educational development.

Various AI-based systems are already being applied worldwide, influencing teaching practices, learning processes, and institutional operations. Schleicher (2015) stresses, however, that the focus should not merely be on introducing technology into classrooms, but on transforming pedagogy to ensure students gain transferable skills that enhance their competitiveness in global labour markets.

2.9 Overview of the further education colleges and skills sector in the UK

In the UK's dynamic further education and skills sector landscape, the importance of research is crucial to support colleges and training providers to ensure relevance of the training and meeting employer expectations and are accurately meeting the ever-changing needs of developing a future ready workforce. The latest survey report published by the Adult Learning Improvement Network and the AMFE published a survey report, and a key finding is that 60% of respondents stated that staff are not up to date with their digital skills needs that need development to ensure meeting the challenges associated with advances and inclusion of AI. (Amfe & skills workforce fit for the future: Amfe consultancy). In recent years, digital technology tools such as AI has had an impact on all aspects of education, from schools, further education, and skills sector to higher education.

The extensive use of Artificial Intelligence (AI) in Technical and Vocational Education and Training (TVET) has the potential to transform the entire landscape of vocational learning and the FE sector. AI can enrich the students' learning process, enhance skills acquisition, and better prepare learners for evolving labour market needs. Technologies such as machine learning, natural language processing, and computer vision are being currently applied across multiple areas within UK's FE sector including aspects such as curriculum design, personalised learning, assessment design and implementation, career & guidance counselling, and job matching.

The unique ability of such technology to process and interpret large datasets, AI can enable the development of dynamic and industry aligned curricula that accurately reflect real-time market trends. AI driven adaptive learning systems can also tailor and personalise educational content to individual learners' abilities and preferences, leading to improved engagement, retention, and competency development. In addition, AI tools in career guidance and employment services can analyse labour market information to match learners' skills and aspirations with job openings, offering relevant customised career pathways that will boost learners' employability outcomes.

AI technology use within TVET can increase the quality, relevance, and responsiveness of vocational education while narrowing the gap between training and industry expectations and needs. Nonetheless, the success of this transformation depends on the ethical and transparent use of AI, with particular attention to issues of data privacy, fairness, and accountability (Chen, 2022; Li et al., 2021; Spöttl & Windelband, 2020).

A key question for the FE colleges is what the most appropriate digital technologies are and how to choose, define, and use them (Jisc 2020), alongside digital pedagogy (Person, Helen, R. and Beetham, S. 2019).

The recent publication by the UK of the impact of AI on UK jobs and training report DFE (November,2023), the UK department for education (DfE,2023a) Generative artificial intelligence report Call for evidence Education, and the Further Education Learning Technology Action Group (FELTAG) Report (FELTAG 2015), this combined with recent advancement and inclusion of AI in further education and skills sector has demonstrated the complexities and difficulties faced by those working and involved in the further education and skills sector in particular work based/apprenticeships routes.

2.10 Overview of Work base training/Apprenticeship

Further education colleges and training providers play an integral role in the delivery of work base training, apprenticeships to support the skills sector. The emphasis in workplace learning is on ensuring learners gain experience in both the social, cultural, and emotional facets of a job in addition to experience relevant to work. (Batholmeus & Pop, 2019; Rook, 2017).

In the UK the Apprenticeship is becoming an increasingly popular study route for post 16 learners in the further education and skills sector. Apprentices will have the opportunity to gain hands – on experience. Apprentices earn a wage while they are working towards an industry recognised qualification. A recent report by the Department of Education in the UK for the future skills that measures the exposure of UK jobs to AI. The published research demonstrates that employees with Level 4 and above apprenticeships are in jobs that will be most exposed to the prevalence of artificial intelligence compared to any other training route, DFE (November,2023).

The COVID-19 pandemic expanded the traditional approach to work base learning during which there was a constraint and limited accessibility for apprentices/trainers and employers to have access to workplace environments and practical training (Cook, 2021; Dean & Campbell, 2020; Gallaher & Schleyer, 2020). This resulted in the inclusion of online-placement, no-physical, or simulated work base learning to be all included under the concept of work base learning/training.

2.11 The role of digital technologies such as AI to support FE colleges to mitigate learning interruptions

Artificial intelligence (AI) is the replication of human intelligence in computer systems, designed to think and learn like humans. It enables computers to perform tasks that typically require human intellect, such as problem-solving and language comprehension. AI is a multidisciplinary field that encompasses computer science, machine learning, robotics, natural language processing, and more (Smith, 2022).

In the field of education, there is a growing interest in using AI as a solution to learning disruptions. The recent COVID-19 pandemic has highlighted the importance of AI in supporting uninterrupted learning experiences. International research, exemplified by the study conducted by Smith et al. (2020), recognizes the transformative role of AI in mitigating the impact of external factors on education. AI-powered solutions, such as virtual classrooms, intelligent tutoring systems, and adaptive learning platforms, offer innovative approaches to ensure continuous learning regardless of physical limitations or unforeseen circumstances.

These tools facilitate remote collaboration, personalized instruction, and real-time feedback, allowing learning to persist regardless of time or location. The emergence of AI as a remedy for learning interruptions represents a paradigm shift in the educational landscape. Educators and institutions can proactively adapt to changing conditions and provide a seamless learning path for students through the integration of AI. However, it is crucial to consider ethical concerns, privacy safeguards, and equitable access to learning technology when implementing digital technology in education. Achieving the full potential of AI to enable continuous learning and improve educational outcomes requires ongoing research, collaboration, and partnerships at both the international and local levels.

2.12 Challenges of digital technology such as Artificial Intelligence in Students' Learning

The integration of artificial intelligence (AI) technologies in higher education has already become a reality. Yet, as Popenici and Kerr (2017) argue, "AI is not (yet) ready to replace teachers but presents a genuine possibility to augment them." While AI is transforming educational institutions in profound ways, it brings with it a series of significant challenges as well as opportunities. The literature highlights several major issues that students face when interacting with AI-driven learning tools.

Students increasingly rely on AI technologies embedded in their institutions, but these tools often provide only superficial assistance and lack the capacity to support complex learning processes (Kabudi, Pappas & Olsen, 2021; Popenici & Kerr, 2017). As Aasman (2018) notes, AI systems demand vast datasets to function, yet they do not truly understand what they are processing. They excel at identifying patterns but have limited ability to interpret meaning or context.

Consequently, AI-based learning solutions remain technology-centric rather than human-centric, and thus lack emotional depth, social interaction, and adaptive communication (Xin & Zhao, 2021). This limits students' opportunities for collaboration, critical analysis, and nuanced problem-solving (Yu, 2019). For example, a teacherbot can explain course content but may fail to respond effectively to complex or unexpected questions unless such information is already programmed into the system. Ma and Siau (2018) highlight that AI's strengths lie in speed, accuracy, and consistency areas where humans cannot compete. However, AI remains weak in "soft skills" such as creativity, innovation, critical thinking, leadership, empathy, and communication. Frue (2019) similarly observes that while AI enables efficiency, its lack of human qualities means it can provide incorrect or decontextualised solutions.

2.13 Lack of Flexibility and Adaptability

Although digital technology in particular AI has been used in higher education for several years, it continues to lack adaptability to the diverse needs of students (Owoc et al., 2021). Learners differ in goals, interests, and learning styles, yet AI systems often prioritise technical objectives rather than individual learning requirements (Katuk et al., 2013; Mouakket & Bettayeb, 2016). Without sufficient human interaction, AI-driven content can appear rigid and generic, leaving students struggling to engage or achieve their full potential (Kabudi, Pappas & Olsen, 2021).

2.14 Cost

Another pressing challenge is cost. Developing, implementing, and maintaining AI systems requires significant investment in infrastructure, data availability, and data management (Carrico, 2019). As Dhawan (2021) warns, these costs may be passed on to students through increased tuition fees, potentially discouraging enrolment particularly among international students. Although universities may eventually benefit from cost reductions through automation (Mulling, 2021; Dilmegani, 2022), the initial financial burden remains a substantial barrier.

2.15 Digital Illiteracy

Digital illiteracy also constrains students' ability to benefit from AI. Despite the rapid expansion of digital tools, access remains unequal. For instance, in 2020, 4% of the UK population lacked internet access, with disparities much greater in regions such as Central Africa (12%) compared to Northern Europe (95%) (Johnson, 2020). Limited access to technology and insufficient digital skills makes it difficult for many students to engage with AI systems (Dhawan, 2021).

Researchers categorise these challenges into five areas: technological literacy and competency, technological sufficiency, technological complexity, self-regulation, and student isolation (Rasheed et al., 2020).

- Technological literacy & competency: Students often struggle with new interfaces, lack confidence with digital tools, and experience confusion about where to seek help (Brown, 2016; Prasad et al., 2018).
- Technological sufficiency & complexity: Poor internet infrastructure, bandwidth issues, and technical errors disrupt learning, while overly complex systems create further distractions (Henrie et al., 2015; Gopalan et al., 2018).
- Self-regulation & isolation: AI-driven independent learning requires strong time-management and self-discipline. Many students fall into procrastination (AlJarrah et al., 2018) and struggle with organisation (Broadbent, 2017). Furthermore, reliance on AI can increase feelings of isolation, particularly in online learning contexts (Lightner & Lightner-Laws, 2016).

Although UNESCO (2018) and the UN's Sustainable Development Goals stress the importance of building digital literacy worldwide, these challenges will require sustained global strategies over several decades.

2.16 Ethical Concerns and Bias

Beyond technical challenges, digital technologies such as AI use in education also raises ethical concerns. Research in this area is limited, and few policies or regulatory frameworks exist (Paddick, 2018; Holmes et al., 2018). Ethical risks include issues of privacy, transparency, and accountability, as algorithms may reinforce hidden biases (Akgun & Greenhow, 2021; Zeide, 2019). Bias remains a critical concern. Since data is only a partial reflection of reality, all algorithms carry some degree of bias (Remian, 2019; Stahl & Wright, 2018). A well-known example is Amazon's AI recruitment tool, which unintentionally discriminated against women because its training data favoured male CVs (Ravi, 2021). Similar risks could arise in higher education, for example, if AI is used to evaluate or admit students.

2.17 Impact of digital technology and Artificial Intelligence on the further education sector

The potential use of AI in assessment of work based/apprenticeship frameworks (EPA – end point assessments) is an area that requires attention and could stifle digital innovation. The recent published report published by the Gatsby foundation addressing e-assessment in technical education in England (Stewart Edwards, 2024) states "E-assessment has growing potential to tackle some of the underlying challenges of providing assessment that is both valid and consistent, particularly for practical skills and behaviours. AI technology continues at pace to transform the workplace and if it is not fully utilised in assessing workplace competence, there is a risk, especially with the current emphasis on end point assessment, that some apprenticeships become anachronistic." The report also concludes that AI could extend the capabilities of how technology can be used for assessment and may undermine conventional assessment models across both technical and academic education.

Further education colleges and independent training providers generally have a positive and a buy in introducing new technologies, especially AI. However, the sector is pragmatic and accepts that AI technologies are in the early stages and AI could potentially widen already existing inequalities. The report published by Association of Employers and Learning Providers (AELP) (Dr Chihiro Kobayashi, June 2023) shows that there are significant barriers to technology use including connectivity issues, such as lack of Wi-Fi (55%) and devices (66%), and lack of digital skills including digital pedagogy (64%), all of which can greatly and adversely impact learning.

Assessing learning outcomes and particularly in a workplace vocational setting is an area where AI-based assessment systems can provide students and assessors with immediate feedback. According to Sanchez-Piero et al. (2019), to adequately accept and use assessment tools by teachers, there was a need to enhance the AI knowledge base.

The latest AI agenda in UK and roadmap with extensively research publications show a wide application of AI in a workplace integrated learning environment. Personalisation of instructions, availability of adaptive learning, and automated assessment processes, shows that AI can bring a huge benefit to the skills sector and provide a positive learning experience.

The in-depth development of artificial intelligence will affect many situations, from the restructuring of social order in the broadest sense to the education and administration processes in classes and schools. Schools that are expected to adapt to the digital age and embed 21st century skills in their main agendas are some of the main institutions that could be most affected by the development of artificial intelligence (Gocen & Aydemir, 2020).

The use of AI technology in education will have a great impact and benefit in the UK's vocational and skills sector. It has the potential of enhancing vocational training and ensuring graduate readiness for the labour market. Artificial intelligence can be utilised in various ways in the further education and skills setting such as curriculum development, vocational assessment, personalised learning, guidance and on job training.

However, ethical, and responsible AI implementation remains crucial, with considerations for issues such as data privacy, bias, and transparency (P. Chen, 2022; T. Li et al., 2021; Spöttl & Windelband, 2020).

Technological advancement in AI application and integration in the UK further education and skills sector is moving at a very fast pace and necessary to ensure the UK is globally connected and competitive thus there is a need to change to teaching, learning/training and assessment is being delivered in the further education colleges and consequently changes to the role of practitioners/teachers in the sector (Hallissy et al., 2013).

2.18 Narrowing the digital skills gap among staff in FE colleges & skills sector.

The UK economy is expected to be significantly impacted by advancements in artificial intelligence. However, the exact extent and scope of this impact remains uncertain. The current research estimates that AI has the potential to automate 10-30% of current jobs, while also increasing productivity and creating new high-skilled job opportunities in the UK economy.

The further education and skill sector is at the forefront and expected to play a major role in addressing the changes to the UK economy. However, the continuation of the presence and occurring issue of the digital skills gap among educators highlights the importance of staying updated with digital advancements.

There is a concerning lack of up-to-date digital skills among staff colleagues. This emphasizes the need for targeted interventions and resources to effectively bridge this gap. Furthermore, providers face a significant challenge in assessing digital skills needs and competencies. Unlike traditional subjects such as English and math, there is a lack of standardized assessments for digital literacy.

Colleges and training providers must innovate in this area by developing comprehensive frameworks to evaluate digital skills needs, including understanding the advancements, opportunities, and potential pitfalls presented by artificial intelligence. Furthermore, the impact of the pandemic on learning styles has led to behavioural changes among 16–18-year-olds students who are engaged in teaching and training. The Covid-19 crisis brought about significant societal changes, particularly in the field of education, which faced numerous challenges. Consequently, young people now approach learning, training, group work, and assessments/exams differently.

The expectations of learners, parents, and employers have all evolved, albeit not always in the same direction. In response, further education teachers and trainers have recognized the need to develop new strategies that prioritize mental health and pastoral support. However, some teaching staff in the further education college and skills sector feel ill-equipped to navigate these complexities, and when training is provided, it is often reactive rather than proactive.

Further education colleges like all other education sectors encounter difficulties when it comes to recruiting qualified teachers to stay or enter the teaching profession. This is an ongoing challenge for educational providers, and our focus groups have revealed widespread frustrations. The issue has been exacerbated by Ofsted's (The Office for Standards in Education, Children's Services and Skills) identification of shortages in certain subject areas without offering viable solutions at a national level.

To address this, providers have been sourcing highly technical experts from various industries. While these experts bring valuable cutting-edge knowledge and experiences that are essential for learners and apprentices in a rapidly evolving job market, they lack formal teaching is challenging and need to be addressed by the sector.

Those in the further education sector and policy makers strive to build a more efficient future that aligns with the financial constraints and reforms, digital technologies in general and AI in particular has emerged as a potential and a cost-effective solution that is often perceived as standardized and cost effective. However, it is essential for further education colleges to approach technology with caution.

While financial constraints and the effect of economic austerity may pish colleges and training providers towards using AI for mass, low quality, automated education that can be delivered on a large scale, it is crucial to consider the potential consequences. Beetham (2015) argues against the notion that technology can be a simple economic solution that requires fewer qualified practitioners. Such a perspective risks undermining the quality of teaching and subsequently, the learning experience.

The risk of turning education and training to a standardised automated process, there is a danger of oversimplifying the complexities of effective pedagogy and inadvertently diluting the depth of learning. Moreover, as the UK government pushes for educational reforms and demands more with limited resources, the pressure to adopt AI for economic efficiency becomes increasingly pronounced.

However, it is important that digital technology should not be seen to cut costs or streamline processes. Instead, it should be viewed as an opportunity to enhance the learning experience, grounded in pedagogical principles that priorities student/trainee engagement, critical thinking, and meaningful interactions.

Fullan (2013) highlights the potential disruptive nature of technology when its implementation lacks a solid foundation in educational principles. Simply incorporating technology without considering its alignment with effective teaching and learning practices can lead to unintended consequences and hinder the overall educational experience for students.

Emerging trends in artificial intelligence and digital education indicates that both areas will see rapid changes soon. Further education colleges and training providers and employers alike must collaborate and apply new innovative strategies that will respond to the evolving demands for technological proficiency.

There will be a need for practitioners to harness the power of AI to automate routine tasks and refocusing their workforce on strategic, creative work. Further education colleges and training providers will need to develop curriculums that teach essential digital skills and ensure lecturers stay abreast of new digital tools.

This will require the skills sector to develop a digital strategy, investment in infrastructure and continuous professional development strategy to promote digital technology through continuous training, leveraging government and industry resources. Therefore, it is imperative for further education colleges and training providers to approach the integration of artificial intelligence with a holistic perspective.

While economic efficiency is an important consideration, it should not overshadow the fundamental goal of providing high-quality education. By incorporating digital technology including AI in a pedagogically sound manner, institutions can ensure that students are not only equipped with the necessary skills for the future but also receive a comprehensive and engaging learning and training experience.

The UK's digital strategy published in 2017 and commissioned by the Department of Culture, Media, and sport in conjunction with Department for Business, Innovation and Skills commissioned Ecorys UK ltd to undertake a study into digital skills for the UK economy (ECORYS 2016). The report's findings are particularly important for the further education colleges and skills sector with their barriers and market challenges, the report identifies bottlenecks, barriers, and market failures and one of these is the education sector. The report states "The digital skills of staff across the education and training system are uneven, and often it is not mandatory for staff to 'upskill' digitally.

A learner's digital education will depend on the digital competencies and skills of those teaching them, as well as awareness and adaptability of education institutions to changes in technology" (ECORYS 2016, p.77). Furthermore, the latest report by the department for education (DfE) and the Government's Open Innovation Team (OIT) published a report exploring opportunities and risks for GenAI in education. The report interviewed teachers and educators at 23 educational institutions.

The published report that teacher adoption of GenAI is mainly hindered by a lack of knowledge and understanding about how to use tools. Lack of knowledge about how to use tools in an educational context was the most prominent barrier to use among teachers not currently using GenAI, as well as digital infrastructure. This will also revolutionize further education colleges and training providers by creating more connected and intelligent campus. However, time pressure is another factor that can impact the upskilling of those working in the further education and skills sector.

DfE survey shows that teachers point to time constraints as a serious concern due to workload was a barrier to accessing continuous professional development. (Department for Education, 2023). The further education sector cannot avoid digital technology and AI; it is almost fully integrated in many operations of further education colleges and these changes do have the potential to bring about a great benefit and vibrance to the UK economy and local communities. As part of the UK government's wider strategy of making the most of the opportunities AI has to offer launched a "new call for evidence" taking in the views of the education and training sector that can provide a base for future work.

The findings from the respondents focused on how digital technologies and AI could be used in education to reduce workload for staff, how to improve learner outcomes, how to run the operations more efficiently and how to around misuse and validity and security of assessments.

The outcome of the report also confirmed the need for further research to inform and shape GenAI use in education (DfE, Call for evidence summary of responses - review into online targeting 2023).

Following on from the call for evidence report, the Department for Education (DfE, 2023), has released a policy paper on the use of generative AI in education, which outlines the opportunities and challenges that come with the use of digital technology and AI. Generative AI refers to technology that can be used to generate content based on large volumes of data that models that have been trained on from a variety of works and other sources.

Generative AI tools like ChatGPT Google Bard can answer questions, complete written tasks, and responds to prompts in a human – like way. This new technology can be utilised to improve student learning experience, best use of personalised learning and student feedback, changes to assessment, staffing efficiencies, meeting employer expectations. The DfE findings show that of those using or experimenting with GenAI in education, a majority reported positive result or impact of use.

The positive impact included allowing tutors and administrative staff to have free time to plan and prepare lessons and prepare engaging material for the students. Although the use of AI is widespread in the Further education sector among teachers and students albeit not in a regulated way, there was a widespread recognition of the challenges and risks GenAI presents for education (DfE, 2023).

It is important that Further education colleges can explore and lead to inform and shape on how artificial intelligence can be best used to enhance the students' learning experience and support and mitigate risks to students' journey to ensure positive progression into work and further studies.

In the UK, further education colleges are still trying to understand and analyse the impact of AI on their sector, particularly distant learning and work-based learning provision. The rapid advances of AI into the education sector and workplace, further education colleges need to adopt a flexible approach that ensures those working in colleges have the knowledge and skills to engage positively with this new technology to support their students safely and responsibly to ensure the potential AI can bring them and how to best support their students.

There are signs of collaboration between colleges on best approach to use of AI and it can be effectively used to overcome many of the challenges faced in work-based learning and improving teaching and learning and student outcomes. The further education sector must also not to rely excessively on AI and new online technologies that could limit students' interaction among each other and with their tutors that can stop their soft skills development (Ikedinachi Ayodele Power Wogu, Olu-Owolabi, Assibong, & Udoh, 2018).

2.19 Current state of digital technology such as Artificial Intelligence in Further Education

In the UK's vibrant further education and Skills sector landscape, the importance of research is becoming increasingly crucial to support further education colleges and training providers to ensure relevance of the training and meeting employer expectations and are accurately meeting the ever-changing needs of developing a future ready workforce.

The latest survey report published by the Adult Learning Improvement Network and the AMFE published a survey report, and a key finding is that 60% of respondents stated that staff are not up to date with their digital skills needs that need development to ensure meeting the challenges associated with advances and inclusion of digital technology and AI. (An fe & skills workforce fit for the future: Amfe consultancy). Furthermore, the publication identifies critical threads across various industries, different learners, and programme types and at all levels. Three T's emerges:

1. **Targeted**, **Timely** and **Transformative**, which are vital for successful workforce CPD planning.

Here are some of the key areas where digital technology tools such as artificial intelligence can be utilised:

- Intelligent Tutoring Systems: AI-powered tutoring systems can provide personalized feedback and guidance to students, assisting them in their learning journey. These systems use machine learning algorithms to analyse student performance data, adapt instruction to individual needs, and provide targeted interventions.
- Adaptive Learning Platforms: AI is being used to create adaptive learning platforms that tailor educational content and activities based on individual student progress, learning style, and preferences. These platforms can provide personalized learning experiences, ensuring that students receive the right level of challenge and support.
- Chatbots and Virtual Assistants: AI chatbots and virtual assistants are being deployed in educational institutions to provide 24/7 support to students. These AI-powered systems can answer common questions, provide information about courses and programs, and assist in administrative tasks, freeing up human resources for more complex interactions.
- Automated Grading and Feedback: AI algorithms are being used to automate the grading and feedback process for objective assessments, such as multiple-choice questions and quizzes. This saves time for educators and provides prompt feedback to students, enabling them to track their progress and make improvements.
- Data Analytics and Learning Analytics: AI is being used to analyze large datasets of student information, performance data, and learning activities to extract

valuable insights. Learning analytics can help educators identify patterns, predict student outcomes, and make data-informed decisions to improve teaching and learning strategies.

- Virtual Reality and Augmented Reality: AI is being integrated with virtual reality (VR) and augmented reality (AR) technologies to create immersive and interactive learning experiences allowing students to explore virtual environments, simulate real-world scenarios, and engage in hands-on learning.
- Language Learning and Translation: AI-powered language learning platforms are being developed to assist students in acquiring new languages. These platforms use natural language processing (NLP) techniques to provide interactive language exercises, pronunciation feedback, and translation assistance.
- Personalized Recommendations and Pathways: AI algorithms are being used to provide personalized recommendations for courses, resources, and learning pathways based on individual student interests, goals, and previous performance. This helps students make informed decisions and find relevant educational opportunities.

2. **Educational Content Generation:** generating educational content, such as automated essay grading, automated textbook summaries, and interactive educational materials. This can help reduce the workload of educators and provide additional resources for students.
    - Collaboration and Communication Tools: AI-powered collaboration and communication tools are being used to facilitate remote learning and online collaboration. These tools provide features like real-time language translation, speech-to-text transcription, and intelligent content organization.

While digital technology in further education shows great promise, there are still challenges to address, including ethical considerations, data privacy, and ensuring equitable access for all learners. Continued research, collaboration, and thoughtful implementation are essential for maximizing the benefits of digital technology and AI in the further education sector.

AI has the potential to revolutionize conventional methods of teaching and learning, streamline administrative tasks, and enhance the quality of student experiences in higher education (Smith et al., 2020). In the UK, AI and GenAI are widely used in the further education and skills sector from helping teachers in producing learning resources, supporting teaching and personalizing learning for students.

The latest data indicates that Pupils and students may be using GenAI more than their teachers. 74% percent of online 16–24-year-olds in the UK have used a GenAI tool. (Generative AI in education - GOV.UK 2024).

Further education colleges in the UK play a central part in the delivery of work based and apprenticeship training in collaboration with employers. The implications of integration of digital technologies and specifically AI into the delivery of apprenticeship programmes is both promising and challenging.

Further education providers in partnership with employers need to identify where the investment in training, standard development and resources need to be invested. The Institute for apprenticeships and Technical Education in the UK (IfATE) have developed and published occupational maps that people navigate the technical education landscape.

The occupational maps provide further education providers with data on apprenticeships that lead to jobs with the most exposure to AI and these will include higher level apprenticeships. However, there is little evidence or a detailed impact analysis on the effect of AI will have on apprenticeships.

The latest department for education policy paper in the UK, titled Generative Artificial Intelligence in Education, lays out and in detail the research into the required future skills for workforce training but fails to reference apprenticeships or work-based training and needs. Artificial Intelligence is found in almost all areas of industry and training providers need to ensure their graduates are ready to enter successfully enter the market. (Generative AI in education - GOV.UK 2024).

Advancement in digital technologies is making great strides and impacts all sectors and industries including vocational technical education. Artificial Intelligence is making a noticeable impact on the education sector and is making a substantially reforming the landscape of further education and skills sector. The influence of digital technologies stretches from vocational instructors, trainees, assessors, assessment, and quality assurance of vocational programmes.

The latest data issued by the UK government shows that by November 2023, 42% of primary and secondary teachers had used GenAI, this is an increase from 17% in April 2023. A total of 74% percent online of 16–24-year-olds in the UK have used a GenAI tool. The data also shows the use of GenAI in educational context ranges from 14% to 67% of students having used GenAI for schoolwork and studies. (Generative AI in education - GOV.UK 2024).

Nevertheless, the substantial usage of digital technologies in education comes with an increased risk to the reliability and validity of assessment malpractice as well as ethical, safety and data privacy concerns. Education practitioners raise valid concerns that the existing educational regional disparity will only increase due to digital technologies due to availability of digital infrastructure and poor digital skills.

Digital technologies and artificial intelligence will continue to all aspects of education, skills required by employers and readiness of colleges and training providers to ensure their students are equipped with the knowledge and skills to make a positive progression into the workforce.

Further education (FE) colleges and training providers need to develop a clear understanding of both the current landscape and the future implications of digital technologies, including artificial intelligence (AI). This understanding should inform strategic planning and organisational development. All stakeholders within the skills sector including policymakers, employers, and training providers must adopt a forward-looking approach. Where possible, taking anticipatory action will help TVET institutions and their graduates to thrive in a digitally driven economy and contribute positively to economic, social, and individual outcomes.

A substantial body of research supports the need to rethink and redesign education to meet the demands of the digital age, an increasingly interconnected global context, and the expectations of learners who are growing up in a digitally dependent economy (Beetham and Sharpe, 2013; Garrison, 2015; Harrison, 2000; Laurillard, 2012; Salmon, 2013; Hallissy et al., 2013; Savin-Baden, 2015).

However, changes to teaching and learning practices are often slow, and if not carefully planned and managed, they can lead to resistance and disengagement. Dewey (1938) highlights that poorly managed change can result in negative attitudes among participants. This suggests that shifts in trainers' and assessors' roles, responsibilities, and professional identities along with their willingness to reflect and adapt are strongly influenced by their exposure to, and confidence with, digital and AI technologies.

To support this transition, FE college leadership must prioritise high-quality professional development that enables trainers and assessors to engage positively with new technologies and develop effective learning experiences. Like other education sectors, FE continues to face challenges in recruiting and retaining qualified teachers. This issue was repeatedly highlighted in the focus groups, where participants expressed frustration at ongoing staffing pressures. These challenges have been further compounded by Ofsted's identification of shortages in specific subject areas, often without corresponding national solutions.

In response, many providers have turned to recruiting highly skilled industry specialists. While these practitioners bring valuable, up-to-date technical expertise that is vital for learners and apprentices entering a rapidly changing labour market, they often lack formal teaching experience. Traditionally, teachers have been responsible for designing, planning, and facilitating students' learning journeys (Luckin et al., 2012). Scholars including Dewey (1938), Salmon (2013), Laurillard (2013), and Beetham and Sharpe (2013) emphasise that the quality of learners' experiences is closely linked to the learning opportunities created by teachers and trainers. Careful planning before, during, and after learning activities remains essential. Dewey (1938) further argues that teachers must actively guide learners to make the most of new opportunities such as those presented by AI tools rather than leaving them to navigate these changes alone. This does not suggest that learners are unable to learn independently or informally. However, in the FE and skills sector, the teacher or trainer continues to play a crucial role, particularly due to the practical and assessment-focused nature of many programmes.

This study therefore seeks to explore trainers' and teachers' perspectives, needs, and capacity to engage with the opportunities presented by AI tools, as well as the impact of AI tools on teacher -student interactions. Research consistently shows that strong, positive relationships between teachers and learners significantly support learning and progression (Hattie and Yates, 2014).

For FE colleges to fully benefit from digital technologies and specifically AI tools, cultural change is required. Dewey (1938) stresses the importance of moving away from traditional approaches towards more progressive forms of education. Although such transformation can take time, the FE sector cannot afford complacency given the rapid pace and pervasive influence of digital technologies. A growing number of digital and AI-based tools have been designed specifically for education, with the potential to reduce workload through support for lesson planning, schemes of work, content creation, and assessment. Used effectively, these tools can free up time for teachers and assessors to focus on learners and maximise the value of classroom interactions.

This shift implies a redefinition of teachers' and assessors' roles, ensuring that digital technologies are used to enhance, rather than detract from, the learning experience. Staff across the FE and skills sector therefore need access to foundational training in digital and AI tools, alongside protected time to explore and embed them into practice. Simply increasing access to technology does not guarantee learning. As Laurillard (2012) cautions, students' use of technology does not automatically translate into meaningful learning, and poorly managed digital proliferation may even have negative effects. Garrison (2015) similarly warns against chasing the latest technological trends without considering their educational value.

The central challenge for FE colleges and training providers is therefore how to use AI in ways that genuinely enhance learning for all students. Improving AI literacy among both staff and learners is essential. A recent Department for Education report, *Generative AI in education: Educator and expert views* (January 2024), identified lack of knowledge about how to use generative AI in educational contexts as the primary barrier for teachers who are not currently using these tools. Concerns about job security were also evident. Survey data indicates that 64% of respondents believe AI may reduce the number of available jobs, while 48% are concerned about AI replacing aspects of their role.

However, research from the International Labour Organization (ILO) suggests a more balanced perspective. Their findings indicate that most roles are only partially exposed to automation and are more likely to be augmented by AI rather than fully replaced. In this sense, generative AI has the potential to enhance human capability, create new opportunities, and increase productivity across sectors. For FE, the challenge lies in ensuring that AI is positioned as a supportive tool that complements professional expertise, rather than a threat to it.

2.20 The pace of change & Role of Communities of Practice in Navigating digital technologies in FE

Digital technologies and in particular artificial Intelligence (AI) is advancing at a pace that far exceeds the ability of individual educators or institutions to remain fully informed. New applications emerge almost daily, each offering opportunities for pedagogy while simultaneously presenting challenges related to assessment integrity, safeguarding, governance, and strategic planning. In the Further Education (FE) sector where resources are often constrained and stakeholder groups particularly diverse this creates the risk of fragmented and duplicated efforts if institutions attempt to respond in isolation (Jisc, 2023).

The complexity of digital technologies and AI adoption in FE stems from the breadth of stakeholders involved. Teachers are primarily concerned with using AI to save time and enhance learning; regulators and awarding bodies focus on integrity and validity; safeguarding teams address risks to learners; IT departments prioritise data security; governors consider strategic implications; while learners themselves require guidance on how to engage with AI ethically and effectively.

Employers engaged in work-based learning add yet another perspective, emphasising the need for skills aligned with shifting labour-market demands. Each viewpoint is legitimate, yet without spaces for dialogue, the result is often piecemeal adoption and duplication of effort (Selwyn, 2019). Communities of Practice (CoPs) provide a framework for overcoming these challenges. Wenger (1998; 2002) defines CoPs as groups of people who share a concern or passion for something they do and learn how to do it better through regular interaction.

In the context of digital technology in FE, CoPs create collaborative spaces where diverse voices can be heard, insights exchanged, and solutions co-developed. Jisc's AI in FE community exemplifies this approach, bringing together staff across roles and institutions to explore common challenges. For example, one initiative involving nine colleges examined how AI is reshaping assessment, starting not with fixed solutions but with collective questions about fairness, integrity, and learner wellbeing (Jisc, 2023).

The outcome of this collaboration was a set of practical and adaptable guidelines for integrating AI into assessment. These guidelines emphasised actions staff could take before assessment such as setting clear expectations, designing tasks that encourage higher-order thinking, and providing safe opportunities for learners to practise using AI responsibly and after assessment, including responding empathetically to suspected misuse, checking understanding through multiple methods, and encouraging reflective practice. Crucially, this guidance was trusted because it was developed collaboratively, grounded in the lived concerns of practitioners, and applicable across diverse FE contexts.

The significance of this process lies not only in the outputs but also in the collaborative method of production. As Wenger (2002) suggests, the knowledge generated within CoPs is dynamic and socially constructed. This means the guidance is not static but a "living resource" that evolves as AI tools and institutional practices develop.

Such agility is essential in a technological landscape where tools and risks change rapidly (Williamson & Hogan, 2020). The wider benefits of CoPs for FE extend beyond producing shared resources. They help reduce duplication of effort by enabling open sharing of solutions, ensure staff feel supported rather than isolated when responding to rapid change, and strengthen the sector's collective voice when engaging with policymakers or technology providers (Luckin, 2018; Jisc, 2020).

Most importantly, they demonstrate that AI adoption does not have to be an isolating or overwhelming process. By pooling collective expertise, creativity, and professional judgement, CoPs enable the sector not only to keep pace with technological change but also to shape AI adoption on its own terms, aligning it with the pedagogical and social mission of FE.

Looking ahead, the role of communities of practice will be increasingly vital. They provide the sector with the means to make sense of change collaboratively, ensure diverse perspectives are represented, and transform uncertainty into practical, context-sensitive guidance. If AI is to reshape education, then CoPs offer the mechanism by which the FE sector can ensure it does so in a way that is ethical, equitable, and aligned with its values.

2.21 Future Application of digital technologies & Artificial Intelligence

digital technologies and artificial intelligence (AI) have already begun to shape higher education, producing measurable benefits (Rose et al., 2016; Lemaignan et al., 2017; Rivers et al., 2017). However, as Leer and Ivanov (2013) observe, its role is still marginal, as it has not yet been fully developed or widely implemented. Popenici and Kerr (2017) argue that the capacity to direct computer systems through cognitive processes and integrate AI extensively into teaching and learning could radically transform higher education worldwide, ushering in a genuine technological revolution.

Woolf et al. (2013) similarly claim that AI will be a game changer in education, enabling individuals and groups to learn far more effectively than if taught by a single human teacher. Although AI has been present in education for decades, its prospects (Nye, 2016) and applications (Hao, 2019) are now greater due to wider internet access, increasing digital literacy, and advances in research. Schiff (2021) notes that AI is leaving the laboratory and entering the classroom. Hao (2019) cites Derek Li, founder of Squirrel AI, who boldly asserts that only AI's adaptive systems can produce miracles, while relying solely on teachers risks hindering genius.

2.22 A New Paradigm

Popenici and Kerr (2017) suggest that digital technologies in particular AI technology will push policymakers and higher education leaders towards a fundamentally new paradigm, one that emphasizes creativity, inspiration, civic engagement, and personalised learning. With its ability to monitor participation, guide progress, and provide tailored feedback, AI has the potential to support more imaginative and student-centred approaches to education.

Aran and Chen (2021) also argue for reimagining higher education in light of today's complex and uncertain world. AI, they contend, can accelerate the transformation of institutions by making learning more adaptive and aligned with student needs. Ocana-Fernandez et al. (2019) highlight that AI-based tools could significantly enhance the quality of higher education by enabling customised learning experiences and better integration between human instruction and AI support.

2.23 Curricula

Vocational Curricula will be among the most significantly affected areas. As digital technologies evolve, higher education curricula will become increasingly flexible and adaptable (Ocana-Fernandez et al., 2019). Ma and Keng (2018) argue that AI's speed and accuracy allow institutions to deliver subject material universally, fulfilling the historical mission of universities to make knowledge available anytime, anywhere. While MOOCs (Massive Open Online Courses) made progress towards this goal, AI technologies may advance the universalisation of curricula and improve quality (Schiff, 2021).

MOOCs are already offered by leading institutions such as Harvard, Stanford, MIT, Berkeley, Birmingham, York, Southampton, and Glasgow, with platforms including Coursera, FutureLearn, France Université Numérique, Miriadax, EduOpen, OpenHPI, SWAYAM, Fisdom, Edraak, and XuetangX (Shah, Pickard & Ma, 2022). However, challenges remain. AI can more easily model structured subjects like mathematics but struggles with interpreting meaning and context in fields that require deeper human understanding (Schiff, 2021).

2.24 Feedback

AI technology will also revolutionise feedback mechanisms. Aldosari (2020) suggests that AI could fully automate grading systems, giving students more timely support than ever before. By facilitating two-way feedback between students and teachers, AI can enhance reflection and shared learning. Research shows that timely, targeted feedback boosts academic performance, supports self-regulation, motivates learners, increases engagement, and strengthens accountability (Dawson, Henderson & Mahoney, 2019; Faulconer, Griffith & Gruss, 2021; Hooda et al., 2022).

2.25 Information and Improvement

Digital technology in particular AI will continue to reshape how students search for, access, and process information. Already central to information management, AI is expected to play an even greater role in shaping research and study practices (Lutz, 2019; Appedu, 2022). AI systems can track student progress, identify weaknesses, and ensure foundational knowledge is established through immediate feedback (Aldosari, 2020). By accelerating data analysis, AI supports faster decision-making and enhances learning outcomes (Ghai, 2022).

2.26 Learning Without Fear and Beyond Location

The technology may also reduce students' fear of learning by supporting trial-and-error approaches in flexible, low-stakes environments. Aldosari (2020) notes that AI can provide guided feedback that helps students learn without fear of failure. Moreover, AI allows education to transcend geographical, physical, and linguistic barriers. Marr (2021) emphasises that AI will create truly global classrooms, enabling students to learn from anywhere whether at home, on campus, or even in a café while bridging language and accessibility challenges.

2.27 Deeper Understanding of Learners

Future AI systems will be capable of deeply understanding students' cognitive development, emotional reactions, levels of engagement, and likely educational pathways (Schiff, 2021). Thomas (2022) similarly predicts that AI will advance to fully comprehend human language, encompassing both written and spoken forms. This level of understanding may allow AI to deliver highly personalised and responsive learning experiences.

2.28 FE College Teachers

A central question remains: what role will teachers play in a digital technology driven future with a focus on AI technology? Schiff (2021) stresses that AI should empower, not replace, educators by automating repetitive tasks and freeing teachers to focus on guidance, mentorship, and career development. Pinkwart (2016) supports this view, noting that AI tools are designed to complement, rather than displace, teachers. However, concerns remain. Derek Li (Hao, 2019) suggests that in the long run, human teachers may play only a monitoring role, focusing on emotional support while AI manages academic delivery. Popenici and Kerr (2017), however, caution against equating education with algorithmic solutions, arguing that replacing human educators with AI risks reducing learning to superficial outputs.

2.29 Educational Ownership

Finally, digital technologies such as AI tools is expected to enhance students' educational ownership. Schiff (2021) describes this as giving students full control over their learning journeys choosing courses, setting their own pace, and directing their academic and professional pathways. McClaskey (2018) similarly defines ownership as self-directed, engaged learning, where students are empowered to design their own educational experiences. Such ownership has the potential to strengthen not only academic outcomes, but also broader social and civic engagement.

The future of AI in higher education promises transformative change across curricula, pedagogy, information access, feedback, and student empowerment. While AI is unlikely to fully replace teachers, its role in shaping new paradigms of learning is undeniable. The key challenge will be ensuring that AI complements human expertise, fosters equity, and supports genuine educational ownership, rather than reducing education to algorithm-driven processes.

2.30 AI and the Future of Further Education in the UK

As the UK seeks to position itself as a global leader in artificial intelligence (AI), the further education (FE) sector stands at a critical turning point. Government initiatives such as the *AI Opportunities Action Plan* (2024) and the wider Industrial Strategy set out ambitious goals, including embedding AI across public services, driving economic growth, and reshaping how people learn and work. While these ambitions are far-reaching, they raise important questions for vocational education: how can FE providers not only respond to these changes, but also actively influence and shape them?

AI tools is no longer a future prospect; it is already disrupting established educational practices. Much like earlier debates around the introduction of calculators or word processors, AI now presents both challenges and opportunities for FE. Technologies such as adaptive learning platforms, automated assessment tools, and AI-driven simulations are already changing how learners engage with content, how educators deliver teaching, and how awarding bodies design qualifications. For vocational and apprenticeship learners, this opens up opportunities for more personalised learning pathways that reflect individual strengths, career aspirations, and learning preferences. For neurodiverse learners in particular, these developments have the potential to be transformative.

The use of AI-powered simulations and digital technologies in sectors such as healthcare, engineering, and digital media demonstrates how technology can enhance practical, hands-on learning. In addition, AI can support real-time formative feedback, giving educators clearer insights into learner progress while enabling learners to receive immediate, personalised guidance. Together, these developments have the potential to reduce barriers for disadvantaged and neurodiverse learners, while improving the overall quality of learning experiences. Government programmes such as *TechFirst*, a £187 million initiative to accelerate AI and digital skills adoption, further underline the commitment to embedding AI across classrooms and communities.

Despite this potential, the UK continues to face a significant shortage of AI-related skills. Current policy increasingly emphasises the expansion of AI education pathways not only through higher education, but also through FE and apprenticeships. Meeting this challenge will require systemic change. Educators, employers, and training providers will all need to be upskilled to use AI confidently and responsibly in both teaching and workplace settings. Curriculum reform will be essential to embed digital literacy, AI literacy, and data fluency across vocational subjects, while assessment models must evolve to keep pace with technological change. Learners must also be supported to critically evaluate AI-generated outputs, recognising the risks of bias, inaccuracy, and the continuing importance of human judgement.

The government has committed to training 7.5 million workers in AI-related skills by 2030 through a mix of modular learning pathways, apprenticeships, higher technical qualifications, and growth zones. However, there is a clear need to ensure that this expansion does not deepen existing inequalities. FE colleges have a vital role to play in promoting inclusive design, providing mental health and wellbeing support, and ensuring flexible access to digital technologies and AI-enabled learning. Approaches such as micro-credentials, hybrid delivery models, and modular qualifications can help widen participation and support lifelong learning, aligning with the forthcoming Lifelong Learning Entitlement in 2027.

Recent Department for Education toolkits (DfE, 2024), developed in partnership with organisations such as the Chiltern Learning Trust and the Chartered College of Teaching, offer practical guidance for FE providers. These resources encourage the wider use of AI across teaching, assessment, and administration. In pedagogical contexts, AI tools can support lesson planning, generate quiz and exam questions, analyse assessment data, and provide adaptive feedback. They can also assist with creating teaching resources such as images, exemplars, and presentation materials, helping to reduce workload and diversify learning materials.

In assessment, AI may support formative evaluation, but the guidance stresses the need for caution due to risks such as biased outputs and so-called “hallucinations”, where AI generates inaccurate information. From an operational perspective, colleges are encouraged to use AI to reduce administrative pressures, including tasks such as drafting correspondence, developing policies, managing timetables, and supporting budget planning.

Crucially, the toolkits highlight the importance of establishing a clear institutional vision for AI. Colleges are encouraged to define which tools are appropriate for use, set clear boundaries, and ensure staff receive training on both the capabilities and limitations of AI. Leaders are expected to model responsible AI use, foster an informed AI culture, and embed ongoing training within professional development. Transparency, inclusivity, and human oversight are positioned as essential principles, particularly where AI systems may influence decisions that affect learners.

At the same time, the guidance draws attention to wider risks, including safeguarding, data protection, and intellectual property concerns, particularly where student work may be used as training data. The potential misuse of generative AI tools, including the creation of deepfakes, further reinforces the need to embed digital safety, critical thinking, and AI ethics within FE curricula. The digital divide also remains a pressing concern; as one FE vice principal observed, without equitable access to safe and institutionally supported AI tools, learners' risk being separated by a "digital chasm" rather than connected by a bridge.

FE colleges therefore have an opportunity not simply to adopt digital technologies and in particular AI tools, but to redefine its role within the UK's wider AI strategy. This includes embedding green and digital skills across vocational pathways, strengthening dual professionalism by combining industry expertise with pedagogical excellence, and contributing to policy innovation around qualifications, funding, and workforce development. Above all, the sector must balance innovation with inclusion, ensuring that the adoption of AI and digital technologies expands opportunity rather than reinforces inequality.

The question is no longer whether AI will transform further education, but how intentionally and ethically the sector chooses to shape that transformation and whether it can do so in ways that reflect the core FE values of inclusion, lifelong learning, and social mobility.

2.31 Summary

This chapter has critically reviewed the existing literature on digital technologies with a focus on Artificial Intelligence (AI) and its role within education, with a particular focus on the under-researched context of the UK Further Education (FE) sector. It began by tracing the conceptual and technical evolution of AI, from early definitions to the emergence of machine learning and deep learning as dominant paradigms.

While early scholarship often conceptualised AI as a generalised computational system capable of mimicking human cognition (Popenici & Kerr, 2017), more recent work has emphasised its practical applications in teaching, learning, and administration across education systems (Nil & Aras, 2019; Marsland, 2014).

The review highlighted the ways in which AI is already reshaping education through adaptive learning platforms, intelligent tutoring systems, chatbots, and automated assessment tools. The literature identifies a range of benefits for learners and educators, including personalisation, efficiency, immediate feedback, collaborative learning opportunities, and expanded access for neurodiverse and disadvantaged learners (Owoc et al., 2021; Zawacki-Richter et al., 2019).

These developments align with broader aspirations to leverage AI for enhanced learning outcomes, improved learner engagement, and institutional competitiveness. At the same time, the chapter examined significant challenges and ethical concerns raised in the literature.

These include risks relating to data privacy, algorithmic bias, academic integrity, over-reliance on technology, and the psychological impact on staff and learners (Chaudhry & Kazim, 2021; Remian, 2019). Scholarship has also drawn attention to gaps in regulatory frameworks and the absence of clear pedagogical strategies for integrating AI effectively and responsibly in FE contexts (Williamson & Hogan, 2020).

A particular limitation is the lack of empirical research focused specifically on FE in the UK, with most studies concentrating on higher education or international case studies (Dhawan, 2021; Aldosari, 2020).

The chapter further considered the emerging role of communities of practice (Wenger, 1998; Jisc, 2023) as a mechanism to help FE navigate the fast-moving AI landscape. By fostering collaboration between teachers, trainers, regulators, IT specialists, employers, and learners, communities provide a practical means of addressing the fragmentation of perspectives.

Sector-led initiatives such as Jisc's AI in FE community illustrate how practitioners can co-develop guidance, share solutions, and create "living resources" that evolve alongside technological change. Overall, the literature reviewed in this chapter indicates that while AI offers transformative opportunities for FE, its adoption must be carefully managed to mitigate risks and ensure equity of access.

There is a clear need for further empirical research to understand how AI is being experienced and applied in FE colleges in the UK, particularly from the perspectives of trainee trainers and trainers. This gap provides the rationale for the present study, which seeks to investigate the impact of AI on teaching and learning in FE, with attention to benefits, challenges, and ethical implications, and to contribute to both theory and practice in this emerging field.

CHAPTER 3: RESEARCH DESIGN & METHODOLOGY

3 Chapter Introduction

This chapter seeks to examine the research methodology and design employed to explore the impact and influence of digital technologies specifically the use of AI technology has on the further education and skills sector in the UK. The study adopted a carefully integrated Q methodology design combining desk-based research and analysis, interviews and a Q methodology informed survey. The use of multiples complementary data sources strengthened methodological rigour by enhancing credibility, dependability, and triangulation, thereby reducing reliance on any single method (Noble & Heale, 2019). Q methodology was selected deliberately for its ability to systematically examine subjectivity viewpoints while applying quantitative structure to qualitative data.

The paper will detail the research methodology and structure of the study and present a detailed description of the research process with a focus on factors such as ethical considerations provided in the report. Digital technology is advancing at a pace that feels almost impossible to keep up with. New tools emerge daily, offering fresh opportunities for teaching and learning but also raising challenges around assessment, safeguarding, and governance. No single college or individual can manage this alone. That is why communities of practice are essential.

In further education, AI touches a wide range of stakeholders where teachers want to use it to save time and enhance learning, regulators and awarding bodies focus on integrity, safeguarding teams look at risks to learners, IT departments manage security, governors consider strategic implications, and learners themselves need clear guidance on responsible use. Work-based learning adds further perspectives on employers' changing skills needs. Each viewpoint is valid, but without collaboration the risk is fragmentation and duplication.

Communities of practice provide the structure to manage this complexity. They bring diverse voices together, helping us focus on what truly benefits learners and staff. Jisc's AI in FE community has already shown the power of this approach: over the past year, staff from across the sector have connected, shared experiences, and tackled common challenges.

One example is a collaborative project with nine colleges exploring how digital technologies including AI is reshaping assessment. Rather than imposing a fixed outcome, the group worked with shared questions about fairness, integrity, and learner wellbeing. The result was practical guidance:

- Before assessment: set clear expectations, design tasks that encourage higher-order thinking, and create safe opportunities for learners to practise AI use.
- After assessment: address suspected misuse with empathy, check understanding in multiple ways, and build time to reflect on what worked.

This is not a rigid rulebook, but adaptable guidance grounded in the lived realities of practitioners. Because it was shaped collectively, staff recognise their own concerns within it and trust its relevance. Importantly, such guidance evolves alongside the technology.

Communities enable living resources to continually update, debated, and improved as both tools and understanding advance. This agility is vital in a landscape were AI changes almost daily. The benefits go further: communities prevent duplication by sharing solutions openly, help staff respond quickly without feeling isolated, and give the sector a stronger, unified voice when engaging with policymakers or technology providers. Most of all, they remind us that we are not facing these changes alone. Working together reveals the expertise and creativity already within FE, enabling us not just to keep pace with AI but to shape its use for the benefit of learners. As AI technology continues to evolve, the importance of communities will only grow. They are how we make sense of change, ensure diverse perspectives are included, and turn uncertainty into practical action. If AI is going to reshape education, communities are how we ensure it does so on our terms.

In the United Kingdom (UK) Skills England recognises that the fast evolution of technology poses a unique set of challenges for business and educational institutions in terms of enhancing and updating their skills sets and knowledge base to meet demands in the market efficiently and effectively to cater to these evolving needs of the sector in the coming years.

Further education colleges and training institutions operating in the delivery of skills development should be flexible and well positioned with resources to adapt accordingly to this technological advancement, especially in artificial intelligence (AI) are expected to drive the demand for skills that can harness these breakthroughs across various industries. In fields such as Cyber Security, these advancements may shift the focus of existing roles and give rise to new specializations (Skills England: Driving Growth and Widening Opportunities, September 2024).

The study seeks to enhance our understanding of how further education colleges and training providers perceive the evolution of their operations, particularly concerning the roles of academic instructors and trainers in integrating digital technologies such as AI into teaching and learning within the vocational education and training landscape.

To address this primary focus, several specific inquiries are proposed:

- What steps are Further education colleges and vocational training providers taking to prepare for challenges posed by the integration of AI in education and the evolving employer needs?

3.1 Trainers' and Assessors' self-perceived digital capability and confidence

How do certain trainers and assessors, in education feel about their abilities in the age of digital technology and how do they perceive their specific training requirements in this context? What level of confidence do they have regarding the integration of digital technology into curriculum delivery and assessment processes?

- How will digital technology influence training in the workplace?

This question seeks to explore how digital technologies, particularly artificial intelligence (AI), are shaping education and skills development for educators, trainers, and assessors working with trainees in the further education and skills sector. The inquiry is designed to examine how FE trainers and assessors understand and experience changes to their roles, as well as how they perceive their own digital literacy in response to advances in AI within education. The focus on trainers and assessors reflects their central role in shaping organisational culture and practice within the sector. In line with Creswell's framework (2014, p. 142), the research positions this group as key agents of change, while maintaining a clear emphasis on the influence of AI technologies.

The study adopts a mixed-methods research design, combining qualitative and quantitative approaches to gain a richer understanding of participants' perspectives. Open-ended questions are used to support a flexible and exploratory approach, allowing participants to articulate their experiences, perceptions, and concerns in their own words (Creswell, 2014, p. 140). By deliberately incorporating open-ended questions and action-oriented language that encourages reflection and engagement (Creswell, 2014, p. 142), the methodology aims to empower participants to express how they view their professional roles and how AI is influencing both their practice and the wider industry.

3.2 Role of a researcher

This research seeks to explore the perceptions and experiences of Further Education College (FE) teachers in relation to their engagement with AI technologies in teaching and learning.

The aim of the study is utilising the research questions to understand how teachers construct their own realities around digital practice and how they anticipate these practices evolving in the future. The focus as a researcher is to gain insight into participants' lived experiences and to interpret their historical, social, and cultural contexts. This orientation aligns with constructivism and interpretivism as guiding philosophical foundations (Creswell, 2014, p.8).

Accordingly, meaning is co-constructed through interaction with participants, whose worldviews shape the data as much as my own background, culture, and habitus influence its interpretation (Gadamer, 1975; Bourdieu, 1998). As Lincoln and Guba (1985, p.84) observe, within this ontological stance "a number of constructions might be

made," implying that multiple realities exist according to differing perspectives and interpretations.

3.3 Interpretivism and the Nature of Reality

The interpretivist paradigm focuses on the social world and the meanings individuals ascribe to it. From this standpoint, reality is neither fixed nor objective but exists as it is perceived and constructed by individuals. The researcher is therefore part of the research setting rather than an external observer. Bassey (1999, p.43) captures this by noting that "concepts of reality can vary from one person to another. Instead of reality being 'out there,' it is the observers who are 'out there'." This recognition situates the researcher within, rather than outside, the process of meaning-making.

As the literature review progressed, it become apparent that a researcher may engage in deeper reflection on the ontological assumptions underpinning the study. Bryman (2016, p.30) argues that constructivism "invites the researcher to consider ways in which social reality is an ongoing accomplishment of social actors rather than something external to them," suggesting that cultures are continually constructed and reconstructed. This aligns with my own growing recognition that social reality is dynamic and shaped through interaction and lived experience. Accordingly, the study is grounded in a constructivist ontological stance, where knowledge and reality are understood as co-created through social processes.

3.4 Constructivist Epistemology and Research Approach

Savin-Baden and Tombs (2017, p. 18) describe constructivism as a philosophical position in which "reality and knowledge reside in the minds of individuals" and are accessed through the exploration of personal experience. This study seeks to uncover such experiences by interpreting and describing teachers' perceptions, viewpoints, and confidence in using digital technologies as they navigate an increasingly digital educational environment. Accordingly, the research adopts an interpretivist epistemological stance, recognising that developing knowledge in this area requires an understanding of how individuals construct meaning and share their experiences. An interpretivist approach was therefore considered the most appropriate for addressing the research questions and for gaining insight into participants' perspectives.

To put this approach into practice, the study combined Q-sort methodology with semi-structured interviews involving experienced FE college teachers, alongside a focus group discussion with trainee education (TED) students. This mixed qualitative design supports the exploration of both individual interpretations and shared cultural understandings.

Willig and Stainton-Rogers (2013, p. 378) suggest that Q-sorts can reveal subtle differences in interpretive frameworks, which may be understood as cultural and historical artefacts. This makes Q-methodology particularly well aligned with a constructivist perspective. Similarly, Ramlo and Newman (2011, p. 178) argue that the

Q-sort process enables participants to construct representations of their own viewpoints, with no "right" or "wrong" configurations, thereby authentically capturing personal meaning-making and interpretation.

3.5 Embracing a Mixed-Methods Design

Ramlo and Newman (2011, p.186) further emphasis that Q-methodology is inherently a mixed-methods, blending quantitative techniques with qualitative interpretation. While positivism is traditionally associated with quantitative approaches and interpretivism with qualitative ones, Creswell (2014) argues that mixed-methods research offers a more holistic and comprehensive understanding than either approach alone. It bridges the perceived dichotomy of "either/or" by integrating numerical and narrative data to capture both breadth and depth.

In this study, a sequential mixed-methods design was adopted (Teddlie & Tashakkori, 2009, in Cohen, Manion & Morrison, 2011, p.25). Findings from the Q-sort phase informed the development of semi-structured interview questions and the themes explored in the group discussion. This sequencing allowed quantitative patterns to guide deeper qualitative exploration and interpretation.

3.6 Considering Alternative Philosophical Worldviews

In defining the study's philosophical position, the author also evaluated alternative paradigms. Kuhn (1970, p.180) describes paradigms as clusters of beliefs that shape what is studied, how research is conducted, and how findings are interpreted what Creswell (2014, p.5) terms "philosophical worldviews." Although some scholars view paradigms as mutually exclusive (Bryman, 2016, p.637), the long-standing "paradigm wars" (Bryman, 2016, p.657) have gradually shifted toward more integrative, pragmatic perspectives.

Lincoln and Guba (1985) identified three historical eras of paradigmatic thinking pre-positivist, positivist, and post-positivist while Bassey (1999, p.42) distinguished between positivist and interpretivist traditions. Positivism, concerned with objectivity and empirical validation, seeks measurable evidence derived from scientific reasoning. In contrast, interpretivism values hermeneutic, social, and creative forms of knowledge. Critics such as Gadamer (1975) have argued that human sciences cannot be confined to the empirical criteria of natural sciences, as human understanding is inherently interpretive.

Conversely, interpretivist research has been critiqued for its perceived subjectivity, with concerns about how findings can be justified given differing individual interpretations. Grey (2017) highlights the limitations of both extremes: positivist methods risk reducing human experience to mere data, while interpretivist approaches can be overly context-bound. He concludes that no single paradigm can provide complete understanding and

that a complementary combination can yield richer insights. The rise of mixed methods research reflects this pragmatic turn (Bryman, 2016, p.657), embracing multiple forms of knowledge and moving beyond the binary "either/or" debate (Tashakkori & Teddlie, 1998, in Armitage, 2007). Ramlo and Newman (2011, p.174) reinforce this view by noting that Q-methodology enables "the objective study of subjectivity."

In this way, mixed methods research accommodates diverse epistemological positions while retaining methodological rigour. Grey (2017, p.14) further emphasises that organisational practice is shaped by theory, and that understanding beliefs and values is central to interpreting culture and behaviour. From this standpoint, investigating the digital teaching and learning culture within FE institutions requires examining both organisational and individual dimensions through a mixed-methods educational research approach.

3.7 Research Paradigm - Method and Approach

A range of research perspectives—including constructivism, post-positivism, participatory action frameworks, and pragmatism—play an important role in shaping contemporary social work research methods and frameworks. These perspectives are grounded in philosophical traditions and encompass key considerations such as axiology, ontology, and epistemology (Creswell, 2009; Lincoln et al., 2011). Makombe (2017) explains that ontological inquiry focuses on the nature of reality that researchers seek to explore and understand.

Epistemology, in contrast, is concerned with how knowledge about that reality can be generated. While ontology addresses what can be known, epistemology focuses on how it can be studied. Methodological inquiry then builds on these foundations by considering the strategies, processes, and procedures required to carry out the research. Together, these philosophical positions shape decisions about a study's design, methods, and overall structure (Creswell & Plano Clark, 2011). Each research paradigm therefore offers a distinct stance on axiology, ontology, epistemology, methodology, and the language through which research is communicated.

Importantly, ontology and epistemology are closely interconnected and cannot be meaningfully separated (Creswell, 2009). Ontology concerns the nature of reality and what is understood to exist, while epistemology focuses on how that reality is explored and interpreted in order to gain understanding. In this sense, epistemology provides the means through which researchers access and make sense of reality (Makombe, 2017).

Research methods are commonly categorised as qualitative, quantitative, or a combination of both. Traditionally, qualitative approaches have been more prevalent in the social sciences, while quantitative methods have dominated the natural sciences (Creswell, 2013). However, contemporary research increasingly draws on mixed-methods approaches across both domains, recognising the value of integrating different methodologies to gain more comprehensive and nuanced insights (Leko et al., 2022).

3.8 Exploratory Literature Review

The findings from Chapter 2 highlighted that, despite the substantial growth of literature on digital technologies such as artificial intelligence (AI) in education, significant gaps remain in understanding its impact within the UK further education (FE) sector. Much of the scholarship has focused on higher education (HE) contexts, particularly in relation to digital pedagogy, student experience, and institutional governance (Luckin, 2018; Selwyn, 2019; Holmes et al., 2021). By contrast, relatively little attention has been given to how AI influences learning in FE colleges, especially in vocational contexts where teaching, training, and work-based learning converge.

The exploratory review of peer-reviewed journals, sector reports, policy papers, and news articles conducted in Chapter 4 identified four recurring themes:

1. The current applicability of digital technology such as AI in FE institutions how digital technology tools are already being trialled for assessment, learning support, and administrative efficiency.
2. The impact of digital technology on teaching, training, and learning focusing on changes to pedagogical practices, learner engagement, and teacher workload.
3. Ethical concerns linked to digital technology in FE including safeguarding, assessment integrity, equity of access, and the risks of over-reliance on technology.
4. The future application of digital technology in vocational education projecting how generative AI, adaptive systems, and data analytics might reshape FE curricula and training models.

These themes informed both the design of the empirical phase and the choice of methodology. They pointed to the need for a research strategy capable of capturing both collective practices (as explored in the literature on Communities of Practice) and individual subjectivities (as captured through Q methodology). Accordingly, this study adopts a mixed-method approach that integrates thematic qualitative analysis with Q-method factor analysis.

3.9 Research Strategy

Mixed-Method Approach with Q Methodology

Qualitative research provides in-depth insights into experiences and meanings (Hays & McKibben, 2021). In this study, it allows for exploration of how trainers and trainee trainers in FE colleges perceive AI and how it shapes their pedagogical practices. Quantitative research, by contrast, focuses on measurement, comparison, and testing relationships (Mehrad & Zangeneh, 2019). Both approaches have distinct strengths, but their integration within a mixed-method design creates richer, more triangulated findings (Johnson & Onwuegbuzie, 2004; Plano Clark & Ivankova, 2016).

This research employs a qualitatively driven mixed-method design, in which qualitative interviews and thematic analysis are combined with Q methodology. Q methodology, developed by Stephenson (1935), is particularly suited to this research because it captures subjectivity in a systematic and interpretable way.

Participants are asked to sort a series of statements (Q-set) reflecting different perspectives on digital technology ‘s role in FE. Statistical analysis of the Q-sorts (via factor analysis) reveals clusters of shared viewpoints, thereby mapping how different trainers and trainee trainers position themselves in relation to digital technology adoption.

Q methodology sits at the intersection of qualitative and quantitative paradigms (Watts & Stenner, 2012). It provides the richness of subjective expression (qualitative) while producing statistically interpretable groupings of perspectives (quantitative). This makes it particularly well aligned to a research problem that requires both understanding diversity of perceptions and identifying structured patterns within that diversity.

The rationale for Q methodology is twofold. First, FE colleges contain diverse stakeholders whose views on digital technology are often fragmented (Jisc, 2023). Capturing this diversity systematically avoids privileging dominant narratives.

Second, the use of Q in conjunction with Communities of Practice (CoP) theory allows the research to link individual subjectivities (how trainers perceive digital technology) with collective practices (how institutions and professional networks negotiate digital technology adoption).

3.10 Communities of Practice and the Methodological Fit

The conceptual framework underpinning this study draws on Wenger’s (1998) theory of Communities of Practice (CoPs), which positions learning as a socially negotiated process. CoPs provide a valuable lens for understanding how FE practitioners collectively make sense of digital technology, share practices, and generate “living guidance” (Jisc,

2023). However, CoPs are not homogenous: within any community, individuals hold different priorities and levels of enthusiasm or scepticism about digital technology.

Here Q methodology provides a methodological bridge. It surfaces the patterns of subjectivity within a community, showing, for example, that one group of trainers may prioritise efficiency and workload reduction, while another stresses ethical risks and safeguarding concerns. By combining CoP theory with Q methodology, this study links the collective and the subjective, offering a more comprehensive account of how digital technology is experienced and negotiated in FE colleges.

3.11 Validity and Reliability

Validity

Internal validity refers to how rigorously a study is conducted, while external validity is about how far its findings can be applied beyond the original group studied (Dörnyei, 2007, p.50). Yet, these traditional definitions are often less relevant for qualitative researchers, whose primary aim is to understand rather than to generalise.

In a broader sense, validity is often described as a measure of truth (Nunan & Bailey, 2009). Vu (2021) explains that in the social sciences, validity acts as an epistemic benchmark suggesting that research findings accurately reflect the realities they explore and are backed by solid reasoning and evidence. However, many qualitative researchers question this notion because it assumes there is a single, fixed truth to be discovered. From a constructivist perspective, reality is viewed as subjective and multifaceted, shaped by individuals' experiences and contexts. This makes the idea of one absolute "truth" problematic.

As a result, qualitative researchers often turn to alternative concepts such as trustworthiness, worthwhileness, and credibility to evaluate the strength of their studies (Vu, 2021). These ideas recognise that qualitative research seeks to offer interpretations that are authentic, transparent, and meaningful rather than universal or replicable.

In contrast to quantitative research which values replication and consistency qualitative research focuses on transparency, depth of insight, and the transferability of findings to other settings. In quantitative studies, validity tends to concern how well the chosen methods measure what they are intended to measure and how closely results align with objective reality.

Qualitative validity, on the other hand, depends on whether the findings are credible, well-supported, and convincingly presented. Because of these differences, qualitative researchers use a range of terms such as credibility, dependability, trustworthiness, transparency, and transferability to capture what validity and reliability mean in their own paradigm. Together, these qualities help ensure that the research genuinely represents participants' perspectives and offers insights that others can relate to and learn from.

This study is grounded in an interpretivist epistemology, and therefore differs from positivist traditions of empirical science, which rely on fixed procedures for establishing reliability and validity. Within interpretivist research, the focus shifts from measurement to understanding meaning. However, Q-methodology occupies a distinctive position between these paradigms. It brings a degree of structure and numerical representation to subjective viewpoints, allowing a form of objectivity in exploring personal perspectives.

Stenner and Stainton-Rogers (2004) describe Q-methodology as "qualiquantology" a blend of qualitative and quantitative processes. The Q-sort captures the participant's subjective view, which is then explored through quantitative factor analysis and qualitative interpretation. This process brings together the strengths of both traditions: the interpretive depth of qualitative research and the analytical precision of quantitative methods.

As Stenner and Stainton-Rogers (2004, p.196) note, Q-methodology "adopts different relationship to validity and reliability, as it makes no claim to be measuring anything". Effectively, it means if measurement is not the goal, it is meaningless to ask whether one is measuring the intended paradigm.

In addition to Q-methodology, this research also draws on semi-structured interviews with advanced teachers and a focus group discussion with TED students. To ensure rigour and integrity across these elements, I used the trustworthiness framework developed by Lincoln and Guba (1985, pp.289–331).

They propose that qualitative research should be evaluated not through traditional measures of validity and reliability but through the lens of trustworthiness, which encompasses credibility, transferability, dependability, and confirmability.

Equally, Brown (1980a, pp.174-175) argues that validity is not central to Q methodology because there is no external benchmark for a person's own viewpoint; the only issue would be whether participants are true in expressing their own perspectives.

Reliability

Silverman (2006, p. 282) defines reliability in quantitative research as "the degree to which an experiment, test, or measurement consistently produces the same result when repeated." Similarly, Chalhoub-Deville (2006, p. 2) describes reliability as the consistency of data, scores, or observations generated through research instruments. In both definitions, reliability is fundamentally concerned with consistency.

However, this apparently straightforward concept raises important questions when applied to qualitative research. What does consistency mean in studies that prioritise interpretation and context over replication and control? Silverman (2006, p. 283) argues that traditional, positivist understandings of reliability are based on the assumption of a stable and predictable reality, in which findings can be exactly reproduced.

This assumption conflicts with interpretivist perspectives, which view reality as complex, fluid, and shaped by context. From this standpoint, human experience cannot be replicated in the same way as experimental results, as it is influenced by multiple, shifting factors. Wolcott (2005) reinforces this view, suggesting that expecting statistical consistency in qualitative research misunderstands the dynamic nature of human behaviour. As a result, qualitative researchers rarely attempt to calculate conventional reliability coefficients.

Instead, emphasis is placed on demonstrating that findings are dependable and grounded in transparent, systematic research processes. Silverman (2006) introduces the concept of "low-inference description", which involves presenting data in a clear, detailed, and descriptive manner so that readers can trace how interpretations and conclusions were reached. This approach reduces the influence of researcher bias and allows readers to form their own judgements about the credibility of the findings. Reflecting this shift, many qualitative researchers prefer the term *dependability* rather than *reliability*, as it aligns more closely with interpretivist principles (Merriam, 2009). Merriam also identifies key strategies for enhancing dependability, including triangulation, peer review, reflexivity, and maintaining an audit trail that documents methodological decisions throughout the research process.

In this study, where qualitative methods are central, careful attention was given to ensuring dependability. Two key strategies were employed: triangulation and low-inference description. Triangulation involves cross-checking findings using multiple data sources or methods to enhance credibility (Burns, 2010; Merriam, 2009). In this research, survey data were analysed alongside semi-structured interviews and relevant literature to validate emerging themes. Low-inference description was achieved by incorporating direct participant quotations within the analysis, ensuring that their meanings were accurately represented and that interpretations remained grounded in the data. Together, these strategies strengthened trust in the study's findings while remaining consistent with interpretivist qualitative inquiry.

To further enhance validity (Noble and Heale, 2019) and to develop a deeper understanding of how artificial intelligence is shaping learning in UK higher education, findings from the semi-structured interviews and survey were systematically compared. These primary data sources were then triangulated with insights from the existing literature through a rigorous thematic analysis, ensuring that conclusions were robust and well supported. The participant demographics reflected wide national representation and considerable diversity, enabling the exploration of digital technology's impact on learning from multiple perspectives.

A sequential mixed-methods design was adopted, incorporating Q-methodology with both participant groups, followed by semi-structured interviews with advanced teachers and a focus group discussion with trainee education (TED) students (Watts and Stenner, 2012). Q-methodology was selected for its emphasis on subjectivity and positionality, allowing participants to express their viewpoints through self-referenced meaning-making (Brown, 1980a). The relatively homogeneous patterns identified in the Q-study

provided rich areas for deeper exploration during the interviews and group discussion (Willig and Stainton-Rogers, 2013). Each Q-sort generated a structured representation of an individual's first-person perspective, enabling the study to capture subjective experience in a systematic and meaningful way. With its origins in psychological research, Q-methodology added a distinctive and valuable dimension to the overall research design (Willig and Stainton-Rogers, 2013, p. 378).

Rather than relying on a single method, the study combined both primary and secondary data to strengthen triangulation. Secondary sources informed the design of the survey and interview instruments, while primary data collected through Q-sorts, surveys, and interviews offered rich empirical insight into the research topic (Timans et al., 2019). This multi-method approach enhanced the study's validity and dependability by providing a more comprehensive perspective than any single method could achieve alone.

A cross-sectional time horizon was adopted, with all primary data collected during a single period. This ensured consistency across participant responses and aligned with the study's aims. The secondary data reviewed focused on the most relevant publications from the past seven years, with particular emphasis on the last four years to reflect the rapid pace of developments in artificial intelligence and its increasing influence on education. Collectively, these methodological choices enabled the collection and analysis of rich and credible data, supporting the achievement of the study's aims and objectives and contributing to well-grounded and trustworthy findings.

3.12 Credibility

The credibility of this research is strengthened by the depth of the researcher's long-term engagement with the FE organisation and by the authenticity of the Q-study concourse. Through several years of professional involvement and continued research activity, the author developed a detailed understanding of the institution's culture, the everyday realities of FE teachers, and their evolving relationship with digital and AI-enabled learning technologies. This sustained engagement enabled the development of a Q-set that was inductively grounded in teachers' voices and their lived perceptions of digital technology within the FE sector.

To further enhance the quality of the Q-set, the researcher worked collaboratively with experienced Q-methodology colleagues. This peer review process helped refine the initial concourse from 60 to 42 statements, ensuring clarity, precision and representativeness. Such external scrutiny provided an additional layer of validation and strengthened the robustness of the instrument.

Q-methodology contributes to credibility by providing a structured yet participant-led means of capturing subjectivity. Each participant constructs a representation of their own viewpoint through the Q-sort, enabling their meanings to emerge independently of researcher influence. This aligns well with the FE digital technology context, where

diverse digital experiences and levels of digital capital shape how teachers position themselves in relation to digital technology.

To deepen and contextualise the interpretation of the Q-sort findings, the study incorporated semi-structured interviews with advanced teachers and a group discussion with TED students. These additional qualitative phases allowed participants to elaborate on the meanings behind their Q-sorts and offered richer insight into their digital teaching habitus and experiences of digital technology in FE. This methodological triangulation enhanced the depth, trustworthiness and confirmability of the findings by drawing on multiple, complementary sources of evidence.

3.13 Transferability

Lincoln and Guba (1985, p.316) argue that for research to be transferable, it must provide a "thick description" a detailed, contextualised account that enables others to judge whether findings can apply in other settings. In line with this, I have presented the research design, process, and interpretation in detail, giving readers a comprehensive understanding of the study's setting and methodology.

The Q-concourse of statements (Appendix 1), distribution grid, and procedural steps have been fully documented to allow replication in similar educational contexts. Lincoln and Guba (1985, p.360) highlight that it is the researcher's responsibility to provide enough contextual information to allow others to make meaningful comparisons. This study therefore offers a transferable model for examining teachers' perceptions of digital learning cultures within further or higher education environments.

This research offers a level of external validity in that its insights can be applied to FE colleges with similar characteristics. Because the data was gathered from two FE colleges in England, the findings should be viewed as transferable to comparable settings rather than statistically representative of the entire UK FE sector.

External validity and reliability are further supported through the use of data triangulation. By combining survey responses with semi-structured interviews, the study draws on more than one source of evidence, helping to build a fuller and more trustworthy picture of the issues explored.

3.14 Dependability and Confirmability

Dependability and confirmability were ensured through the maintenance of a detailed audit trail documenting each stage of the research process. This audit trail includes field notes from observations within the FE environment, survey datasets, transcripts from semi-structured interviews and the TED student group discussion, records of supervisory meetings, and feedback from Annual Progress Reviews (APRs). Collectively, these materials provide a transparent account of how methodological decisions were made, how interpretations developed, and how the analysis evolved over time. This level of documentation strengthens the dependability of the study by demonstrating a consistent

and systematic approach to examining teachers' and students' experiences of digital technology and digital learning in FE colleges.

Reflexive practice also plays a central role in supporting the integrity of the research. Throughout the study, the author engaged in continuous reflection on positionality, particularly in relation to shifting roles as an insider, outsider, or an "alongside" participant within the FE context. These positional shifts have the potential to influence interactions with participants, interpretations of data, and the overall direction of inquiry. By explicitly acknowledging these dynamics, the researcher demonstrates an awareness of how personal and professional positioning may shape knowledge construction.

This transparency not only reinforces the confirmability of the study but also helps ensure that interpretations are grounded in the participants' perspectives rather than the researcher's assumptions. Making reflexivity visible demonstrates a commitment to honesty, openness and professional responsibility—qualities that are especially important when investigating sensitive areas such as teachers' digital confidence, digital technology adoption, and the cultural implications of technological change in FE settings.

3.15 Triangulation

Triangulation enhances validity, reliability, and credibility by combining multiple data sources and methods (Renz, Carrington & Badger, 2018; Noble & Heale, 2019). This research employed methodological triangulation through:

1. Secondary data (exploratory review of literature and policy).

2. Semi-structured interviews with trainers and trainee trainers.

3. Q-methodology survey to capture structured subjectivity.

This triangulation allowed convergence of findings: for instance, themes of ethical concern identified in interviews could be cross-checked against factors emerging from the Q-sort. Likewise, survey-based patterns of optimism about digital technology could be contextualised by qualitative accounts of workload pressures. This multi-layered approach strengthens internal validity (credibility, confirmability) and external validity (transferability across FE settings) (Onwuegbuzie & Johnson, 2006).

3.16 Time Horizon

Due to practical and resource constraints, the study employed a cross-sectional research design (Saunders et al., 2016). Data were collected during a single time period across the two participating FE colleges. While this approach did not allow for the examination of how teachers' and students' perceptions of digital technology evolve over time, it offered a valuable snapshot of attitudes toward AI adoption at a point when the FE sector is experiencing rapid technological change.

Capturing perspectives during this transitional moment is particularly significant, as FE colleges are navigating increasing expectations to integrate digital technology into teaching, assessment and learner support. The cross-sectional design therefore provides insight into how educators and learners are responding to early waves of digital technology implementation, digital transformation initiatives and emerging shifts in vocational pedagogy.

Recognising that attitudes towards digital technology and in particular AI is likely to change as technologies mature and become further embedded within vocational curricula, future research would benefit from adopting a longitudinal approach. Such studies could examine how digital confidence, pedagogical practices, ethical concerns and professional identities evolve as AI becomes a routine feature of FE teaching and learning.

3.17 Data Collection and Analysis

Semi-Structured Interviews

Semi-structured interviews were carried out with trainers and trainee trainers across the two FE colleges. This interview format offered a balance between structure and flexibility, enabling participants to share their lived experiences and perspectives while still ensuring consistency and comparability across interviews (Rowley, 2012). The interview schedule was designed to explore participants' views on AI tools, their pedagogical uses, perceived benefits and risks, ethical considerations, and the institutional supports or barriers influencing digital technology adoption in FE college settings.

The interview data were examined using thematic analysis following the approach outlined by Braun and Clarke (2006). This multi-stage process involved familiarisation with the transcripts, systematic coding of emergent concepts, the development of initial themes, and the iterative refinement of these themes into a coherent and analytically robust thematic structure.

The resulting themes were then compared with those identified in the exploratory literature review, allowing the researcher to identify areas of convergence, divergence and conceptual refinement. This integration of empirical and literature-derived themes strengthened the overall analysis and offered a richer understanding of how digital technology is perceived, experienced and negotiated within FE teaching and learning environments.

3.18 Q-Methodology Survey

The Q-set of statements was developed by drawing systematically on the themes identified in the exploratory literature review and then refined through expert consultation and pilot testing. This ensured that the statements were theoretically grounded, sector-relevant, and reflective of the lived realities of digital technology adoption within FE colleges. Participants were asked to rank these statements along a quasi-normal distribution according to their level of agreement or perceived relevance, encouraging them to make deliberate judgements about the relative importance of different viewpoints. The completed Q-sorts were analysed using factor analysis, employing centroid extraction followed by varimax rotation to identify shared patterns of thinking. This statistical process generated clusters of viewpoints known as factors each representing a distinct perspective on the role of digital technology in FE. These factors effectively capture the diversity of teachers' and trainee teachers' digital teaching habitus and their differing levels of digital capital.

For instance, one factor might centre on the view that digital technology enhances efficiency, supports workload management and strengthens administrative processes within FE colleges. Another factor may express concerns about digital technology implications for safeguarding, digital equity or learner autonomy. By connecting these factor-derived perspectives with insights from the semi-structured interviews and focus group discussions, the analysis provides both breadth through identifying patterns across participants and depth through exploring the nuanced narratives underpinning those patterns. This integrated approach strengthens the interpretation of the Q-method findings and offers a richer understanding of how digital technology is perceived, negotiated and enacted within FE teaching and learning environments.

3.19 Application to the Two FE Colleges

The empirical research was undertaken in two Further Education colleges in the United Kingdom, deliberately selected to reflect contrasting institutional contexts. One was a large metropolitan college with established digital strategies and significant investment in digital technology enabled systems, while the other was a regional provider operating with more limited resources and uneven digital infrastructure. These contrasting environments offered valuable insight into how trainers and trainee trainers perceive and experience digital technology, and how institutional context shapes patterns of adoption, attitudes and levels of digital confidence.

Applying Q methodology within these settings allowed the research to capture not only the diversity of individual viewpoints but also the shared discourses that circulate within FE teaching cultures. The resulting factors represent collective orientations toward digital technology ranging, for example, from safeguarding-focused interpretations to efficiency-driven narratives. When interpreted through a Communities of Practice (CoP) lens, these

factors reveal how diverse subjectivities contribute to collective professional learning within FE.

In practice, differing perspectives such as concerns about learner independence or safeguarding contrasted with enthusiasm for automation and workload reduction may appear to be in tension. However, within a CoP framework, such tensions can be negotiated and transformed into practical, context-sensitive professional guidance (Jisc, 2023).

This interpretation underscores how FE college teachers make sense of digital technology not only as individuals but as members of evolving professional communities responding collectively to digital change.

3.20 Research Design & methodological rationale in the FE digital technology context

Understanding Research Design in social and educational research

Research design provides the framework through which a study is structured, guiding the collection and analysis of data in ways that align with the research questions and underlying philosophical assumptions (Flick, 2022; Baran, 2022). It encompasses the strategies and procedures employed by researchers to generate credible and meaningful insights (Creswell & Creswell, 2003; Melnikovas, 2019; Mouton & Marais, 1990). Johnson and Christensen (2004) categorise research design into three broad types: qualitative, quantitative and mixed-methods.

Qualitative research seeks to understand context, experience and meaning, emphasising participants' perspectives and the significance of social environments (Berman et al., 2000). In contrast, quantitative research involves the collection and analysis of numerical data to test hypotheses and examine relationships (Gay et al., 2006). Mixed-methods research integrates the strengths of both approaches to generate a more comprehensive understanding of complex phenomena (Johnson & Christensen, 2004).

Given the rapidly evolving nature of digital technology such as artificial intelligence (AI) technology in Further Education (FE), the research design for this study needed to capture both the measurable dimensions of digital technology adoption and the subjective experiences of trainers and trainee trainers navigating digital transformation. This required a methodological approach capable of recognising the nuanced issues, concerns and cultural influences shaping staff attitudes toward digital technology.

A robust research design therefore must be shaped from the outset by a clearly articulated research paradigm (Makombe, 2017). Such paradigms defined by Kuhn (1970, p.180) as shared belief systems that guide what is studied and how research is conducted inform decisions about ontology, epistemology, methodology and methods (Creswell, 2014).

3.21 Rationale for Focusing on FE Trainers' Experiences with digital technology such as AI

The study was driven by a clear need to understand the perspectives of trainers, assessors and trainee educators within the UK FE and skills sector regarding AI adoption in teaching, learning and assessment. AI is increasingly recognised as a transformative force that enhances efficiency, supports decision-making and drives innovation across multiple industries, including education. FE colleges that leverage AI effectively stand to gain a competitive advantage in preparing learners for future employment.

Sector-wide evidence underlines this urgency. A 2024 survey by Section found that 64% of employees in the US, UK and Canada were "AI shadow users" using AI tools without Organisational oversight highlighting the speed and informality of AI adoption in workplaces. For FE colleges, this underscores the importance of equipping staff and learners with both technological and human skills required for effective human-machine collaboration.

In a context characterised by outdated curricula, shifting labour market demands, cost-of-living pressures and increasing youth unemployment, FE colleges are under growing pressure to remain agile and forward-looking. Understanding how staff perceive AI and how these perceptions influence professional practice is essential to shaping a sector capable of meeting future workforce needs.

3.22 Justification for a Mixed-Methods Design Grounded in Q Methodology

To address the research questions effectively, a mixed-methods approach was adopted, combining Q methodology with semi-structured interviews and a group discussion. This design acknowledges that neither qualitative nor quantitative methods alone could fully capture the complexity of digital technology adoption in FE settings.

Q methodology was particularly suited to this study because:

- It explores subjectivity, revealing how individuals make sense of digital and AI enabled teaching.
- It identifies clusters of shared viewpoints, allowing comparison of perspectives across trainers and trainee trainers.
- It blends qualitative depth with quantitative structure earning the description "qualiquantological" (Stenner & Stainton Rogers, 2004).

Participants sort statements according to personal significance, enabling the researcher to uncover underlying beliefs, values, attitudes and concerns without imposing predefined categories. Q methodology does not seek to measure how many people hold a particular view but instead to map the range of viewpoints that exist (Stone, 2015).

Robbins and Krueger (2000) argue that Q methodology encourages more democratic research practices by allowing participants to articulate what they consider meaningful.

This is especially relevant in FE, where educators' professional identities and digital practices are shaped by institutional histories, cultures and levels of digital capital.

3.23 Integrating Qualitative Inquiry for Depth and Context

While Q methodology provided structured insight into patterns of subjectivity, qualitative interviews and the trainee trainer group discussion offered deeper, contextualised understanding. Interviews defined by Cohen et al. (2000) as purposeful conversations that produce socially situated knowledge were essential for illuminating participants' experiences, emotions, digital confidence and perceived professional challenges associated with AI integration.

Using a mixed-methods approach therefore enabled the study to:

- move beyond the limitations of a single method (Creswell, 2014);
- explore both collective discourses and individual narratives;
- generate nuanced, practice-relevant insights into digital and AI-related change in FE.

3.24 Researcher Positionality and Interpretive Considerations

The researcher's long-standing engagement with the FE and skills sector shaped both the design and interpretation of the study. FE cultures are deeply influenced by practitioners' histories, organisational practices and sector-wide reforms (Gadamer, 1975; Bourdieu, 1998). Lincoln and Guba (1985) emphasise that individuals perceive reality differently, even when sharing similar environments. This aligns with the subjective and socially constructed nature of digital technology adoption in FE.

Throughout the philosophical reflection process, the researcher critically considered their position within an interpretivist paradigm. Bryman's (2016, p.30) argument that constructivism views social reality as continuously shaped by participants resonated strongly with the FE context, where digital technology continues to reshape teaching roles, learner expectations and pedagogical relationships.

Savin-Baden and Tombs (2017) further emphasise that knowledge is rooted in lived experience. This study therefore centred on engaging directly with trainers and trainee trainers to understand how digital technology such as AI influences their everyday practices, professional identities and perceptions of change.

3.25 Sequential Mixed-Methods Design in Practice

The study followed a two-stage design:

1. Q methodology to identify and map trainers' and trainee trainers' subjective viewpoints about digital technology in FE.
2. Post-Q interviews and group discussion to explore the reasoning, lived experience and contextual factors behind these viewpoints.

This sequential approach aligns with Teddlie and Tashakkori's (2009) recommendation for mixed-methods studies that develop richer insights by allowing one method to inform the next. Q methodology centers on operant subjectivity, which links individuals' viewpoints with their behaviours in context (Watts, 2011). Brown (1996) notes that Q methodology is uniquely positioned to explore subjective perspectives while maintaining analytical rigour.

This research design recognises that digital technology adoption in FE is a complex, multi-layered phenomenon shaped by individual beliefs, institutional cultures, digital infrastructures and broader socio-economic pressures. By employing a mixed-methods approach grounded in Q methodology, the study captures both the range of viewpoints present among FE educators and the deeper meanings underpinning these perspectives.

The integrated design spanning philosophical orientation, methodological rationale and practical data collection ensures that the study generates rich, credible and contextually grounded insights into how digital technology is perceived and enacted within the UK FE sector.

3.26 Q-Methodology Origins, Principles and relevance to FE/ digital technology study

Q methodology is a research technique widely used in the social sciences to investigate individuals' personal viewpoints, beliefs and subjective experiences. Developed in the 1930s by psychologist William Stephenson, it blends qualitative sensitivity with quantitative rigour to illuminate the structure of human subjectivity. Its strength lies in its ability to reveal shared viewpoints while also uncovering the nuances, contradictions and subtle variations that characterise complex attitudes. The method is particularly valuable in contexts such as Further Education (FE), where educators' experiences with AI and digital technologies are shaped by diverse professional roles, digital confidence levels, institutional cultures and personal histories. Q methodology's ability to capture both divergence and commonality in perception makes it especially suited to exploring how FE trainers and trainee trainers interpret the integration of digital technology into teaching, learning and assessment.

3.27 Strengths and Limitations of Q Methodology

A major advantage of Q methodology is its capacity to combine the depth of qualitative insight with the precision of quantitative evaluation. It enables researchers to map shared perspectives in a systematic and replicable manner, while still attending to the subjective richness of participant viewpoints. This inclusivity is particularly important when exploring digital change in FE, where multiple and sometimes conflicting interpretations coexist among staff. However, Q studies can be time-consuming, requiring careful development of statements, structured sorting procedures and detailed factor interpretation. Despite this, the method provides a uniquely rigorous approach for examining meaning-making processes in environments characterised by rapid technological change, such as digital technology implementation in FE settings.

3.28 Key Stages in the Q Methodological Process

The Q methodology procedure consists of four main stages:

1. **Statement Generation**
   A concourse of statements is generated to capture the breadth of opinions surrounding a specific topic in this case, digital technology adoption in FE. The concourse draws from literature, policy documents, sector reports and authentic practitioner voices. These statements reflect concerns such as safeguarding, workload efficiency, digital confidence, learner autonomy and ethical risks.

2. **Q-Sorting**
   Participants, trainers, assessors and trainee trainers rank the statements along a forced, quasi-normal distribution according to their levels of agreement or relevance. This sorting process requires participants to make meaningful judgements, allowing their distinctive interpretations of digital technology in FE to surface.

3. **Data Analysis**
   Completed Q-sorts are subjected to factor analysis, typically using centroid extraction followed by varimax rotation. These statistical procedures identify clusters of participants who share similar viewpoints known as factors. Each factor represents a coherent perspective on digital technology in FE, capturing how groups of educators do construct meaning around digital transformation.

4. **Interpretation**
   The resulting factors are interpreted to explain the distinct viewpoints they represent. For example, one factor may highlight digital technology such as AI technology as a tool for workload efficiency and administrative support, while another may emphasise safeguarding, digital equity or risks to learner independence. These interpretations offer deep insight into how digital technology is conceptualised within FE teaching cultures.

3.29 Historical Context and Philosophical Foundations

Q methodology emerged from Stephenson's critique of the dominant R-method factor analysis championed by Cyril Burt. While Burt argued that correlating traits across people was sufficient for understanding human behaviour, Stephenson maintained that such approaches obscured the inherent subjectivity of individual experience. Stephenson contended that Q methodology foregrounded this subjectivity by placing communication, perception and self-expression at the heart of the research process (McKeown & Thomas, 2013).

Stephenson argued that objectivity in behavioural research was often arbitrary (Brown, 1980b). The focus was instead on operant subjectivity how individuals enact and communicate their viewpoints in context (Watts, 2011).

This principle aligns closely with FE settings, where staff interpret AI not only through institutional directives but through their own professional identities, workload pressures and ethical concerns. While Q methodology faced early criticism from scholars aligned with positivist traditions, later researchers including Schwartz (1978) demonstrated the method's validity for capturing lived experience. Ramlo and Newman (2011) argue that Stephenson's approach anticipated contemporary trends in mixed-methods research and constructivist inquiry long before they became mainstream.

3.30 Subjectivity, Researcher Positionality and Interpretation

Q methodology is grounded in the philosophical idea that people experience and interpret the world differently, shaped by their unique experiences, values, and backgrounds. This perspective resonates with the principle that "the map is not the territory" (Dilts & DeLozier, 2000), meaning that human understanding is always a filtered, interpretive process rather than a direct reflection of reality. Jankowicz (2005) refers to this as *phenomenal flow*, suggesting that both researchers and participants selectively attend to certain aspects of reality based on their own viewpoints.

As a result, researchers must remain critically aware of their own interpretive lenses. Reflecting on personal perspectives, potential biases, and positionality is particularly important in studies examining digital transformation, where individual experience with technology can strongly influence how meaning is constructed. In the context of Further Education (FE), this awareness is crucial: staff perceptions of digital technologies are shaped by vocational backgrounds, organisational culture, professional expectations, and digital competency. Bryman (2001) contrasts positivism—which treats institutions and social structures as fixed, governed by objective rules—with constructionism, which views social reality as continuously created and recreated through human interaction. This study adopts the constructionist stance, recognising that FE educators actively construct their own understandings of digital technology, informed by their lived experiences, professional identities, and the contextual pressures within their institutions.

3.31 Relevance of Q Methodology to FE and AI Research

Q methodology is uniquely suited to examining the experiences of FE trainers and trainee trainers navigating digital technology enabled environments because:

- It captures the diversity of attitudes from enthusiasm for efficiency gains to concerns about ethics, safeguarding or learner independence.
- It reveals shared discourses that circulate within FE teaching cultures.
- It accommodates contradictory viewpoints, which are common in times of technological disruption.
- It empowers participants, enabling them to articulate their perspectives without researcher-imposed categories.
- It maps how different groups within FE make sense of digital technology, providing practical insight for leadership, CPD planning and digital strategy.

The method allows the researcher to explore how educators perceive shifts in their responsibilities, identities and workloads as digital technology becomes embedded in FE teaching, learning and assessment practices.

3.32 Research Methodology and Research Instrument

3.32.1 Methodological Orientation and Underpinning Assumptions

The methodological approach for this study is rooted in the understanding that individuals interpret the world differently, influenced by their backgrounds, experiences, and professional contexts. This perspective aligns with the idea that "the map is not the territory" (Dilts & DeLozier, 2000), which suggests that people's mental representations of reality are inherently subjective, filtered through personal meaning-making. Jankowicz (2005) describes this interpretive process as *phenomenal flow*, emphasising that researchers, like participants, attend to aspects of reality according to their own standpoint, values, and theoretical assumptions.

With this in mind, the researcher maintained a continuous focus on reflexivity and potential bias throughout the study. Such reflexive awareness is particularly important when investigating perceptions of digital technology in FE settings, where staff beliefs, prior experiences, and professional identities strongly influence how technological change is understood and enacted. This requires careful reflection on whether the study is guided by existing expertise, professional strengths, or a genuine inquiry into unfamiliar perspectives. Bryman's (2001) distinction between positivism and constructionism provides a useful conceptual lens. Positivism treats organisational structures and social systems as fixed, objective entities governed by established rules. In contrast, social constructionism emphasises that social forms, including organisational cultures, are continuously produced and reshaped through human interaction.

This dynamic is especially evident in FE colleges, where institutional practices around AI evolve through the actions, beliefs, and interpretations of educators, leaders, and learners, rather than being dictated by predefined frameworks. Similar patterns can be observed in corporate settings, such as Microsoft or Apple, where empowered communities shape organisational identity a parallel that resonates with professional cultures in FE.

3.33 Managing Data and Ensuring Rigour

Collecting and analysing data in an interpretive, mixed-methods context presents practical challenges, particularly when differentiating between the stages of data creation, handling and analysis (Miles & Huberman, 1994). Guest et al. (2005) emphasise that systematic organisation of data is central to research integrity, as it strongly influences the quality of the analytical process. In this study, digital tools and specialised software were used to organise and analyse Q-sort data, identify patterns of similarity across participants and support rigorous factor comparison. This ensured a structured and transparent approach to analysing educators' subjective viewpoints about AI in FE colleges.

3.34 Overview of the Q Methodology Process

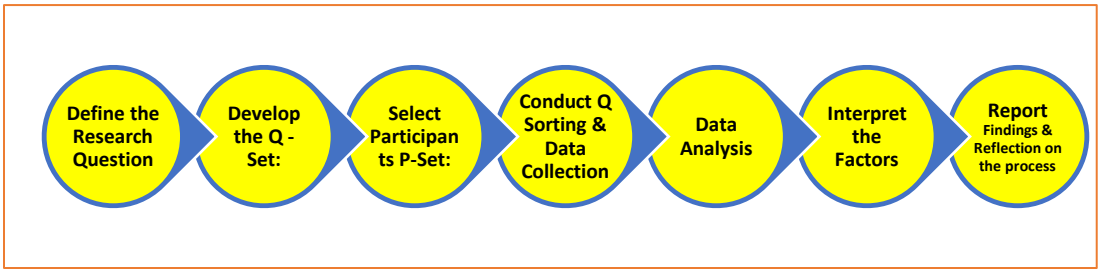
Q methodology was chosen as the central research instrument because of its suitability for exploring complex and contested topics such as digital technology adoption in FE teaching and learning. The method offers a structured system for eliciting subjectivity while retaining methodological transparency and analytical precision.

The Q methodological process used in this study unfolded across the following stages:

1. **Defining the Research Questions:** Clear research questions were established to explore educators' perspectives on digital technology in FE, grounding the study in specific, relevant and empirical concerns.
2. **Developing the Q-Set:**
    - Statement Generation: Statements were gathered from literature, policy documents, practitioner interviews and sector discussions to reflect the full spectrum of views on digital technology in FE.
    - Refinement: Statements were reviewed for clarity, relevance and representativeness, ensuring the concourse captured multiple perspectives on digital teaching, workload, safeguarding, learner independence and ethical concerns.
3. **Selecting Participants (P-Set):** A diverse sample of trainers, assessors and trainee trainers was recruited to represent variations in digital confidence, teaching experience and occupational backgrounds across FE settings.
4. **Q-Sorting and Data Collection**: Participants were asked to sort 42 statements into a quasi-normal forced distribution ranging from "most agree" to "most

disagree." This ranking process encouraged deliberate reflection and captured the subjective salience of each statement. All Q-sorts were collected and documented systematically.

5. **Data Analysis**: Factor analysis using centroid extraction and varimax rotationwas used to identify shared patterns of meaning across participants. These factors represent clusters of educators who view digital technology in FE through similar interpretive lenses.
6. **Interpretation of Factors**: Each factor was interpreted by examining distinguishing statements, demographic patterns and contextual insights. This allowed the researcher to identify coherent, contrasting and sometimes contradictory viewpoints on digital technology adoption in FE.
7. **Reporting and reflecting**: Findings were presented clearly, highlighting distinct perspectives, shared discourses and implications for FE policy and practice. Reflective commentary addressed methodological effectiveness, statement quality, participant engagement and limitations, guiding future Q methodological studies.



The phases above are illustrated in **Figure 1: Q Methodology Step-by-Step Process.*

3.35 Integration of Q-Sorts with Qualitative Inquiry

Following the Q-sort exercise, qualitative data were collected through semi-structured interviews with trainers and assessors and a group discussion with trainee trainers. This mixed approach provided:

- Analytical breadth through Q factor analysis; and
- Contextual depth through qualitative narratives.

The integration of both strands allowed the researcher to explore not only how participants ranked statements but why revealing deeper insights into digital confidence, pedagogical values, ethical concerns and professional identity. As Simons (2009) notes, onsite and participatory forms of qualitative inquiry support richer understanding by grounding interpretations in authentic interaction.

3.36 Alignment with Research Aims

The research questions guiding this study were rooted in the earlier literature review and shaped by the researcher's professional experience across the UK and international FE and skills sectors. The methodology centered on Q-sorting followed by interviews was selected to explore how digital technologies, particularly digital technology, are reshaping technical and vocational education and how FE institutions adapt to these technological shifts.

The combination of Q methodology and qualitative inquiry illuminates both the diversity of educators' perceptions and the contextual factors driving these interpretations, offering a comprehensive lens for understanding AI's influence on FE teaching and learning.

3.37 Research Setting and Participating Cohort

The UK Further Education (FE) sector is extensive and diverse, comprising 262 colleges as of September 2024: 219 in England, 24 in Scotland, 13 in Wales, and 6 in Northern Ireland. Given this scale, it was neither practical nor methodologically appropriate to involve the entire population. Instead, this study focused on a purposeful sample of two FE colleges that agreed to participate, chosen to provide contrasting contexts and thereby offer rich insights into how digital technology is experienced and interpreted by trainers and trainee trainers.

A total of eight trainers four from each college were recruited. They represented a range of curriculum areas but were neither specialists in computer science or digital technologies nor ILT (Information Learning Technology) champions. This deliberate exclusion helped avoid bias from prior expertise or strong advocacy for AI tools, ensuring the research captured everyday pedagogical realities rather than the perspectives of technologically advanced outliers.

A second cohort of eight trainee trainers was recruited from a college offering initial teacher-education programmes. Four of these participants were external to the institution and were identified using an "Ex" code to preserve confidentiality. Their early-career status provided valuable insights into how newcomers to the FE sector perceive digital technology at a time when AI and other digital tools are rapidly reshaping teaching practices.

All participants completed the Q-sort activity and took part in interviews or group discussions. Before data collection, detailed information sheets were provided to both participants and senior management at each college, outlining the study's aims, objectives, and ethical safeguards. Throughout the study, confidentiality and anonymity were rigorously maintained.

Reflexive consideration of the researcher's positionality was central to the process, drawing on the idea that self-reflection forms a critical part of analysis (Lynch, 2000 in Bryman, 2016). This reflexivity enabled an open and critical interpretation of

participants' diverse perspectives, ensuring that multiple viewpoints on digital technology in FE could be explored without bias.

The sampling approach aligns with Cohen et al. (2000), who argue that participant selection should be guided by relevance to the research questions rather than representativeness alone. Brown (1980a, p.194) similarly recommends choosing participants whose perspectives are likely to contribute meaningfully to the phenomenon under investigation. In this study, the intentional inclusion of both trainers and trainee trainers provided a balanced comparison, capturing how digital technology is understood across different stages of the FE teaching profession.

3.38 Developing the Q-Set Statements

Developing the Q-set is a key part of Q methodology, involving the careful creation of statements that reflect the full spectrum of opinions relevant to the research topic. For this study, the Q-set was based on the perspectives of FE educators, capturing the variety of views identified through interviews, preliminary discussions, and sector literature. The broader collection of potential statements, known as the concourse, was drawn from interviews, focus groups, policy documents, and research publications. From this concourse, 42 statements were selected for the final Q-set. While Q-sets can range from 20 to over 250 statements, this number was chosen to provide enough depth for meaningful analysis while remaining manageable for participants.

A pilot activity with 80 trainers across both colleges helped refine the statements. This step ensured that the language used was familiar to practitioners and that the final statements reflected authentic concerns in FE teaching, such as workload, safeguarding, digital literacy, professional identity, and ethical issues related to digital technologies, including AI.

Statements were written in the first person (e.g., "I believe that Artificial Intelligence offers opportunities for both trainees and trainers") to make them relatable and personally engaging—a design principle highlighted by Brown (1980). Crafting the statements required balancing scientific rigor with creative judgment, aiming not only for representativeness but also for recognisability, so participants could see their own experiences reflected in the Q-set. As Watts and Stenner (2012) stress, a well-structured and balanced Q-set is essential for a valid Q methodology study.

In this research, the final set of 42 statements (Appendix 1) was carefully designed to capture the complexity of FE educators' views on digital technology while maintaining clarity, neutrality, and focus.

3.39 Selection of the Participant Set (P-Set)

In Q methodology, the P-set refers to the group of individuals who complete the Q-sort. Unlike quantitative sampling, Q methodology does not aim for statistical representativeness; rather, it seeks to include participants who bring diverse and informed perspectives relevant to the topic (Brown, 1980a). The goal is to capture the range of viewpoints, not the frequency of their occurrence.

Two cohorts were therefore selected:

1. **FE Trainers**

- Eight trainers (four per college) were included.
- Participants represented mixed genders and curriculum backgrounds.
- None were ILT champions or digital learning leads, to reduce bias associated with strong pro-technology views.
- Participants were experienced in teaching and assessment practices but not in digital technology specific roles.

2. **Trainee Trainers**

- Eight trainee trainers participated, including four external participants who were coded "Ex" for anonymity.
- Their early-career status provided insight into the expectations and digital confidence of new entrants to the FE sector.
- This group was expected to offer perspectives shaped by more contemporary exposure to digital technologies.

When designing the P-set for this research, two groups of participants were cjosen, a group of advanced teachers and a group of teacher education students – see table 1.Both groups completed the same Q-set to allow comparison across experience levels and career stages. This decision strengthened the reliability of the findings by enabling patterns to emerge horizontally (across participants) and vertically (between cohorts). All participants engaged in the Q-sort activity and subsequent interviews or group discussions. Their viewpoints were essential for understanding how digital technology is framed, accepted, questioned or resisted within FE teaching cultures.

No.	Type of Participant	Type of Provision Taught	Gender
5	Trainer	LR	Female
1	Trainer	ER	Female
2	Trainer	LR	Male
4	Trainee trainer	LR	Female
4	Trainee trainer	LR	Male

**Table 1: Research Participants Demographic information*

LR: Learner Responsive - Classroom Training

ER: Employer Responsive – Work – Based Training

Each participant's identity is coded for anonymity and confidentiality – see table 2.

AT = Trainer	M/F = Male or Female	LR/ER = Type of Training	1 – 8 = Sort number
TTE = Trainee trainer	M/F = Male or Female	EX- External Trainee	1 – 8 = Sort number

**Table 2: Codes used for the trainers and trainer education student participants.*

Example identification code for the Trainer:

MATLR1 = Male, Trainer, learner responsive provision, Q-sort number 1

Example identification code for the trainee trainers:

FTEDEx3 = female, Trainee trainer, external student, Q-sort number 3

3.4 Q Sorting & Data Collection

Q methodology typically involves collecting data through face-to-face interactions, although alternative methods, such as postal or online approaches, can also be used depending on the context. During this stage, participants are asked to rank a set of statements, known as the Q-set, on a designated grid called a Q grid. The grid follows a predetermined distribution pattern, often resembling a pyramid or quasi-normal curve (see Figure 2), where participants arrange statements from "strongly agree" to "strongly disagree." Once all participants have completed their sorting, the researcher collects and carefully organizes the results to allow for systematic analysis. The Q grid uses a rating scale that generally ranges from +4 (most important) to -4 (least important), though the grid can be adapted in size to accommodate a smaller or larger number of statements. The layout of the grid can be either horizontal or vertical, depending on the preference of the researcher and the practical considerations of the study.

The data collection process, known as the Q sort, begins by introducing participants to the research context and objectives, ensuring they understand the purpose of the study. Participants are then provided with the Q-set and instructions to "prioritize the statements from most to least important." In practice, participants usually start by broadly categorizing the statements into three groups: high priority, low priority, and neutral. They then place the statements onto the Q grid, arranging them relative to one another based on their perceived importance. This ranking process encourages participants to reflect on their own beliefs and experiences, making the data rich in personal perspective.

After completing the Q sort, participants typically take part in a short follow-up interview. This allows the researcher to explore the reasoning behind their choices and gain a deeper understanding of the thought processes influencing how the statements were ranked. The entire procedure is carried out in line with methodological guidelines recommended by Watts and Stenner (2012) and Willing and Stainton Rogers (2013, p.219), ensuring rigor and consistency.

In this study, two groups of participants trainers and trainee trainers took part. Each received a Q grid and the Q-set of statements and was asked to categorize and rank their agreement with each statement, placing items into groups reflecting agreement, neutrality, or disagreement. This process required participants to carefully consider the relative importance of each statement, providing nuanced insight into their perspectives on the topic.

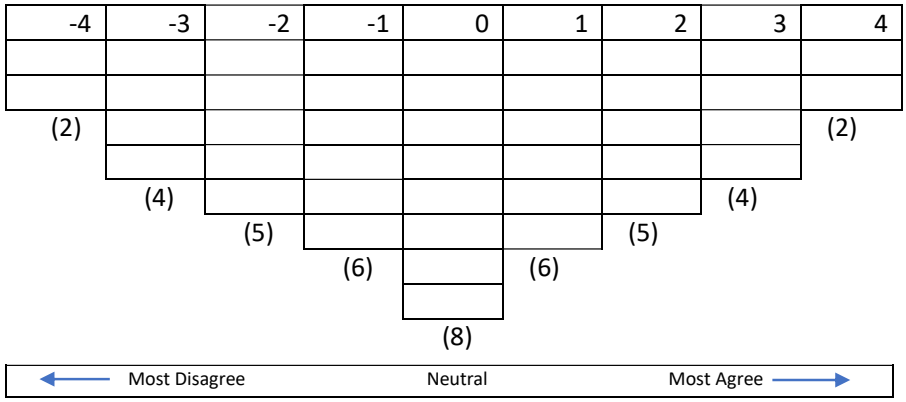


**Figure 2: item quasi-normal distribution grid with 42 ranking positions, 34 forced agree or disagree and 8 neutral places.*

Stephenson (1939) as cited in Willig and Stainton Rogers (2013) highlights how a wide range of items can be grouped together uniformly based on an individual's perspective which allows for a categorization of diverse items concerning that individual. Willig and Stainton Rogers (2013) in their study (p 218) discuss how standardized Q sorts, from participants allow for comparison across individuals in research settings such as Q methodology studies. To aid participants in sorting during data collection sessions in these studies clear and concise instructions were given. An element of Q methodology protocols. Participants were instructed to categorize cards into three piles according to their agreement levels.

One pile for agreed statements another for disagreed statements and a third pile, for judgments. After arranging them initially, participants were then asked to revisit and arrange the statements, on a grid based on distribution (McKeown and Thomas 2013).

The query presented was simple; " How do you feel about your role in a digital education environment?" To avoid any confusion, a prewritten script was employed for guidance (See Appendix 2). Watts and Stenner (2012, p. 56) suggest that these guidelines should be recorded and displayed during sorting to ensure response consistency. At the start of the distribution grid was where I placed the question, for quick access reference purposes.

Participants had the freedom to take their time without any restrictions; typically taking around 50 minutes to finish the task. After finishing up their sorting process, for each participant was when their Q sort was documented on the distribution grid to capture a record of their answers.

3.41 Factor Analysis & Interpretation

Once the Q sort is completed and finalized a person, by person factor analysis is carried out to pinpoint groups of participants who have organized their Q sorts in a manner unveiling perspectives. This examination is usually done using no cost software like Ken Q and PQ Method. Methods such as principal component analysis or centroid factor analysis are utilized. The outcome is a series of factors each depicted by a combined Q sort that shows how a person in tune, with that factor would organize their statements. Everyone's connection, to these elements is measured through a 'factor loading,' which's a correlation coefficient that ranges from -1 to +1, where values closer to 1 indicate greater similarity.

3.42 Factor Descriptions

For each factor identified in the analysis, a detailed narrative was developed to capture the perspectives of participants most strongly associated with that factor. These narratives were enriched with direct quotes from post-Q sort interviews, providing context and helping to explain the reasoning behind participants' rankings. This approach allows the results to reflect both the quantitative patterns in the data and the qualitative insights from participants' experiences. Factor analysis often produces statistically valid solutions, which are evaluated using **eigenvalues** and **explained Kavariance** to understand the shared characteristics of each factor across participants.

Researchers also consider participants' remarks about how they ranked statements, paying particular attention to items placed differently across factors especially those with a significance level of $p < 0.01$ in the composite Q sorts. Combining statistical assessment with participants' qualitative feedback ensures that the factors accurately represent meaningful patterns in perspectives. This study primarily relied on factor analysis to detect trends in the ranking data and uncover shared viewpoints among participants. The analysis highlights commonalities in how participants grouped statements and interprets each factor in connection to the statements and the broader research context. By examining the Q sorts of both groups' trainers and trainee trainers the study identifies trends, similarities, and subtle differences in viewpoints across the sample.

Specialised software designed for Q methodology, such as PQMethod, was used to facilitate the analysis. This software allows Q sorts to be entered directly without

alteration, calculates correlations between individual Q sorts, and applies factor analysis using the **Centroid method** (Brown, 1980a). It systematically compares participants' rankings and simplifies the handling of complex data.

Through this method, four centroids (factors) were extracted. Centroid analysis in Q methodology identifies patterns in participants' perspectives by calculating an average or "centroid" for each factor, representing the shared viewpoint of participants strongly aligned with that factor. This process helps to reveal both common themes and subtle distinctions in how statements were prioritized.

Eigenvalues are closely linked to factor analysis in Q methodology, measuring the extent of variance explained by each factor. Factors with higher eigenvalues are considered more significant in representing participants' perspectives, and those with eigenvalues above 1 are generally retained for further analysis. **Explained Kavariance** complements eigenvalues by indicating how much of the total shared variance is captured by each factor, providing additional insight into the strength and coherence of the factor.

The centroid factors then show how participants aligned with each factor rated the statements, reflecting the shared viewpoint of that group. Comparing eigenvalues and explained Kavariance allows researchers to assess which factors represent the most prominent and coherent perspectives among participants. A higher eigenvalue, combined with strong Kavariance, indicates that the centroid reliably reflects a shared viewpoint, guiding the interpretation of the data.

In this study, three factors were identified with eigenvalues exceeding 1, each corresponding to a distinct cluster of participants with similar perspectives. While numerical measures provide useful benchmarks, Brown (1980a, p. 40) cautions against relying solely on them, noting that qualitative considerations and differences in participant weighting can influence interpretation. By combining statistical metrics like eigenvalues and explained Kavariance with participants' qualitative feedback, the study ensures that the richness and diversity of perspectives are accurately represented.

3.43 Interviews and Group Discussions

The primary purpose of conducting interviews in this study was to explore, clarify, and deepen understanding of the themes and patterns that emerged from the initial questionnaire responses. Following the analysis of questionnaire data, a semi-structured interview guide was developed to maintain consistency across interviews while also allowing participants the flexibility to express their experiences, perspectives, and insights in depth. This dual approach ensured that the research could capture both consistent comparative data and the richness of participants' individual viewpoints. Semi-structured interviews are particularly useful in research of this nature, as they allow for guided exploration of key topics while also providing space for participants to introduce new ideas or elaborate on issues that the researcher may not have anticipated (Johnson & Onwuegbuzie, 2004).

Within Q methodology, interviews and group discussions serve as a critical phase of the research process. They provide an opportunity for participants and researchers to explore individual perspectives on the research topic more thoroughly, enabling the capture of nuanced and detailed insights into participants' beliefs, experiences, and attitudes. By engaging directly with participants, researchers can gain a deeper understanding of the motivations and reasoning behind the ways in which statements are ranked in the Q-sort exercise. The insights generated during these interviews contribute to the creation of Q statements that are authentic, representative, and reflective of the diversity of perspectives within the participant group.

Group discussions play an equally important role in this phase of research. Unlike individual interviews, which allow for focused exploration of personal experiences, group discussions foster dynamic interaction among participants. These discussions encourage dialogue, debate, and the exchange of ideas, allowing participants to respond to, expand upon, or challenge one another's viewpoints. The resulting interactions often reveal perspectives that might not emerge in one-on-one interviews, providing a richer, more comprehensive understanding of the topic under investigation. By allowing participants to reflect on and build upon each other's contributions, group discussions facilitate the development of a wider range of viewpoints, ultimately enhancing the diversity and quality of the Q statements generated.

After the initial collection of statements through interviews and group discussions, the researcher refined the Q-set by selecting statements that resonated most strongly with participants. This process ensured that the Q-set captured a broad spectrum of perspectives while remaining manageable for participants during the Q-sort process. Both interviews and group discussions provided essential context for these statements, offering background information that helped to situate participants' viewpoints within their lived experiences and professional practice. By exploring the reasons behind participants' rankings and opinions, qualitative data complements the quantitative outputs of the Q-sort, contributing to a more nuanced interpretation of results.

The insights gained from interviews and group conversations were also instrumental in shaping the selection of participants for the Q-sorting phase, referred to as the "P set." Understanding which individuals held particular viewpoints helped to inform sampling strategies, ensuring that the participant group included a representative range of perspectives. Following the completion of Q sorts, post-sort interviews or discussions were conducted to validate the findings, clarify any ambiguities, and confirm that the results accurately reflected participants' perspectives. This iterative process, combining qualitative and quantitative methods, strengthens the credibility and depth of the analysis.

After the initial analysis of participants' Q sorts, additional qualitative activities were conducted to enrich the findings and provide further insight into emerging themes. These activities included formal interviews with instructors from both institutions and a group discussion with trainee trainers. Organizing a group discussion allowed participants from

both colleges to engage collaboratively, fostering a shared understanding and ensuring that the perspectives represented were comprehensive and balanced. This approach helped to capture both individual and collective viewpoints, providing a holistic picture of participants' experiences and attitudes.

During the interviews, questions were tailored to each participant based on their Q-sort results. This approach ensured that the discussion addressed relevant themes and allowed for deeper exploration of specific topics. The group discussion with trainee trainers was similarly structured, aligning with insights derived from the Q-sort analysis. These discussions proved particularly valuable in clarifying uncertainties, addressing ambiguities, and exploring themes that were highlighted by the initial Q-sort results. Brown (1980a, p. 200) emphasizes that Q sorts can act as a catalyst for discussion, enabling researchers to explore participants' emotions, reasoning, and perspectives in greater depth. Likewise, Watts and Stenner (2012, p. 82) note that post-Q-sort interviews offer significant opportunities to gain a richer understanding of the research topic and validate the findings obtained from Q sorting.

The results of the initial Q sorts were entered into an Excel worksheet (refer to Appendix 3) to provide a clear overview of how participants ranked each statement. The worksheet was color-coded to visually highlight patterns, allowing the researcher to identify areas of strong agreement, disagreement, or neutrality. Insights from the semi-structured interviews were then incorporated into the analysis (refer to Appendix 4), grouping responses to provide context and support for the interpretation of the Q-sort data.

This visual and structured approach enabled the researcher to identify relationships between participants' rankings and the qualitative insights gathered through interviews and discussions. From the selected group of advanced trainers, five participants agreed to take part in individual interviews: FATLR2, FATLR4, FATLR5, FATLR6, and FATER8. According to Savin-Baden and Tombs (2017, p. 160), semi-structured interviews involve asking predetermined questions while allowing researchers the flexibility to explore participants' responses in more depth as needed. This approach is particularly effective in contemporary research, where balancing structure with adaptability is critical to capturing meaningful insights.

All interviews and group discussions were audio-recorded with participants' consent, ensuring that the data was captured accurately and could be securely stored for research purposes. One-on-one interviews with trainers focused on themes central to the research, including changes in teaching methods, training techniques, trainer-trainee dynamics, and digital proficiency (refer to Appendix 4). The discussions also addressed significant topics such as the digital gap, allowing participants to reflect on the Q-sort results and the themes emerging from their rankings.

These interviews provided a space for participants to consider and articulate the reasoning behind their choices, offering insights that extended beyond the numerical data obtained from the Q sorts.Due to scheduling conflicts and time constraints, one-on-one

interviews with trainee trainers were not feasible. Instead, a structured group discussion was conducted, guided by targeted questions.

This format allowed the researcher to explore key themes such as social media's impact, participants' exposure to digital technology, and the potential consequences for training sessions, assessments, and digital divides. The group discussion also provided an opportunity for participants to collectively reflect on the Q-sort results, discuss shared experiences, and provide clarification on areas of ambiguity identified by the researcher.

The qualitative insights obtained from both interviews and group discussions were used to develop concept maps (see Appendix 5), which visually represented the relationships between themes, participants' perspectives, and key findings from the Q-sort analysis. These concept maps contributed to both the analysis and conclusions of the research, allowing the researcher to integrate qualitative and quantitative data in a coherent and meaningful way. Simons (2009, p. 136) argues that attentive listening in interviews allows researchers to immerse themselves in participants' lived experiences, interpreting social, emotional, and behavioural cues that provide additional layers of understanding beyond verbal responses alone. This approach was particularly valuable in this study, as it enabled the researcher to create visualizations that could be directly compared with the Q-sort results, enhancing interpretation and strengthening the validity of the findings.

In summary, interviews and group discussions played a pivotal role in this research, complementing the Q-sort process by providing contextual depth, clarifying ambiguities, and capturing nuanced perspectives. By combining semi-structured individual interviews with structured group discussions, the study was able to obtain a rich, multifaceted understanding of participants' experiences, beliefs, and attitudes.

This mixed-method approach not only informed the development of the Q-set and the selection of participants for the Q-sort phase but also supported the interpretation of quantitative results, ensuring that the research accurately reflected the complexity and diversity of participants' viewpoints. By integrating these qualitative methods with the Q methodology framework, the study was able to produce findings that are both robust and grounded in the lived experiences of participants, providing a comprehensive understanding of the research topic.

3.44 Research Ethics

Ethical considerations played a role, in the research process when collecting and analysing data during the day phase. The importance of research ethics in Q methodology cannot be underestimated as they safeguard the research's integrity and ensure protection.

A common understanding exists that many participants in the study share information with researchers, during interviews that they did not initially plan to disclose (Barrow et al., 2022; Patton, 2002). This necessitates researchers to uphold confidentiality and obtain participants informed consent securely.

Remember these important ethical factors to consider:

- Consent with knowledge
- Participation is optional, in this activity.
- Transparency is essential.
- Security of data
- Respect for Participants
- Cultural Sensitivity
- Ethical Review
- Honest Reporting

During my research endeavoured to ensured following the guidelines set forth by British Educational Research Association (BERA) adopted in 2011 to lay down a groundwork, for researchers with a strong emphasis on ethical values centred around respect.

These guidelines serve as a compass for guiding research practices by highlighting aspects such as participant well-being, knowledge acquisition, democratic ideals, research excellence and intellectual liberty (BERA, 2011, p. 4). Researchers outline their obligations to groups such, as participants in studies sponsored by research communities and to society, at large (BERA, 2011, p. 5). Therefore, all trainers and trainees agreed to take part by giving their informed consent and signing a consent form (refer to Appendix 6).

3.45 Ethical Considerations

Ethical issues arise at every stage of the research process from the initial design and planning phase through access negotiations, data collection, analysis and dissemination (Saunders et al., 2016). Ethical principles therefore needed to be embedded across the whole study, rather than treated as a discrete, procedural step. Research ethics can be understood as the standards of behaviour that guide the researcher's conduct towards participants and others who may be affected by the study (Bryman & Bell, 2012).

Dooley, Moore and Vallejo (2017) emphasise that researchers must ensure that no harm comes to participants, that relevant information is provided in advance, that informed consent is obtained, and that confidentiality is protected. Zienkowski (2019) further argues that data should be used only for the stated research purposes and that participants should, where appropriate, be able to access both raw data and findings.

In line with these principles, the study addressed the following key ethical dimensions.

3.46 FE Colleges Approval

The research was subject to formal ethical scrutiny and approval by:

- FE colleges' senior leadership tasked with approval
- Research Ethical Guidelines set by British Educational Research Association (BERA)

3.47 Informed Consent

Informed consent requires that participants are fully aware of the nature of the research, what their involvement entails and that participation is voluntary. There was a risk that the identity of the advanced teachers could be found out through their association and work with the college. Hence great care was taken to ensure anonymity was observed and at the same time all participants were made aware of the risk.

Consent was obtained in writing from all participants prior to their involvement in interviews and surveys. Both FE colleges and participants are anonymised using a coding system. Participants were advised that they could decline to participate or withdraw from the study at any point prior to the completion of data analysis, without any negative consequences.

3.48 FE colleges ethical considerations

Both FE colleges has been fully informed and agreed to the study. Particular attention was given to ensure anonymity of the colleges within the study.

3.49 Confidentiality of Data and Anonymity of Participants

Confidentiality requires that information is not disclosed to unauthorised individuals or organisations (International Organization for Standardization, 2018), while anonymity concerns the removal of identifying details from data and reporting. Ethicist (2015) notes that breaches of confidentiality can expose participants to harm, underscoring the need for robust safeguards. In this study, confidentiality, anonymity and privacy were ensured through several measures:

- Secure storage: All data including demographic information, survey responses, Q-sorts, interview recordings and transcripts were stored in password-protected

folders, accessible only to the researcher. Data will be destroyed in line with college's data retention policies upon completion of the research.

- Use of pseudonyms: Participants were allocated pseudonyms and coded identifiers. No real names or easily identifiable details were used in the thesis or any subsequent dissemination, in line with ethical recommendations on anonymity (Lahman et al., 2015).
- Restricted access to recordings: Audio recordings of interviews were securely stored with the rest of the data, with access restricted to the researcher only.

These safeguards were particularly important given the professional nature of the FE colleges context and the potentially sensitive views expressed about digital technology, institutional practice and digital competence.

3.5 Summary

The chapter describes my research strategy, process, and research philosophy. Additionally, Q methodology for data was discussed. This included the definition of Q methodology, data collection process, data analysis methods and measures applied to ensure trustworthiness and validity of the data and research findings. It also highlights that whilst digital technology including AI technology in education is well-researched particularly in, HE, significant gaps remain in FE sector, particularly in relation to how those working in the sector perceive its impact on teaching, learning, and ethics. By adopting a qualitatively driven mixed-method design and embedding Q methodology, this study captures both subjective perspectives and collective practices, linking them through the conceptual framework of Communities of Practice.

The next chapter presents the empirical findings from the interviews and Q-methodology surveys conducted in the two FE colleges, highlighting the patterns of perception that emerge and their implications for digital technology adoption in vocational education.

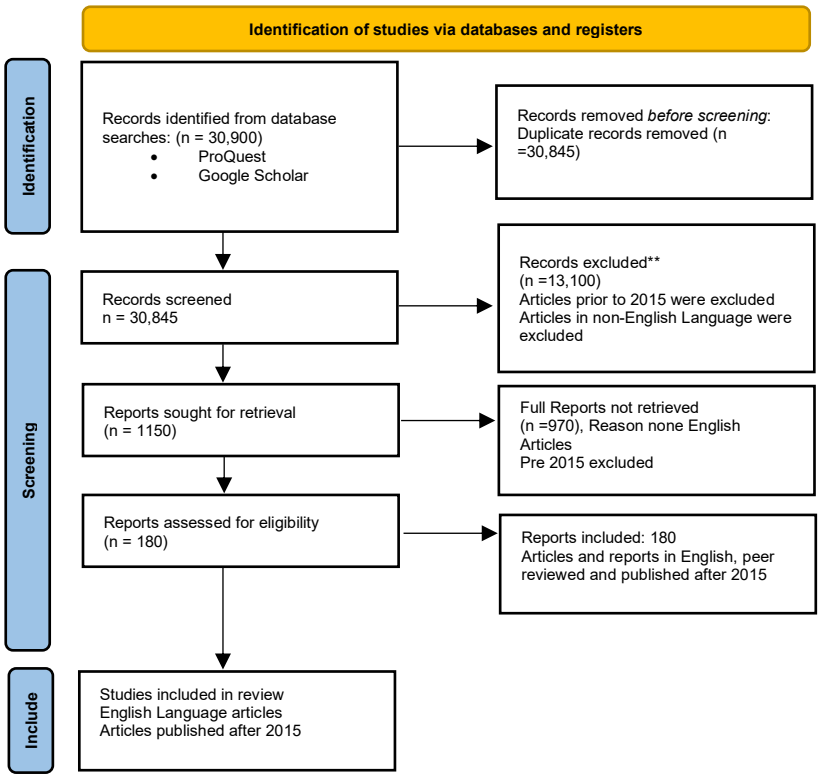
CHAPTER 4: STUDY FINDINGS AND ANALYSIS

4 Introduction & Context

The rapid development of digital technology such as artificial intelligence (AI) over the past few decades has significantly influenced teaching, training, and learning practices across education systems worldwide. While much of the early focus has been on higher education, recent scholarship suggests that digital technology has an equally transformative role to play in further education (FE) colleges, where its impact extends beyond classroom instruction to include vocational training and work-based learning.

Popenici and Kerr (2017) argue that AI has the potential to augment learners' experiences, expand global interaction, and reshape the way knowledge is accessed and applied. This exploratory stage of the research examined the impact of digital technology on students' learning in FE colleges, drawing on secondary data gathered from peer-reviewed journals, policy reports, books, news sources, and other reliable digital materials. Data mining was conducted using four major databases such as EBSCO, ProQuest, Google Scholar, and Locate. To ensure transparency and rigour, the review followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines, which provide a systematic framework for identifying, screening, and selecting relevant literature (Selcuk, 2019). Figure 3 illustrates the PRISMA process used in this study, including the stages of identification, screening, eligibility assessment, and inclusion/exclusion of sources.

**Fig 3: PRISMA flow diagram*



The databases were searched using key terms such as “artificial intelligence”, “student learning”, and “further education”. The initial search identified n = 30,900 results. To refine this sample, inclusion and exclusion criteria were applied in line with the research objectives (Rethlefsen et al., 2021). Exclusion criteria removed articles published before 2015, non-peer-reviewed materials, those without references or full-text availability, and non-English publications. Inclusion criteria limited the review to peer-reviewed, full-text, English-language articles published from 2015 onwards, with a focus on studies conducted in the UK, Europe, USA, China, India, Africa, and Canada. After applying these criteria, n = 180 articles were retained for review. Although the majority of the selected studies were published within the past four years (2018 onwards), given the rapid pace of digital technology development, earlier articles from 2002–2015 were also included where relevant. These earlier works were useful in tracing the evolution of digital technology definitions and in contextualising how understandings of digital technology have shifted in relation to education.

This decision reflects broader commentary in the literature that, compared to other industries, education and particularly FE sector has adopted digital technology at a relatively slower pace (Quan & Sanderson, 2018; Luan et al., 2020).

The selected data were analysed using thematic analysis, which highlighted four core themes:

- The current applicability of digital technology such as AI in FE colleges;
- The impact of digital technology on students’ learning and training outcomes;
- Ethical concerns arising from digital technology use in FE;
- The future potential of digital technology in vocational and further education contexts.

These emergent themes informed the design of the primary research instruments namely, the Q methodology survey and semi-structured interviews and shaped the overall mixed-method research design. They provided the conceptual foundation for exploring how trainers and trainee trainers in FE colleges perceive digital technology, what opportunities and risks they associate with its adoption, and how these perspectives can be interpreted within the framework of Communities of Practice.

The outcomes offer a glimpse into viewpoints held by further education college instructors concerning their responsibilities and the influence of digital technology on their work. The study explores how digital technology is affecting these trainers in education colleges, throughout the UK and the hurdles they face in embracing and using digital technology within their institutions.

The results and interpretation of the research findings include data from the following:

- 14 trainers’ shared Q study factor data analysis.
- 5 advanced trainers’ post Q sort interviews.
- Group discussion of 8 trainee trainers after the Q sort.

The research focuses on delving into how trainers view the impact of digital technology on their roles and, on education and training. This study employed two methods to gather insights, from participants. A questionnaire and interviews conducted by the researcher which were transcribed for analysis. The option to present the findings through a summary that highlights the shared experiences of participants followed by an examination of each research question. In my study work involves looking at how people see things similarly by examining what they say about topics and ideas, as a group (Brown, 1996).

A trend was established within these perspectives and focused specifically on three main areas that stood out the most from the rest. The input from interviews with trainers and talks was considered as well as with trainees who are becoming trainers themselves to make sure all angles were covered and addressed.

In this chapter the following approach was applied to organising the findings; first, an examination of the trainers, followed by an examination of the findings in relation to each presented research question. To do this, a Q set concourse of statements were developed to which is a list of 42 statements that can be found in attached Appendix 1. The trainers were asked to indicate their level of agreement or disagreement with each of the statements.

4.1 Q Methodology Analysis

In Q methodology the factors are specified by the participants' Q sorts which have common understanding of the factors. The result is a factor which is characteristic of those similar viewpoints and can be located on the distribution grid as an "ideal sort" (Watts and Stenner 2012). For instance, factor 1 is shown in Figure 4. Where there are different viewpoints there will be more than one factor; hence in this study there are three factors. Figure 4 is a visual impression only and the full copy is included in Appendix 7.

How do you feel about your role in digital education enviroment? (Factor 1)

-4	-3	-2	-1	0	1	2	3	4
I am nervous, about being a virtual online trainer, it's not for me	Using technology, you can resolve issues quickly and motivate trainees exactly when the need it	I am concerned that the quality of training will go down if trainees are expected to learn online	Digital technologies are a distratcion for trainees' learning	I think the relationship with the trainees needs to be face-to-face	Solely online traininmg will become more impersonal between trainee and trainer	I think technology brings many opportunities for both the trainer and trainee	I feel confident with digital learning technologies	I am confident in teaching myself how to use different digital technology
I feel unprepared for a digital education future	I don't think trainees have the skills or motivation to learn online	I have real concerns with large chuncks of learning being delivered online	Trainees are more confident than we are to use technology	Online training alone will reduce the personal touch between the trainee and the trainer	If we don't use digital technology with trainees, we will be doing them a disservice	Digital learning needs to be carefully supported by trainer and trainee ground rules	I feel stimulated and confident to use digita technology for training and learning	I enjoy incorporating different digital technologies to suit my delivery
2	There is danger to trainers being always accessible, you don't get the time back or the energy	I believe trainees are digital native and feel more comfortable learning online	If I were to teach online, I would need training for this	Digital technology enables trainees to take ownership of tehir learning	I believe there is a requirment to change my teaching practices because of digital technology	There needs to be more staff development for digital technologies to improve digital literacy	Trainers need more training for online pedagogy	2
	Classroom trainers will become extinct	Trainees are leading change as they make a definite choice to use digital resources over print	I worryt that digital technology creates expectation of immediacy of response for trainers	Trainees attitude to learning must change before they will be able to learn online	It is the responibility of the trainer to saty up to date, particularly in relation to sector specific technology	We need to understand what a quality online experience looks like, what is outstanding?	Training will certainly change as digital training takes a more predominant role	
	4	It is a pressure to keep up with constantly changing digital technology	I think technology will have a negative imapct on the future role of the trainer	I see the future role of the trainer as a coach or facilitator, someone who guides the trainee through online learning	Technology is a way of saving money	Digital education is the future for trainers, we need to embrace it	4	
		5	Digital technology offers better opportunities for staff to develop communities of practice	Digital technology will dehumanise and de-professionalise the trainer	Vocational education is practical, you can't do that online	5		
			6	Technology developments have led to a bluring between work, education time and social time	6			
				I used social media and feel it is a great way to engage with students				
				8				
		Most disagree	←	Nuetral	→	Most agree		

**Figure 4: Participants' factor 1 mapped to the distribution grid, showing the ideal Q-sort that best represents participants' viewpoint.*

This factor represents five of the original 16 participants (visual illustration only with readable copy included as Appendix 7). When performing the analysis of the data obtained with the help of Q-methodology, it is crucial to consider the loadings of the factors and the participants' significance because this tells us about the defining sorts and the participants' representation.

The defining Q sort for each factor is denoted by letter 'X' and is shown in table 3. The significance of this will be illustrated by an example: participant MATLR3, who in table 3 has a low loading of 0.0152 in factor 2 and -0.0438 in factor 3 but has a high loading of 0.8019 in factor 1; this means that factor is a good representative of the position of participants MATLR3.

All the 13 participants, their Q-sorts were factor analysed using principal axis and variance rotation, and 13 loaded into three factors that explain 55% of the variance, which means that there is representation in each of the factors and therefore I will consider all three factors. A significance indicator for Q research is the eigenvalue of unrotated factors. All three in my Q study have an eigenvalue > 1.

Factor Matrix an X indicating a defining sort loading				
No	**Q sort**	**1**	**2**	**3**
1	FATLR1	04191X	-0.3371	-0.1411
2	FATLR2	5215	0.3929	0.3518
3	MATLR3	08019X	0.0152	-0.0438
4	FATLR4	07909X	0.2167	0.1974
5	FATHLR5	-0.0944	-0.6231	0.1938
6	FATHLR6	4339	0.6313X	0.026
7	MATLR7	1734	0.7437X	0.1494
8	FATER8	1770	0.6016X	0.3332
9	FTED2	0.33	-0.2262	0.7224X
10	MTDEx3	-0.0117	0.1329	0.7271X
11	MTEDx4	0.1374	-0.7043	0.006
12	MTED5	0.7069X	0.0521	0.2589
13	FTED6	0.6267X	0.1626	0.0137
14	FTED7	0.0194	0.0867	0.7620X

**Table 3: Factor matrix showing the defining Q sorts for factors, 1,2 &3.*

Participants in the study FATLR1, MATLR3, FATLR4, MTED5 and FTED6 are the best representative of factor 1; participants FATLR5, FATLR6, MATLR7, FATER8 and MTEDEx4 are strongly present in factor 2, and FTED2, MTEDEx3 and FTED7 in factor 3, Table 3. One of the participants FATLR2 did not load to any of the three factors, so for the purpose of this study I will consider the position of this participant's Q sort as part of my interpretive process separately (Brown 1996).

Code	Type of Trainer	Gender	Type of Provision	Factor	Interview	Discussion
FATLR1	Advanced	Female	Classroom (LR)	1	No	
FATLR2	Advanced	Female	Classroom (LR)	-	Yes	
MALTR3	Advanced	Male	Classroom (LR)	1	No	
FATLR4	Advanced	Female	Classroom (LR)	1	Yes	
FATLR5	Advanced	Female	Classroom (LR)	2	Yes	
FATLR6	Advanced	Female	Classroom (LR)	2	Yes	
MALTR7	Advanced	Male	Classroom (LR)	2	No	
FATLR8	Advanced	Female	Work based	2	Yes	
FTED1	Student	Female	Classroom (LR)	-		Yes
FTED 2	Student	Female	Classroom (LR)	3		Yes
MTEDEx3	Student	Male	Classroom (LR)	3		Yes
MTEDEx4	Student	Male	Classroom (LR)	2		Yes
MTED5	Student	Male	Classroom (LR)	1		Yes
FTED 6	Student	Female	Classroom (LR)	1		Yes
FTED 7	Student	Female	Classroom (LR)	3		Yes
MTED8	Student	Male	Classroom (LR)	-		Yes

**Table 4: Participant codes, demographic information, factor position, and participation in interviews or discussions*

4.12 Data findings and presentation outline

The data is presented in a manner that reflects participants' placement of statements on a distribution grid. For example, a statement receiving a high score indicates strong agreement, while a low score reflects disagreement. This structured approach allows for an organized comparison of viewpoints across factors. The detailed research findings are presented in Appendix 8, along with ideal sorts for factors 1, 2, and 3 found in Appendix 7.

While this data can be analysed using both statistical and qualitative methods, the study focuses exclusively on qualitative interpretation for each factor, providing a comprehensive overview while addressing each research question in depth.

To illustrate the data derived from the statistical analysis, Table 5 demonstrates how the information is structured, presenting the statement number, the corresponding text, and the placement of each statement within the distribution grid for factors 1, 2, and 3. The researcher's objective is to remain as close to the original statements as possible to accurately represent the participants' perspectives.

Additionally, the tables will assist to visually convey the results, enhancing clarity and facilitating a better understanding of the data and its implications.

No	Statement	F1	F2	F3
27	I see the future role of the trainer as a coach or facilitator, someone who guides the students through online learning.	0	3	-1

**Table 5: Demonstration of how each statement & corresponding factors are presented; the example showcases statement 27.*

For instance, statement 27 (Table 5), - "I see the future role of the trainer as a coach or facilitator, someone who guides the students through online learning" will be referenced as (s27). Only factor 2 agrees with this statement, yielding placements (0, 3, -1). Therefore, for ease of reference, the presentation will appear as (s27; 0, 3, -1) within the narrative.

4.13 Overview of the participants' position as a whole group

When discussing a specific factor, such as factor 2, it will be noted as (s27; 3). It is important to consider the responses of the participants, three distinct positions emerged, and each represented by one of the three identified factors. Where response did not fit into the three categories, they were included in the discussion. Notably, Participant FATLR2 did not significantly align with any of these factors; however, the participant's individual sort was included in the discussion. Upon initial interpretation of the factors and the perspectives of the participants within each category, it becomes evident that the results highlight differing positions among the participants, as illustrated in table 6 below:

Different positions for the research participants
" Trainees are more confident than we are and so I need training" (Factor 3)
"I do not want to do trainees a disservice and so I need support" (FATLR2)
"I am confident and feel prepared for the future" (Factor 1)
"I feel stimulated and believe it is my responsibility to stay up to date" (Factor 2)

**Table 6: Different positions for the research participants.*

4.14 Factor 1: "I am confident and feel prepared for the future"

This factor reflects the most agree and disagree statements from participants, conveying a strong sense of confidence (Table 7). Participating Trainers expressed confidence in utilising digital technologies (s20; 4) (s17; 3), are eager to integrate these technologies into their teaching, feel ready for a digital future (s26; -4), and are open to new experiences such as transitioning to virtual online teaching (s16; -4). These participants acknowledge the evolving role of teaching alongside advancing digital technologies (s39; 3) and recognize the necessity for additional training in online pedagogy (s24; 3). However, they also understand that not all issues can be resolved promptly, nor can student motivation be easily maintained online (s6; -3).

Factor 1 is representative of participants FATLR1, MATLR3, FATLR4, MTED5, and FTED 6. To encapsulate Factor 1 participants' position based on the strongest agree and disagree statements, one could summaries: "I am confident in my ability to use and teach AI technologies for learning, and I feel prepared for the future, though I would benefit from further training in online pedagogy."

	Statement	Most Agree	Statement	Most Disagree
FACTOR 1	(20:4)	I am confident in teaching myself how to use different digital technologies	(16: -4)	I am nervous, about being a virtual online trainer, it is not for me
	(25:4)	I enjoy incorporating different digital technologies to suit my delivery	(26: -4)	I feel unprepared for a digital future
	(17:3)	I feel confident with digital technologies in education	(6: -3)	Using digital technology, you can resolve issues quickly and motivate trainees exactly when they need it
	(22:3)	I feel stimulated and confident to use digital technology for teaching and learning	(8: -3)	I don't think trainees have the skills or motivation to learn online
	(24:3)	Trainers need more training for online pedagogy	(32: -3)	There is danger to trainers being always accessible, you don't get the time back or the energy
	(39:3)	Teaching will certainly change as digital education takes a more prominent role	(41: -3)	Classroom trainers will become extinct

**Table 7: Factor 1 participants' most agree and most disagree statements.*

The initial observations that were carried out from interpretating the factors and participants' perspectives suggested that the results actually highlighting different positions for the participants.

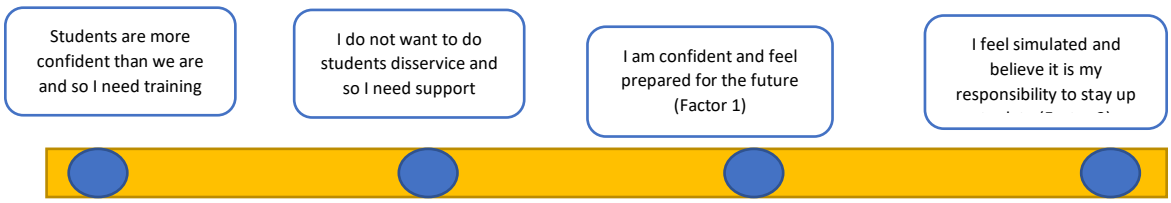


**Figure 5: The different positions for the research participants*

4.15 Factor 2: "I feel stimulated and believe it is my responsibility to stay up to date"

This factor is defined by the statements that participants most strongly agreed and disagreed with, as represented in Factor 2. Trainers aligned with this factor express high levels of motivation and confidence in their use of digital technologies (s22; 4). They emphasize that it is the responsibility of the trainer to remain up-to-date with technological developments (s31; 4) and view digital technology as offering meaningful opportunities for both educators and students (s10; 3). Interestingly, there is also a strong consensus that certain forms of online digital learning, such as AI-based tools, are best suited for the practical elements of vocational education (s40; -4). This suggests that participants are not only confident in using basic digital tools but are also considering more advanced applications, including simulation software and immersive learning environments.

	Statement	Most Agree	Statement	Most Disagree
FACTOR 2	(22:4)	I feel stimulated and confident to use digital technology for teaching and learning	(40: -4)	Vocational training is practical, you can't do that online
	(31:4)	It is the responsibility of the trainer to stay up to date, particularly in relation to sector specific technology.	(41: -4)	Classroom trainers will become extinct
	(10:3)	I think digital technology brings many opportunities for both the trainer and trainee.	(11: -3)	digital technology are a distraction for trainees'' learning
	(27:3)	I see the future role of the trainer as a coach or facilitator, someone who guides the trainee through online training.	(12: -3)	Digital training needs to be carefully supported by trainer and trainee ground rules
	(29:3)	I believe there is a requirement to change my training practice because of digital technology	(14: -3)	Solely online training will become more impersonal between Trainee and trainer
	(35:3)	I use social media and feel it is a great way to engage with trainees	(33: -3)	I think technology will have a negative impact on the future role of the trainer

**Table 8: Factor 2 participants' most agree and most disagree statements.*

Participants strongly affirm that they hold a personal responsibility to stay current with developments in technology, particularly those specific to their vocational sectors. Statement 31, which addresses this responsibility, received the highest priority score across all factors (s31; 1, 4, 2). While other factors also agreed with this statement, participants in Factor 2 prioritized it above all others, highlighting the centrality of professional responsibility in their approach to digital technology.

This emphasis can be interpreted in two ways. First, these trainers view themselves as essential in ensuring that students are digitally literate and prepared for the modern workplace. Second, the focus on sector-specific technologies reflects the vocational nature of the college. Trainers recognize that many students will transition directly into employment after completing a Level 3 qualification (equivalent to A-levels). Consequently, students must develop relevant digital skills, such as proficiency in diagnostics software, engineering tools like Autodesk, or digital applications in healthcare. The strong perception among these participants regarding their duty to stay

technologically current underscores the importance they place on equipping students with work-ready, sector-specific skills. Interviews with trainers supported this interpretation. For example, one participant noted, "We have to prepare students for the world of work and life; digital is a learning skill" (FATLR2). Factor 2 is primarily represented by participants FATLR5, FATLR6, MATLR7, FATER8, and MTEDEx4, all of whom are trainers. Their responses indicate a habitus—an ingrained set of attitudes and dispositions—toward digital technology that combines confidence, motivation, and a sense of professional duty.

In summary, the position of Factor 2 participants can be captured by the following statement:
"I feel stimulated and confident in my use of technologies for teaching and learning, acknowledging that technology is transforming my practice, and I recognize it is my responsibility to stay informed and prepare students for work-ready digital competence."

This factor highlights a sophisticated understanding of the role of digital technology in vocational education. Participants are not only comfortable using digital tools themselves but also actively consider how these tools can enhance learning outcomes and prepare students for the demands of their specific sectors. Their prioritization of sector-specific technologies reflects a practical, applied approach to digital learning that aligns with the vocational mission of their institutions.

4.16 Factor 3: "Students are more confident than we are, and so I feel I need training"

This factor reflects a more hesitant stance among these trainers regarding their use of digital teaching and learning technologies. Factor 3 represents participants FTED2, MTEDEx3, and FTED7, all of whom are Trainee trainers. As the least experienced trainers, they are the only participants to strongly agree that students demonstrate greater confidence in using technologies than they do (s18; -1, 0, 4) expressing scepticism about effectiveness of online student-trainer relationships compared to face-to-face interactions (s5; 0, 0, -3).

Nevertheless, these participants recognize that digital education is the future and need to embrace it (s42; 3), and they enjoy using various digital technologies in their practice, as indicated by their strong agreement with statement 25 (s25; 4). Participants in Factor 3 show willingness to incorporate digital technologies; however, their lack of experience and training results in anxiety regarding what constitutes effective digital teaching and learning (s37; 3).

Being new to teaching, they require additional support, training, guidance, and clearly defined standards for use of digital technologies in teaching and learning. Statements 8 and 13 (s8; -3) (s13; -3) suggest that while trainers believe students are motivated and possess the right attitude for online digital technology learning, they are firm in their reluctance to engage with students via social media (s35; -4).

This finding challenges my assumptions about trainee trainers and new trainers; initial understanding was that those new to the profession would be adept at using social media and digital technologies, thus being more advanced than those perceived as 'set in their ways.'

Therefore, this outcome has surprised and challenged researcher's beliefs during the reflexive process. To summarize Factor 3 participants' position or habitus based on their strong agree and disagree statements, one could articulate: "I enjoy integrating digital technologies into my practice, but I recognize that students are more confident than I am, and I need guidance on what constitutes effective digital practice and how to meet high teaching and learning standards."

	Statement	Most Agree	Statement	Most Disagree
FACTOR 3	(18:4)	Trainees are more confident than we are to use technology	(35: -4)	I use social media and feel it is a great way to engage with trainees
	(25:4)	I enjoy incorporating different digital technology to suit my delivery	(41: -4)	Classroom trainers will become extinct
	(12:3)	Digital education needs to be carefully supported by trainer and trainee ground rules	(5: -3)	I think through online support the trainee, trainer relationship can be effective as a face-to-face
	(16:3)	I am nervous, about being a virtual online trainer, it's not for me	(8: -3)	I don't think trainees have the skills or motivation to learn online
	(37:3)	We need to understand what a quality online experience looks like, what is outstanding?	(13: -3)	Trainees' attitude to learning must change before they will be able to learn online
	(42:3)	Digital training is the future for trainers, we need to embrace it	(30: -3)	Digital technology will determine and de-professionalize the trainer

**Table 9: Factor 3 participants' most agree and most disagree statements.*

4.17 FATLR2: "I do not want to do students a disservice, and therefore I need support"

Participant FATLR2 did not strongly align with any of the three factors, but their unique perspective is worth noting (Table 10). This trainer strongly believes that avoiding digital learning technologies would disadvantage students (s15; 4). They are confident that students are motivated and capable of learning online (s8; -4) and those digital tools do not distract from their learning (s11; -4). FATLR2 sees digital learning technologies as beneficial, helping students take ownership of their learning (s7; 3). At the same time, they recognize the importance of receiving proper training to teach online effectively (s19; 3) and acknowledge that other trainers also need more support in online pedagogy (s24; 4).

Like Factor 3, FATLR2 wants to understand what constitutes a high-quality online learning experience (s37; 3). They are passionate about the potential of digital teaching tools to enhance student learning but feel personally unprepared and in need of guidance, training, and support to implement these technologies successfully.

	Statement	Most Agree	Statement	Most Disagree
FATLR2	(15:4)	If we don't use digital technology with students, we will be doing them a disservice	(8: -4)	I don't think trainees have the skills or motivation to learn online
	(24:4)	Trainers need more training for online pedagogy	(11: -4)	Digital technologies are a distraction for trainees' learning
	(7:3)	Digital technology enables trainees to take ownership of their learning	(14: -3)	Solely online education will become more impersonal between trainee and trainer
	(19:3)	If I were to teach online, I would need training for this	(33: -3)	I think technology will have negative impact on the future role of the trainer
	(37:3)	We need to understand what a quality online experience looks like, what is outstanding?	(40: -3)	Vocational education is practical; you can't do that online
	(42:3)	Digital training is the future for trainers, we need to embrace it	(41: -3)	Classroom trainers will become extinct

**Table 10: Participant FATLR2's most agree and most disagree statements.*

FATLR2's perspectives intersect with the positions of factors 1, 2, and 3, emphasizing a strong belief that while students are ready to engage in online learning (factors 1, 2, and 3), the participant does not feel adequately prepared to teach online (factor 3). A statement that encapsulates FATLR2's strongly agrees and disagree sentiments is: "We will be doing students a disservice if we do not utilize digital learning technologies, but I require training and support to effectively use these technologies with my students."

4.18 Understanding and Interpretation of Participants' Responses to Research Question 1 (RQ1):

How do FE teachers position themselves on how their professional practice will change in the future, because of digital technologies?

How do Further education colleges and vocational training providers position themselves to meet future challenges in response to the use of digital technology in education and employer needs?

Table 11 presents statements pertinent to RQ1, reflecting the trainers' views across factors 1, 2, and 3. For each statement, the Q-data distribution grid placement score is displayed within its respective factor column. By examining this data horizontally, we can identify notable patterns.

For instance, the statement (s28; -1, -1, -1) indicates a consensus of disagreement among all three factors, while the statement (s35; 0, 3, -4) reveals a more controversial stance across factors 1, 2, and 3.

No	Statement	F1	F2	F3
27	I see the future role of trainers as a coach or facilitator, someone who guides the trainees through AI learning.	0	3	-1
28	I worry that digital technology creates an expectation of immediacy of response for trainers	-1	-1	-1
29	I believe there is a requirement to change my teaching practices because of digital technology	1	3	-1
30	AI will dehumanize and de-professionalize teaching	0	-2	-3
31	It is the responsibility of the trainers to stay up to date, particularly in relation to sector or the energy	1	4	2
32	I think digital technology will have a negative impact on the future role of the trainer	-3	-1	0
33	AI developments have led to a blurring work, education time and social time	-1	-3	0
34	I use social media and feel it is great way to engage with trainees	0	1	-2
35	digital technology offers better opportunities for staff to develop communities of practice	0	3	-4
36	We need to understand what a quality online experience looks like, what is outstanding?	-1	1	1
37	Digital technology is a way of saving money	2	0	3
38	Training experience will certainly change as digital technology takes a more predominant role	1	0	1
39	Vocational education is practical; you can't do that online using digital technology	3	-1	1
40	Classroom trainers will become extinct	1	-4	0
41	digital technology training is the future for trainers, we need to embrace it	-3	-4	-4
42	Digital technologies is the future for teachers, we need to embrace it	2	2	3

**Table 11: Represents statements related to RQ1's Q-data with the distribution grid position for each factor.*

4.19 Interpretation of Factors and Qualitative Data for Research Question 1 (RQ1)

The analysis of all factors indicates that participants generally express ambivalence or disagreement regarding the notion that AI technology will dehumanize or de-professionalize the teaching profession (s30; 0, -2, -3). Furthermore, there is a strong consensus against the idea that classroom trainers will become obsolete (s41; -3, -4, -4). Across all factors, participants share similar views about the future of teaching, particularly agreeing with statement 42 (s42; 2, 2, 3), which posits that "digital education is the future for trainers, and we need to embrace it" (Table 11).

Initial observations reveal that participants' perspectives within each factor reflect varied positions among trainers. Participants in factor 2 exhibit greater confidence and a more favourable stance toward integrating digital technologies into their teaching compared to those in factor 3 or participant FATLR2. Conversely, factor 1 participants display a level of confidence regarding AI technologies but express some reservations about implementing digital learning tools.

FATLR2 expresses concern that trainers who do not adapt their practices in response to digital technologies may disadvantage their students. As is often the case with initial analyses, the Q-study generated more questions than answers, revealing complexities in participants' positions that will focus the study at exploring further in the post-Q data collection. To that end, a semi-structured interviews was carried out with five trainers (FATLR2, FATLR4, FATLR5, FATLR6, and FATER8) and facilitated a group discussion with all eight Trainee trainers. This qualitative data is incorporated into the interpretation in the following sections.

4.2 Factor 1: "I Am Confident and Feel Prepared for the Future",

This an interpretation of factor 1 participants' positions and qualitative data collected through post-Q interviews and group discussions

Factor 1 is represented by three experienced trainers and two trainee trainers. These participants share a strong belief that teaching is inevitably going to change as digital education becomes increasingly prominent (s39; 3). They are forward-looking in their approach to technology, viewing it as an integral part of future teaching rather than a threat. Importantly, they do not perceive that digital technology will place unrealistic demands on trainers, such as being constantly accessible (s32; -3) or needing to respond immediately to students due to the ease of online communication (s28; -1). Overall, these participants exhibit confidence in their ability to adapt their professional practices to incorporate digital teaching and learning technologies effectively, suggesting a readiness to embrace evolving educational environments.

While they feel capable of managing student behaviour and setting appropriate expectations around the use of digital tools, these trainers still recognize the value of understanding what constitutes a high-quality online learning experience (s37; 2).

This shows an awareness that, while digital technologies can enhance learning, successful implementation requires careful planning and reflection. Despite this confidence, they express some scepticism about the feasibility of delivering practical vocational education entirely online (s40; 1), reflecting the real-world challenges of translating hands-on skills into a fully digital format.

During interviews, FATLR4 elaborated on their perspective regarding statement 37. She observed, "I have observed an online lesson and there were missed opportunities to engage students." She pointed out that evaluating a single online session is insufficient to judge the overall quality of online learning, as face-to-face lessons can also have gaps in engagement or missed learning opportunities. Nonetheless, she emphasized the importance of trainers being acutely aware of whether learning is actively taking place during an online lesson. FATLR4 expressed some frustration regarding this issue, revealing a degree of discomfort with online lessons despite her overall confidence as a trainer. Her reflections highlight the tension between confidence in teaching ability and the challenges posed by limited experience with online pedagogy.

Participants in factor 1 also demonstrate modest agreement that teaching practices need to evolve in response to digital technologies (s29; 1). They acknowledge this need without expressing extreme urgency, suggesting a thoughtful, measured approach to integrating technology into their professional practice. Similarly, they do not disagree with statement 31 (s31; 1), which emphasizes the trainer's responsibility to stay current, particularly with sector-specific technologies. During discussions with trainee trainers, they were asked whether remaining up to date with digital technology (s31) or adapting teaching practices (s29) should be seen as the trainer's responsibility. Trainees agreed in principle but noted practical constraints, such as limited funding for industry-specific courses, and suggested that "college development days should be used for upskilling in our sectors."

One student reflected on the expectations of part-time students who are already active in the industry, noting, "They expect to learn something from us." This comment, shared with some anxiety, illustrates the pressure on trainers to maintain both their vocational expertise and proficiency in digital technologies. It also highlights the lack of institutional support for trainers to keep their industry knowledge and technological skills current, creating a dual challenge for vocational educators.

Regarding the impact of digital technologies on teaching and learning (RQ1), participants in factor 1 do not perceive technology as negatively affecting their roles (s33; -1). Instead, they recognize that digital tools are now integral to professional practice and will continue to play a significant role in shaping teaching in the future. FATLR4 captured this sentiment in interviews, stating, "As trainers, we should be the leaders, the demonstrators, the mechanism for people to use technology in a way that enriches their lives." This statement highlights not only the evolution of teaching but also the responsibility of trainers to model effective technology use and prepare students for digitally enhanced learning environments. The perspectives of students also reflect this evolving dynamic. For example, a TED student remarked, "Technology is already changing the way we teach," adding, "I think it's true because I use QR codes and

different technologies with my students." This observation underscores the practical integration of digital tools in everyday teaching and aligns with the trainers' recognition of technology's central role in education.

Considering factor 1 holistically in response to RQ1, it is clear that these trainers are confident and feel generally well-prepared for a digital future. At the same time, they remain mindful of ongoing challenges in their industry, particularly the need to balance vocational expertise with keeping up-to-date with digital teaching methodologies, including emerging AI tools. This highlights the dual responsibility for trainers: staying current in their sector while ensuring that technology is used effectively to enhance student learning experiences.

4.21 Factor 2: "I Feel Stimulated and Believe It Is My Responsibility to Stay Up to Date",

Factor 2 comprises four trainers and one TED student external to the College. Participants in this factor agree with statement 42 (s42; 2), which asserts that digital education is the future and should be embraced. They strongly believe in the responsibility of trainers to stay current, particularly regarding sector-specific technologies (s31; 4), which received the highest priority score among all factors. Factor 2 participants assert that there is a necessary shift in teaching practices due to digital technology (s29; 3) and view the future role of trainers as coaches or facilitators who guide students through online learning (s27; 3).

However, they slightly disagree with statement 39 (s39; -1), which suggests that teaching will certainly change as digital in education takes a more central role, indicating they may already be on this journey without concern for the impact of digital technologies on their professional practices.

Surprisingly, FATLR5 was categorized in factor 2, previously observed a participant as one of the least confident users of AI learning technologies. In our interview, the participant expressed a viewpoint that technology is beneficial for students: "I think I am inclined to agree, gosh, am I saying this? Because they are living in a technology age." Her tone suggested a reflective realization, acknowledging her students' natural affinity for digital technology. She remarked, "You can find an app for everything; I am amazed by it all and think, wow!" (FATLR5).

Nevertheless, most factor 2 participants acknowledged that students require support to enhance their digital and online skills. These participants do not disagree with statement 34, indicating that they perceive the boundaries between work, education, and social time as increasingly blurred due to digital technologies (s34; 1). They are the only group to strongly agree with statement 35 (s35; 3), affirming their use of social media as an effective means of engaging with students. Furthermore, they do not disagree with statement 36 (s36; 1), recognizing that digital technologies can facilitate the development of better teaching and learning communities of practice.

When asked about the social aspect of technology and its potential for sharing best practices with colleagues, FATER8 responded, “digital Learning technology brings people together to solve problems and learn. We all have similar issues with technology, so helping each other as a team is really beneficial.”

Factor 2 participants firmly believe that practical vocational activities can be conducted online, strongly disagreeing with statement 40 (s40; -4), which posits, “Vocational education is practical; you cannot do that online.” This perspective has implications for the future of vocational teaching practices. This group approaches RQ1 with confidence, strongly disagreeing that technology will negatively affect the future role of trainers (s33; -3). FATER8 stated, “digital technology will support what we are already doing, rather than lead the way. People are leading it, and technology is simply a tool to assist us.” This aligns with my observations of FATER8, who is a confident user of learning technologies and actively promotes their adoption for teaching and assessment.

4.22 Factor 3: "Students Are More Confident Than We Are, and So I Feel I Need Training",

Factor 3 participants consist of three Trainee trainers, including one external to the College. These participants strongly agree with the notion that digital education is the future for trainers and that it must be embraced (s42; 3). However, they express the least confidence regarding RQ1, highlighting the necessity of understanding what constitutes a high-quality online experience (s37; 3) and strongly disagreeing with statement 35 (s35; -4), which discusses the use of social media to engage students. In our group discussion, the Trainee trainers noted that “students get bored, and technology can be a distraction. If they access the computer, they often turn to social media.” This sentiment was echoed by others in the group.

They further expressed concerns that while students may know how to use social media, they often lack proficiency in other essential digital technologies. This contrasts sharply with factor 2 participants, who view social media as a learning tool. The trainee trainers were challenged to consider how social media could be leveraged for teaching and learning, but their resistance was evident as they expressed frustration about its potential to disengage students from learning.

This frustration suggests that the primary concern may revolve around student behaviour and classroom management rather than the digital technologies themselves. It reinforces the emerging theme that Trainee trainers may not feel adequately prepared or trained to integrate digital technologies into their teaching practices, leading them to prefer avoiding such tools.

Participants in factor 3 agreed with statement 36 (s36; 1), recognizing the potential for digital technologies to foster better opportunities for staff to develop communities of practice and acknowledging how this can enhance their teaching and learning community. They also concurred that it is the trainer's responsibility to remain current,

particularly concerning sector-specific technologies (s31; 2) and believe that teaching will inevitably change as digital education takes on a more significant role (s39; 1).

During group discussions, Trainee trainers expressed that technology is constantly evolving, and they need time and opportunities for training and development. They highlighted that upskilling has always been a challenge within further education, and this challenge is exacerbated by the rapid pace of technological advancements. Statement 18 is a high priority for this group, scoring 4 (s18; 4), as they feel that students are more confident than they are when using technology.

This led to a discussion about students' competencies with digital technologies. One participant remarked, "You would assume that all students are tech-savvy, but some don't even have a smartphone; some have basic phones and no Internet connection." Another noted that "for some subjects, students may not want to use digital technology, as it can alienate them." The trainee trainers raised concerns that those who are not digitally literate or lack the necessary equipment may be disadvantaged and excluded from learning opportunities.

Additionally, the Trainee trainers challenged the merits of flipped learning, questioning how instructors can ensure that students have engaged with the required materials, such as videos. They acknowledged the variability in needs across different subject areas. This indicates a lack of understanding among this group regarding how digital technologies can support teaching, learning, and assessment, as well as challenges in managing students' use of digital technology both in the classroom and online.

The study intended to examine this further in RQ3, focusing on trainers' perspectives regarding their confidence in using digital teaching and learning technologies. When asked if they see themselves as coaches, facilitators, or trainers (s27; -1), most participants responded, "All three." This prompted a discussion about the role of the trainer in an online environment, with comments such as, "I don't think you can effectively be a facilitator as a virtual trainer." This reflects the strong priority response from factor 3 participants regarding statement 16 (s16; 3), "I am nervous about being a virtual trainer; it is not for me."

When inquired about their initial trainer education (ITE) program and the extent to which it covers digital technologies in teaching and learning, the trainee trainers mentioned using a digital reflective journal for their reflective practice but noted that there is minimal instruction on digital technology in teaching design, online pedagogical development, or integrating digital learning technologies into their practices.

All participants in factor 3 are Trainee trainers (FTED2, MTEDEx3, and FTED7). Considering the ambivalent statements scored '0,' it is clear that these participants have yet to form definitive opinions based on their experiences:

- There is a danger of trainers being always accessible; you do not get the time back or the energy (s32; 0)

- I think technology will negatively impact the future role of the trainer (s33; 0)
- Vocational education is practical; you cannot do that online (s40; 0).

These students have yet to develop firm opinions, but I believe that the ITE program should effectively prepare new trainers for an increasingly digital digital environment that will influence their teaching methodologies in the future.

4.23 FATLR2: "I do not want to do students a disservice and therefore I need support."

Although participant FATLR2 did not load significantly onto any of the three identified factors, their Q-sort provides important insight into an educator who holds a distinct and internally consistent viewpoint (12). FATLR2 expresses a strong conviction that failing to use digital learning technologies would constitute a disservice to students (s15; + 4). This participant believes that students are motivated, digitally capable and prepared for online learning (s8; – 4), and does not perceive digital technologies as a distraction to learner engagement (s11; – 4).

FATLR2 also strongly endorses the view that digital tools promote learner autonomy and support students in taking ownership of their learning (s7; +3). However, this positive orientation towards student readiness contrasts markedly with FATLR2's perception of their own professional preparedness. The participant reports a strong need for training to teach effectively online (s19; +3) and agrees that teachers, in general, require more support to develop online pedagogical competence (s24; +4). FATLR2 also aligns with perspectives associated with Factor 3, expressing uncertainty about what constitutes high-quality online learning and recognising the need for clearer exemplars and guidance (s37; +3).

Taken together, FATLR2's viewpoint reflects a dual positionality:

- a firm belief that students are digitally ready, consistent with viewpoints found across all three factors;
- a contrasting recognition that they personally lack the skills, confidence or knowledge required to deliver effective online learning an issue aligning more closely with concerns raised in Factor 3.

This participant is therefore highly supportive of digital and digital technology enabled learning but identifies a clear professional development gap. Their overall position can be summarised as follows: "Digital learning technologies are essential for students, but I need training and support in order to use them effectively."

Statement		Most Agree	Statement	Most Disagree
FATLR2	(15:4)	If we don't use digital technology with students, we will be doing them a disservice	(8: -4)	I don't think students have the skills or motivation to learn online
	(24:4)	Teachers need more training for online pedagogy	(11: -4)	digital technologies are a distraction for students' learning
	(7:3)	digital technology enables students to take ownership of their learning	(14: -3)	Solely using digital technology in online education will become more impersonal between student and teacher
	(19:3)	If I were to teach using AI, I would need training for this	(33: -3)	I think digital technology will have a negative impact on the future role of the teacher
	(37:3)	We need to understand what a quality teaching experience using AI looks like, what is outstanding?	(40: -3)	Vocational education is practical, you can't do that using digital technology online
	(42:3)	digital technology in education is the future for teachers, we need to embrace it	(41: -3)	Classroom teachers will become extinct

**Table 12: Participant FATLR2's most agree and most disagree statements*

FATLR2 represents a meaningful crossover profile an educator who is enthusiastic about digital transformation in FE but who simultaneously highlights the structural need for targeted training, confidence-building and institutional support. Their perspective reinforces the importance of professional development in shaping teachers' readiness for digital enhanced pedagogy and underscores the tension between student digital capability and teacher digital confidence observed across the dataset.

4.24 Interpretation of Participants' Responses to Research Question 2 (RQ2)

Research Question 2 (RQ2) investigates how confident are further educational training trainers and assessors who see themselves in the era of digital technology and their individual training needs?

Table 13 presents statements relevant to RQ2, representing the participants from factors 1, 2, and 3. The Q-data distribution grid placement score is shown for each statement across the factor columns. By analysing this data horizontally, similarities are identified, such as (s2; -2, -2, -2), which indicates a consensus of disagreement among all three factors, while (s12; 2, -3, 3) highlights a controversial statement across factors 1, 2, and 3.

No	Statement	F1	F2	F3
1	I think the relationship with the student needs to face-to-face	0	-2	-1
2	I am concerned that the quality of training will go down if students are expected to learn online	-2	-1	-2
3	I have real concerns with large chunks of learning being delivered online	-2	2	-2
4	I believe students are digital natives and feel more comfortable learning online	-2	0	2
5	I think through online support the students, teacher relationship can be as effective as face-to-face	0	0	-3
6	Using technology, you can resolve issues quickly and motivate students exactly when they need it	-3	1	-1
7	Digital technology enables students to take ownership of their learning	0	-1	2
8	I don't think students have the skills or motivation to learn online	-3	1	-3
9	Students are leading change as they make a definite choice to use digital resources over print	-2	3	0
10	I think AI technology brings many opportunities for both the trainer and trainee	2	-3	0
11	Digital technologies are a distraction for trainees' learning	-1	-3	0
12	Digital training needs to be carefully supported by teacher and student ground rules	2	-2	3
13	Students\ attitude to learning must change before they will be able to learn online	0	-2	-3
14	Solely online training will become more impersonal between Student and trainer	1	-3	1
15	If we don't use Digital technology with trainees, we will be doing them a disservice	1	1	-2

**Table 13: Represents statements related to RQ2's Q-data with the distribution grid position for each factor.*

4.25 Interpretation of Factors and Qualitative Data for Research Question 2 (RQ2)

Research Question 2 shifts the focus of my inquiry towards the pedagogical aspects of trainer-student interactions and the overall student learning experience. The findings reveal that participants across all factors do not believe the quality of learning will decline if students are expected to engage in online learning (s2; -2, -2, -2) or if substantial portions of the curriculum are delivered online (s3; -2, -1, -2).

Additionally, all factors disagree with statement 8 (s8; -3, -1, -3), indicating a belief that students possess the skills and motivation to learn effectively in an online environment. Overall, there is a positive perception regarding students' responses to online learning, as demonstrated by the results for statements 11 (s11; -1, -3, 0) and 13 (s13; 0, -2, -3).

During the semi-structured interviews with trainers and the group discussions with Trainee trainers, concerns regarding multiple digital divides emerged. This aspect was not initially considered in my research questions. Both groups expressed a strong commitment to ensuring that the teaching and learning experience remains equitable and inclusive. FATLR2 remarked, "We often make assumptions, but many students, especially adults, lack the necessary equipment or reliable Internet access.

A researcher must be careful from a social justice perspective; those individuals are not inadvertently excluded, as digital technology can be costly." FATLR4 added that the issue extends beyond just equipment, citing that "some students have never utilized the Internet for research and are unaware of anything beyond their immediate environment" (FATLR4).

The Trainee trainers echoed these sentiments, expressing concerns about "ostracizing" those without the requisite AI digital skills or technological tools for learning. They provided examples of students lacking the digital competencies necessary for effective learning or lacking access to suitable digital resources. Considering the geographical context of the College, it is notable that 68% of 14- to 19-year-olds attending the College come from areas classified as band 1, 2, or 3 of deprivation (DfCLG 2015). Thus, the ramifications of digital divides must be considered when planning future online provisions.

4.26 Factor 1: "I Am Confident and Feel Prepared for the Future"

Participants in factor 1 demonstrate strong disagreement with statement 8 (s8; -3), indicating that they do not believe students inherently possess the skills and motivation needed for independent online learning. Despite this, they recognize that digital learning technologies offer significant opportunities for both trainers and students (s10; 2). Additionally, they do not disagree with the idea that failing to incorporate digital AI tools with students would be a disservice (s15; 1), highlighting a cautious optimism about the potential benefits of technology when applied thoughtfully.

This perspective was reinforced during interviews with both trainers and trainee trainers. One experienced trainer, FATLR4, shared how digital technologies had allowed her to engage students who were previously less active in class discussions. She explained, "Discussions and activities conducted online provide every individual student with the opportunity to respond. This is a very inclusive practice." This illustrates how effectively using AI and other digital tools can foster participation and ensure that all students have a voice in the learning process.

Factor 1 participants consistently provided examples of integrating digital tools into their daily teaching practices to enhance engagement and inclusivity. During a group discussion with trainee trainers, the conversation focused on students' engagement with online learning. One trainee highlighted a blended learning arrangement: "I have a student who attends class just one day a week while completing the rest of her work through distance learning. However, she needs that one day a week with the trainer." This example emphasizes the importance of face-to-face contact for students, particularly mature learners balancing responsibilities such as childcare, while also demonstrating the flexibility that digital technologies can offer.

While factor 1 participants acknowledge that students have some capacity for online learning (s8; -3), they strongly disagree that AI technologies can reliably resolve issues or motivate students exactly when needed (s6; -3). During interviews, trainers expressed anxiety about the unreliability of AI tools. FATLR2 commented, "If the digital technology is unreliable, it undermines both the trainers' credibility and the students' trust in the trainers' abilities; this is crucial for building student confidence in the initial weeks of term." Several participants indicated that they would be more willing to integrate digital technologies more frequently if they were confident in their reliability across different environments, expressing frustration over technical inconsistencies.

Factor 1 participants did not disagree that fully online education has the potential to become impersonal (s14; 1), and they concurred that AI in education should be guided by clear rules for both trainers and students (s12; 2). This reflects a thoughtful awareness that while technology can enhance learning, it requires structure and boundaries to be effective.

Further discussions revealed nuances in how participants approach different types of digital learning. Several trainers expressed comfort with blended learning but raised

concerns about fully distance learning. FATLR2 noted, “I’m comfortable with blended learning, but we should be cautious about distance learning. It depends on what you aim to achieve.” In this context, distance learning refers to self-directed and autonomous study, while blended learning combines regular face-to-face contact with online learning activities.

Statements 1 and 5, which consider the relative effectiveness of face-to-face versus online learning, were scored ‘0’ by this group, indicating ambivalence and a lack of definitive opinion. When prompted, participants explained that their concerns centered on students’ digital capabilities. Responses to statement 4 support this, as participants expressed doubt about students’ digital confidence, scoring (s4; -2).

FATLR4 cautioned against assumptions about young learners being “digital natives,” explaining, “There is a common assumption that young people are digitally native; however, most of our students prefer face-to-face interactions.” While students often use technology in their daily lives, this does not necessarily equip them with the skills required for effective online learning. Participants in factor 1 are clearly aware of the broader implications of digital learning technologies for trainer-student relationships. They recognize that integrating technology into teaching is complex and evolving, with considerations that have yet to be fully defined. Their cautious stance regarding students’ online learning abilities highlights an important insight: while students may be digitally active in everyday life, they do not automatically possess the skills or motivation necessary to thrive in structured online learning environments.

4.27 Factor 2: "I Feel Stimulated and Believe It Is My Responsibility to Stay Up to Date”

Participants in factor 2 strongly agree that digital technology offers numerous opportunities for both trainers and students (s10; 3) and that AI learning technologies empower students to take ownership of their learning (s7; 1). This group concurs that students are leading change by opting for digital resources over print (s9; 1) and trainers would be doing students a disservice by not utilizing a diverse range of digital technologies (s15; 1). However, they strongly disagree with the notion that technology serves as a distraction from students’ learning (s11; -3).

This perspective was echoed during the trainers’ interviews, with comments like, “It’s not a distraction; it just needs to be managed effectively. If a student is engaged in their work but responds to a text message, who does that harm?” (FATER8). This view illustrates the trainers’ confidence in managing student behaviour and technology use in a learning context.

Factor 2 participants prioritize statement 14, asserting that solely online education will become more impersonal between students and trainers (s14; -3). They agree that interactions with students do not necessarily have to be face-to-face (s1; -2), yet they hold an ambivalent view regarding statement 5 (s5; 0), which suggests that online support can

be as effective as face-to-face interactions. Noticing a disconnect between these statements, prompting trainers to elaborate on their thoughts during the interviews.

One trainer who recently facilitated a distance-learning program for the Level 3 Teaching Award shared her experience: “I noticed students disengaging during my distance learning program. While setting up and delivering the course went smoothly, once control was handed over to the students, it became apparent the need for flexibility than anticipated” (FATLR6). The participant explained that students had busy lives and balanced professional commitments with studying, emphasizing that while they completed the work, they did so at their own convenience.

Although similar situations may arise in face-to-face settings, it is evident that trainers feel more confident utilizing established teaching strategies to re-engage students and monitor their progress in person. In this instance, the trainer felt less assured in an online context and was unsure of the appropriate strategies to implement, leading her to believe the course did not proceed as planned.

As the further education sector transitions toward more use of digital resources and flexible teaching and learning approaches, the College must consider changes in both trainer and student behaviours. Additionally, this research indicates that trainers' expectations for online learning experiences need clearer definitions. This underscores the importance of a deeper understanding of digital technology, online, self-study pedagogy and student engagement.

The interviews reinforced the notion that regular trainer interaction with students is essential in both blended and distance learning models. Most factor 2 trainers exhibit confidence in utilizing digital classroom technologies and learning tools that support traditional face-to-face teaching, such as flipped learning, virtual learning environments, and social media, but they are less confident regarding distance learning models.

Responses from factor 2 participants to RQ2 reflect their confidence in the future of trainer/student relationships within a digital education setting, asserting that students are prepared and capable of learning online and that trainers can benefit from online opportunities. While participants maintain a positive stance, this is tempered by the realities of their personal experiences. For instance, FATER8 shared insights about workplace perceptions and her use of digital devices to support her apprentices.

With over 99% of apprentices at the College utilizing an online e-portfolio, she explained, “We must be cautious about perceptions; we have the technology available on an app, which is fantastic, but when you start using your phone, people think you’re texting friends or playing around. This is particularly challenging to manage in the workplace. It feels awkward, although this was done with the same with paper” (FATER8).

4.28 Factor 3: "Students Are More Confident Than We Are, and So I Feel I Need Training"

Participants in factor 3 hold a strong belief that AI-mediated online trainer-student interactions are not as effective as face-to-face relationships (s5; -3) and assert that these connections should primarily occur in person (s1; 1). Discussions within the group revealed a range of perspectives, particularly among trainee trainers, reflecting different experiences with digital learning. One trainee noted, “My Level 3 students are doing really well using technology and have made significant progress,” while another emphasized the importance of balance: “It’s about variety; the first hour engaging and interacting with them, which prepares them for research in the second hour.” These examples suggest that thoughtful integration of digital learning technologies can support student progress, particularly at higher levels.

In contrast, other trainee trainers expressed concerns about motivation, stating, “It’s all about motivation; students get too distracted by digital technology, especially those studying at Level 2.” They explained, “We don’t use online learning with our students, or only on rare occasions; our students need face-to-face interaction.” This highlights the particular support needs of students transitioning from school to college at Level 2, who require significant guidance whether learning in-person or online. The discussion underscored that the students’ course level directly affects their capacity to engage effectively with digital learning technologies.

Overall, trainee trainers felt that lower-level students lacked the maturity, motivation, or digital skills necessary for independent online learning. One participant summarized, “There’s a real need for face-to-face interaction with the trainer for lower-level courses.” These insights emphasize the importance of helping lower-level students develop foundational learning skills as part of their study program. While the College already provides support in this area, the research suggests that how online learning is implemented for these students may benefit from review and refinement.

Factor 3 participants strongly agree with statement 12 (s12; 3), stressing that the use of digital technologies in education requires clear support through established ground rules for both trainers and students. Combined with their concerns about what constitutes quality online learning (s37), these participants lack confidence in interacting online as naturally as they do in the classroom. This uncertainty is compounded by ambiguity around online standards, structures, and expectations.

Trainee trainers expressed a need for clear teaching and learning strategies, structured guidance, and support when using digital technologies with their students. While participants are generally unconcerned about substantial portions of online learning (s3; -2), they acknowledge that fully digital instruction could lead to more impersonal trainer-student relationships (s14; 1). Factor 3’s responses highlight pedagogical concerns about how relationships and learning dynamics evolve in digital contexts.

Although participants recognize that students possess the skills, motivation, and attitude to learn online (s8; -3), they disagree that failing to use digital learning technologies would disadvantage students (s15; -2). This is a distinctive position for factor 3, reflecting a belief that students can succeed online even if digital tools are not fully integrated.

At the same time, factor 3 participants acknowledge the empowering potential of digital technologies. They agree that such tools help students take ownership of their learning (s7; 2) and those students are generally confident digital natives who feel comfortable learning online (s4; 2). This aligns with their perspective on students' competence with AI technologies (s18; 4). However, participants remain ambivalent about whether students are leading change by favouring digital resources over print (s9; 0), suggesting that their observations are still inconclusive in this area.

Overall, factor 3 participants are the least confident about the future of trainer-student relationships in online learning, despite acknowledging that students are ready and capable of learning using digital technologies. Qualitative data from post-Q study group discussions provide a more nuanced view, with some participants offering examples of effectively integrating digital learning technologies in both classroom and blended learning settings. The group highlighted the importance of differentiating approaches based on course level, advocating for specific strategies for Level 2 students compared to higher-level learners. This reinforces the need for structured guidance, clear teaching strategies, and practical support for using AI and digital learning technologies effectively in online, distance, and blended learning environments. Participants also expressed significant anxiety about their own digital competencies, emphasizing the importance of ongoing training and structured support to navigate the complexities of digital technology confidently.

4.29 Interpretation of Participants' Responses to Research Question 3 (RQ3)

Research Question 3 (RQ3) examines How confident do they feel about the inclusion of digital technology such as AI in the curriculum and assessment & how will digital technology impact work base training. Table 12 presents statements relevant to RQ3 and reflects the responses of participants across factors 1, 2, and 3. The Q-data distribution grid placement scores are displayed for each statement within the respective factor columns. By analysing this data horizontally, we can identify consensus points, such as (s23; 2, 1, 2), which indicates agreement across all three factors, while (s18; -1, 0, 4) highlights a controversial statement among the three factors.

No	Statement	F1	F2	F3
16	I am nervous about being a virtual online trainer, it is not for me	-4	0	3
17	I feel confident with digital technologies in education	3	2	-1
18	Trainees are more confident than we are to use of digital technology	-1	0	4
19	If I were to teach adapt digital technology, I would need training for this	-1	-1	2
20	I am confident in teaching myself how to use different digital technology	4	2	-2
21	It is a pressure to keep up with constantly changing digital technology	-2	0	0
22	I feel stimulated and confident to use AI technology for teaching and learning	3	4	0
23	There needs to be more staff development for AI technologies to improve digital literacy	2	1	2
24	Trainers need more training for use of digital pedagogy	3	-2	1
25	I enjoy incorporating different digital technology to suit my delivery	4	2	4
26	I feel unprepared for a AI digital education future	-4	0	-1

**Table 14: Represents statements related to RQ3's Q-data with the distribution grid position for each factor.*

4.3 Interpretation of Factors and Qualitative Data for Research Question 3 (RQ3)

Research Question 3 investigates trainers' confidence in utilizing digital technologies in teaching and learning. Participants across all factors, particularly in factors 1 and 3, express strong agreement that they enjoy integrating various digital technologies into their teaching (s25; 4, 2, 4). Additionally, participants from factors 1 and 2 strongly concur with statement 22 (s22; 3, 4, 0), stating, “I feel stimulated and confident to use digital technology for teaching and learning.” All participants recognize the necessity for enhanced staff development in digital technologies to improve digital literacy (s23; 2, 1, 2) (Table 13). This need is particularly pronounced among factor 3 participants, who believe that students exhibit greater confidence in using AI digital technology than they do themselves (s18; -1, 0, 4).

Upon reviewing the Q-study responses from all participants in relation to RQ1, RQ2, and RQ3, it becomes evident that even the most confident trainers require support and development regarding how and when to effectively use digital learning technologies in their teaching.

My interpretation suggests that while digital technologies are employed by trainers, they are not always pedagogically integrated, leading to student disengagement, as reflected in their responses to RQ1 and RQ2. For instance, trainers might assign online research tasks but fail to facilitate subsequent online peer-to-peer discussions to share the insights gained.

4.31 Factor 1: "I Am Confident and Feel Prepared for the Future"

In response to RQ3, participants in factor 1 demonstrate a high level of confidence regarding digital learning technologies, agreeing that they feel competent in using them (s17; 3) and are confident in their ability to teach themselves how to use various digital tools (s20; 4). Participants such as FATLR2, MATLR3, and FATLR4 expressed their willingness to self-learn, stating, “I’m happy to try, ask for help if needed, and experiment” (FATLR4). They report feeling stimulated and confident in using digital technologies for educational purposes (s22; 3) and strongly enjoy incorporating these technologies into their lessons (s25; 4).

This group feels prepared for digital technology future (s26; -4) and believes they can effectively serve as online virtual trainers (s16; -4). Moreover, they do not feel a need for additional training to teach online (s19; -1). However, when considering the collective findings from factor 1, including insights from RQ1 and RQ2, it becomes apparent that additional training would be beneficial. While participants are confident in digital technologies they currently use, they possess a limited understanding of the broader range of digital learning technologies and the potential advantages of tools like immersive simulation learning environments (s40; 1).

They strongly agree that trainers need more training for use of digital technology in online teaching (s24; 3) and additional staff development to enhance AI digital literacy (s23; 2). As FATLR4 noted, “It’s about how we build staff confidence, removing the fear; you can’t break it.”

Factor 1 participants are unique in their disagreement with the notion that students are more confident than trainers in using digital technology (s18; -1, 0, 4). Prioritized statements indicate a highly confident group of trainers who would benefit from further training and development to bolster their confidence.

4.32 Factor 2: "I Feel Stimulated and Believe It Is My Responsibility to Stay Up to Date",

This is an interpretation of factor 2 participants’ positions and qualitative data collected through post-Q interviews and group discussion.

Factor 2 participants continue to exhibit confidence in their use of digital learning technologies in response to RQ3, strongly agreeing with statement 22 (s22; 4) regarding their stimulation and confidence in utilizing technology. They also agree with statements 17 and 20 (s17; 2) and (s20; 2). Furthermore, they do not feel the need for training to teach online (s19; -1).

While factor 2 participants agree there is a need for more staff development to improve digital literacy, they attribute this need to the broader staff rather than themselves. During trainers’ interviews and trainee trainer’s student group discussions, most participants expressed confidence in their ability to experiment with learning technologies, noting, “Fewer people are frightened of technology these days” (FATER8).

There was a consensus that trainers are at varying levels of proficiency, highlighting the need for digital skills training across the board, from novices to more advanced users.

This notion was echoed in the trainers’ interviews, with comments such as, “Staff need to overcome their fear and resistance to change; different subject areas have different needs” (FATLR6) and “We have ample training; confidence comes from practice.

Staff need to develop trust and feel secure” (FATER8). Although factor 2 participants show ambivalence toward statement 21 (s21; 0), several expressed concern that the rapid pace of technological advancement can be overwhelming, stating, “Trying to keep up can be discouraging” (FATLR5). This challenge also affects the organization’s ability to stay current with the latest technologies, staff continuing professional development (CPD), and facilitating the tools trainers wish to utilize for effective teaching and learning.

4.33 Factor 3: "Students Are More Confident Than We Are, and So I Feel I Need Training",

This is an interpretation of factor 3 participants' positions and qualitative data collected through the Trainee trainer's students' group discussion.

Factor 3 participants reflect the least confidence in using digital technologies for teaching and learning (s17; -1). They strongly agree that students are more confident in using technology than they are themselves (s18; 4) and feel that being an online virtual trainer is not suitable for them (s16; 3).

This contrasts with their agreement with statement 25 (s25; 4), which states, "I enjoy incorporating different digital technologies to suit my teaching." These participants acknowledge their need for training and staff development, recognizing they would require support to teach online (s19; 2) and agreeing with statements 23 and 24 (s23; 2) and (s24; 1) that emphasize the necessity for staff development and training in online pedagogy.

The group discussion quickly turned toward the topic of staff development, with all Trainee trainers agreeing that development days at their colleges often prioritize mandatory training, such as PREVENT and Safeguarding, over opportunities to enhance teaching skills. Comments indicated that these development sessions lack time for reflection on teaching practices or sharing best practices. Several participants expressed frustration, stating, "There's too much packed into development days; we don't have the time to practice new skills." Given that the Trainee trainers are currently engaged in their initial trainer education (ITE) program, I inquired about how well the course prepares them for AI digital learning technologies in their teaching practice.

The students indicated that the course includes minimal content related to AI education and learning technologies, explaining, "We have an online portal for building our online portfolio; however, we don't learn how to conduct an online lesson or webinar." While the Trainee trainers use technology as learners, they do not have opportunities to explore or facilitate online lessons, nor do they learn strategies related to online student motivation and engagement. This gap arguably fails to adequately prepare new teaching professionals for the contemporary workplace or to expose them to a variety of digital teaching and learning tools.

These participants lack confidence in teaching themselves how to utilize different technologies (s20; -2) but express ambivalence regarding their preparedness for a digital education future (s26; -1). Many participants were hesitant about their ability to use digital technologies for teaching, with one student commenting, "It depends; I'm not rushing into it," followed by laughter from others in the group. Most participants shared sentiments that they would prefer to avoid digital teaching and learning technologies, viewing them as distractions rather than beneficial tools for students.

4.34 Summary

In this chapter, I have presented and interpreted the research findings from the Q-study and qualitative data. Through my analysis, I discussed the research findings in relation to each of the three research questions, compared the three factors, and examined responses from semi-structured interviews and group discussions. The emerging themes from the research will be further explored and compared alongside relevant literature in the following chapter.

CHAPTER 5: COMPARISON OF Q DATA AND FINDINGS TO LITERATURE

5 Introduction to comparing Q methodology findings and qualitative data with the reviewed literature

This chapter draws on the findings from both the Q methodology study and the qualitative interviews, several key themes emerged that illuminates how FE college teachers and trainee teachers perceive the role of digital technology in vocational education. This chapter aims at examining those themes in depth, situating them within the wider body of the reviewed literature on digital technology, impact on the F sector and teachers' perception and adaption of digital technology in the further education sector.

By bringing together subjective viewpoints from the Q sort data and the richer contextual insights from the interviews and group discussions. The chapter provides a coherent critical exploration of the patterns, tensions and alignments that characterise the current attitudes within the two colleges toward digital technology in the sector that could be generalised to the FE sector.

5.1 The changing role of the instructor and the dynamic, between the instructor and trainee are constantly evolving.

Many educators acknowledge that their teaching methods are changing because of the impact of digital technology such as AI with the growing need, for graduates skilled in digital technologies and its application in various industries. A majority of them do not view digital technology as a danger to their roles or believe that it will diminish the value of teaching professionalism; likewise, they do not support the idea that traditional classroom teachers will be replaced entirely by technology, this sentiment is consistent, with existing research indicating that integrating technology effectively can improve learning experiences (Selwyn, 2014).

Selwyn (2014, p.60) in his analysis, on technologies raises concerns about how political and commercial interests influence these tools and questions whether caution is necessary in embracing these advancements (Richtel 2011; Selwyn 2014). He suggests that these influences might diminish the role of teachers and disrupt student educator interactions (Selwyn 2014).

The study's results show that most participants do not foresee a reduction, in their roles but instead see education as a future direction to be embraced enthusiastically. Semi formal conversations and group chats showed that participants recognize the progress of technology, in areas such, as robotics and artificial intelligence algorithms but emphasize the value of having a trainer involved in the learning process to feel reassured than intimidated by technology advancements one trainee instructor commented, having a trainer's support and engagement is essential.

One individual mentioned that many people are worried about robots taking over teaching roles but personally I think it's unlikely to happen as most learners value the connection with their teachers. Consensus suggests that the effectiveness of education won't suffer with the shift towards learning and that students find motivation, in this mode of learning.

Both participants, in factor 1 and factor 3 slightly agree that online education could result in a connection between students and instructors a perspective not held by individuals, in factor 2. Educators, like Dewey (1938), Vygotsky (1978), and Hattie and Yates (2014) emphasis how important it is for teachers to build relationships with their students because positive interactions can lead to lasting advantages, for students since positive relationships create experiences and good experiences foster positive relationships" (Hattie and Yates 2014, p.21). In online learning settings some educators and students may feel that potential risks are more noticeable. During a conversation, among trainee trainers it was mentioned that they prefer in person interactions with students than relying solely on online learning methods or using them occasionally.

According to Newman, Beetham, and Knight (2018, p.14) students seem sceptical about how digital tools enhance their connections with tutors or classmates even though there is a desire for technology driven learning experiences, among 37% of further education students (Newman, Beetham, and Knight 2018, p.57). This adds stress to instructors as they strive to provide engaging educational experiences.

Savin-Baden (2015) delves into the difficulties of learning in a time of proficiency where students are consistently linked via devices. Participant raises the question of whether this continuous digital connection brings about advantages or drawbacks, for student education. Participants from categories 1 and 2 demonstrate in their Q sorts a conviction that digital technology presents chances, for both teaching and learning.

The study found that instructors raised concerns, about losing control over the teaching and learning process and their ability to stay connected with students effectively while assessing their engagement and motivation levels an aspect that could impact the achievement of desired learning outcomes as per Hattie and Yates (2014).

They emphasised the importance of interactions between trainers and students based on expectations and shared experiences as highlighted in FATLR6's narrative about facing challenges, with student behaviour in her remote Teaching Award Program. Students, at FATLR8 were feeling anxious because their work was finished later than expected; this reflects the belief that instructors should understand what students need to learn and when they need to do. By no means does this study argue for student freedom, in learning.

Rather emphasizes the importance of educators adjusting to the increasing independence of students. According to Savin-Baden (2015) students should have autonomy, in their learning by engaging in work with peers and problem-based learning strategies as well as co construction methods influenced by (Vygotsky and Kozulin 2012).

Dean et al. (2014) study highlights the increasing impact of advancements in students social and personal lives which heightens their demands for learning encounters; they stress that educational institutions are no longer sole authorities, over knowledge or technology access.

Furthermore, according to Newman, Beetham, and Knight (2018, p.12) students who work together in environments are honing skills, for future work settings; however, their latest study reveals that 27 percent of further education (FE) students have not participated in collaborative online projects (2018, p.12). Scholars such, as Dewey (1938) as more recent researchers like Salmon (2013) Laurillard (2013) Garrison (2015), and Savin - Baden (2015) highlight how trainers play a crucial role in shaping students learning experiences through carefully crafted learning opportunities in education settings.

The importance of trainer involvement is underscored throughout students learning journeys as emphasized by these scholars. Dean et al. (2014, p.19), pinpoint elements that contribute to digital technology learning which encompass aspects such as active participation of trainers maintaining open communication channels, with students navigating cultural shifts and boosting student self-assurance. According to Savin - Baden (2015, p.44) there is recognition that new AI learning methods varied and intricate and could challenge perspectives of education and training in significant ways, over time as instructors begin to incorporate digital tools more widely.

Factor 3 participants acknowledge that although students are ready, for learning there is a gap where instructors might not feel adequately prepared to deliver teaching in this medium. Misunderstandings, between instructors and learners can result in varying expectations and impact the learning process significantly. In studies conducted on this topic far; instructors have raised issues, about evaluating student progress in online settings and have emphasized the challenges that even seasoned educators encounter when gauging effective learning outcomes.

The use of digital technology such as (AI) according to the Further Education Trust, for Leadership (FETL) might help address these issues by giving educators tools to monitor and assist students in settings more effectively. It is suggested by FETL that digital technology could provide instructors with feedback and valuable insights that allow them to help precisely when it is most needed (Barber 2016, pp. 67–74). Barber (2016) argument is that digital technology has the capability to improve customized learning experiences.

As a result, this can help in relieving trainers from some administrative tasks and allowing trainers to focus more on guiding learning and offering the elements of empathy and creativity. Newman, Beetham and Knight (2018) point out the importance of tutors in assisting FE students with skill development despite their reception of digital learning tools. Leading technology experts like Mitra (2018) illustrate the potential for digital technologies such, as augmented reality, and computer vision to revolutionize education

when both educators and learners are empowered. Mitra (2018) in his argument highlighted the potential of digital technologies in learning. Firmly stated their incapacity to ever substitute a skilled trainer.

5.2 The Pace of Industry AI Technological Change

Many individuals feel that it's, up to the instructor to stay to date with the latest digital AI trends, in their fields of expertise and teaching methods. Keeping pace with the evolving AI technology landscape poses notable hurdles for educators. According to McDonald and Cullen (2009) the rapid speed of advancements can be quite daunting as it puts demands on teachers to adapt to new technologies swiftly. This issue is also discussed in research studies, by Jisc (2018a), Phipps et al. And Hartland (2018b) well as, by Beetham (2015, p.8). Beetham mentions how professionals and educators react differently to these changes. Some are excited while others feel distressed. She also points out that stress commonly stems from the worry of falling when changes are seen as quick or widespread and especially when they are implemented in ways that employees cannot influence or manage themselves effectively.

The authors Hargreaves and Fullan (2012) further emphasize that educators frequently sense a need to catch up with advancements underlining the importance of well-structured ongoing professional development (PD/CPD programs to enhance their professional skills and knowledge. Mitra (2018) points out that the fast evolution of technology could make devices outdated quickly and create challenges, for organizations investing in technologies or training staff with budgets already in place. A trainee instructor mentioned how his construction students are well informed because of their industry experience and thus have expectations from trainers to stay updated with their knowledge.

This underscores the challenges trainers encounter due to advancements in their fields, like construction technologies. As a result of this situation, at the Colleges premises is the belief that trainers lack assistance for enhancing their industry knowledge and skills. Those involved have a belief that they bear the responsibility as educators, in a school to equip students for their upcoming professional paths.

According to Newman et al (2018, p.48) students hold views regarding their course software meeting industry standards and preparing them well for a digital work environment, with only half agreeing with its adequacy in meeting these standards and 41 percent feeling adequately prepared for a AI in the workplace, in further education settings.

This aligns with my findings that suggest colleges may not be fully meeting students' expectations when it comes to preparing them for a career, in a driven world. Many participants raised concerns, about the opportunities for trainers to enhance their skills in their roles despite believing it is their duty to stay updated with current practices and trends in AI technology that are reshaping various industries today.

For initiatives like the Post 16 Skills Plan (Department for Business Innovation and Skills 2016) which emphasize incorporating skills into qualification standards to meet demands for digital skill development (ECORYS 2016, p.78) it is crucial to have a clear understanding of trainers upskilling requirements, across all Further Education Colleges. The Educational Task Force (2018 edition b) is dedicated to setting up standards, for teaching using tools and methods in the field of education and training (FE).

It may be premature to gauge its influence on the FE sector at this point; nevertheless, it shows potential in offering direction for education practices and AI learning methodologies. Even though the ETF (2018 edition b) highlights a segment for teaching related to industries; its main focus seems to lean towards keeping of industrial advancements rather, than effectively incorporating these digital technologies into educational settings. With the industry technologies quickly evolving these days I reckon that the ETF framework needs more attention to keep up with these changes effectively.

5.3 Changes in the Further Education Sector Bring Further AI Technological Challenges for Trainers

The implementation of the Technical Level (T Level) qualification changes, between 2020 and 2023 (Department for Education 2018) along with updates to apprenticeship criteria demand educators and evaluators to exhibit assurance in their competencies aligned to their sector requirements. Effectively executing these reforms calls for competent application of tools, in educational delivery and evaluation methods (Education and Training Foundation 2018a, 2018b; Jisc 2018a).

The expert group, at the ETF Technical Education Panel is currently studying how the changes in qualifications are affecting the workforce in the FE sector and trying to determine how many people might be transitioning as a result (information from an ETF document).

The ETF has tasked Frontier Economics with looking into the lack of trainers with digital technology skills and has estimated a gap of 4,700 and 10,900 full time equivalent teaching positions by 2024–2025 (details, from an unpublished ETF document). In a speech, on July 6th in 2017 by Justine Greening, the Secretary of State for Education "We need to do more for trainers in technical education those career professionals who will lead the teaching of the new routes.

Over the next year, she promised to introduce a package of support for trainers in FE sector…, this will include a dedicated program to help industry experts join the profession" (DfE 2017). Though the effort to bring in industry professionals, for teaching is praiseworthy it overlooks the difficulties of enhancing the skills of teaching staff members.

The Commission, on Adult Vocational Teaching and Learning (CAVTL 2013) and the Teach Too project by ETF have taken steps to enhance relationships with employers. The extent of these efforts is somewhat restricted and may not fully grasp the skill

development obstacles encountered in the Further Education sector. In her speech, Greening identified a significant challenge, stating, “I’ll start with technical education and further education because it’s here I feel that we have the furthest to go” (DfE 2017). However, she has not yet revealed any training initiatives or financial support specifically aimed at assisting FE colleges as of now.

The report, from the education and training foundation (2018a, 2018b) emphasizes its role in supporting and improving the Further Education sector in preparation for the reforms outlined in the Post 16 Skills Plan by the Department for Business Innovation and Skills in ((DfBIS 2016),). The report proposes that this support will focus on recruiting and training several technical trainers while also emphasizing their retention.

This study highlights those trainers have a belief in the significance of preparing students for the workforce with an emphasis, on enhancing their digital skills. Teachers want to improve their digital skills to help students better. Are frustrated by the lack of focus, on their own professional development training days are filled with mandatory sessions such as safeguard updates and mental health awareness leaving little room for specialised digital training although these concerns are not new in the education sector the intensity of emotions expressed in this study indicates a need, for quick action to keep up with rapidly changing times.

Recent studies and reports have shown that digital technology is poised to alleviate the workload of staff members, in institutions like colleges based on findings from Jisc and the Department for Education in the UK (2022). The reports emphasise the importance of providing staff members with skills to fully leverage digital skills potential, in streamlining workload and enhancing learning and teaching effectiveness.

5.4 The Digital Teaching Habitus and Initial Trainer Education (ITE)

The results suggest that there are still disparities, in access that affect students’ ability to participate in educational activities. Participants highlighted the need for fairness, in learning and proposed measures to assist students from various backgrounds.

The study highlights three factors that show a difference, in confidence levels among trainers who excel in using digital technologies in their teaching. Mostly experienced trainers. And those who are less sure of themselves, like trainee trainers. This variation has led me to contemplate my views and convictions as outlined in section 3.4.1. At glance I thought the trainee trainers would show dedication and interest, in learning technology compared to the seasoned trainers I consider conventional in their ways of teaching.

However, this change, in perception has made me doubt the mindset and self-assurance of these educators. English and Bolton (2016, p.18) in their study, on practices noted that viewing habits through a perspective can deepen our insights and aid, in bringing about positive transformations since Bourdieusian believed that habit is not fixed but rather fluid and ever evolving (English and Bolton 2016, p.31). The findings suggest that

seasoned educators exhibit self-assurance in adjusting their teaching methods and re-evaluating their approaches to pedagogy.

Factor 2 participants have adapted their ways of using technologies, with confidence to enrich their encounters possibly due to their personal teaching styles in the field of further education.

In contrast, to this group are factor 3 participants who are currently forming their teaching methods that will mature through efforts and relevant learning opportunities as outlined by (Bourdieu 1984). In 2015 and 2016 combined a total of 38,500 aspiring trainee trainers embarked on further education trainer courses as noted by Zaidi et al in their study (2018, p.5).

This information prompts me to ponder whether initial teacher education programs sufficiently equip education trainers for what lies ahead in their careers. Enhancing trainers' digital skills is crucial, for shaping their teaching practice. Taylersons work (2014) pointed out that current initial teacher education curricula do not align well with learning technologies; they lack tools, for evaluating digital literacy levels and fail to provide tailored support to aspiring trainers accordingly.

Four years down the line, Jisc (2018a) presented a competency framework as a diagnostic resource. However, it remains premature to assess its influence on the education domain. Based on this study the colleges Initial Teacher Education program integrates portfolios for aspiring educators but falls short on necessitating preparation, for use of AI in online teaching or fostering a comprehensive grasp of online AI teaching methodologies. Therefore, the teacher training program, at the College does not effectively build up a trainer's skills, which hampers the development of AI teaching approach.

As Dewey (1938) pointed out if trainers are not familiar, with or have not experienced a way of learning. Like using digital tools such as AI. They might find it challenging to establish engaging learning settings for their students. According to this study's findings show that when trainers become more comfortable, with AI tools and technologies they tend to embrace their skills responsibility even more pronouncedly as seen in the second factor participants who firmly believe in keeping up to date with their skills development.

However, it appears that there has been advancement made since Taylersons (2014) assessment regarding the implementation of AI learning technology experience in the FE Colleges ITE program, under study. The digital AI learning encounters of students are diverse; according to ECORY (2016, p.77) their instructors digital competencies play a role, in shaping these experiences.

5.5 Concerns Raised About AI digital divides

Participants, from groups 2 and 3 concurred with statement 4 referred in the study to as (s4; 2,2) indicating their belief that students are adept at using AI technology and find learning comfortable. However, this viewpoint conflicts with worries about disparities in access among students. According to Bennett and Maton (2010) the notion of being digital technology natives is not applicable to all individuals and is not limited to just the youth population.

Furthermore, the argument that digital technology is progressing at a rate than, before instils a feeling of urgency among educators to stay current or face the risk of being outdated (as noted by Bennett and Maton in 2010). Hattie and Yates (2014) argue that the assumption that young individuals have advanced learning abilities because of technologies is inaccurate and impractical. This study highlights trainer's genuine worries, about excluding students from learning chances because of their restricted digital competencies. In conversations, with trainers there was an emphasis on the greater assistance required by lower-level students in contrast, to their higher-level counterparts.

The UKs Digital Strategy was unveiled by the Department, for Culture Media and Sport (DfCMS) in March 2017, pointed out that even though we are in an era many people are still left out of the digital loop. A study revealed that one in ten adults has never gone online. Some individuals are unable to take advantage of opportunities due to reasons like access, to the internet or lacking the necessary skills or motivation.

The emphasis, from The Department for Culture Media and Sport in (2017) stresses on how important it's for individuals to constantly enhance their skills due to the fast-paced technological advancements happening around us all the time. The trainers argue that they require time and opportunities to improve their expertise in industry technological progress as well as their teaching digital skills. Another study by ECORYs in (2016) suggests that "educators in FE and HE should have access to CPD programs to acquire and update their digital AI skills" (ECORYS 2016, p.6). ", even as we acknowledge the vital role digital AI skills play in the UK economy's success story¸ it seems that support, for education falls short of what is truly needed.

5.6 Structure, Guidance, and Online AI Teaching and Learning Strategies

One key idea that stands out in this study is the importance of having guidelines and effective teaching methods, for using tools in education settings The participants with a good grasp of their online teaching methods still expressed worries about keeping students engaged and motivated in remote or blended learning setups. The Educational Training Foundation (ETF) introduced a framework, for digital teaching professionals in November 2018 to tackle some of these issues (ETF 2018a; 2018b), whilst other institutions have adopted education methods, like the Microsoft Certified Educator Programme (Hallissy et al., 2013) and the FutureLearn Blended Learning Essentials Programme (FutureLearn 2018).

The study participants highlighted the importance of providing teaching and learning support to all staff members regardless of their proficiency in using educational technologies. From beginners to experienced users. This assistance is vital, for improving their skills and ensuring a workforce that's digitally adept.

5.7 Trainers Need Time to Explore and Practice

The study highlights the significance of giving teachers the opportunity to explore technologies at their pace and discretion. The participants noted that conducive surroundings encourage creativity and boost self-assurance in utilising resources. The progress, in technologies indicates that mastering the art of teaching is achievable with the help of these tools.

However, this necessitates instructors to feel confident, in reassess in their students' online interactions and educational prospects to make sure they are not just providing information. Students nowadays expect more, from their education. According to Newman et al. (2018) More, than a third of further education students want digital technologies to be better integrated into their courses.

Some individuals, in factor 3 showed concern and nervousness when it came to taking on the role of trainers in a setting or incorporating modern technologies like flipped learning into their teaching methods. They seemed assured compared to those, in factors 1 and 2 when it comes to learning how to use digital tools on their own.

This uncertainty is reasonable since new trainers usually don't have training in these areas and must figure out how to use technologies through their own exploration before incorporating them into their teaching methods. The results suggest that instructors who develop a self-assured approach, to teaching are inclined to try out and delve into teaching and learning tools more often. According to Trowler (1998, p.154) trainers play a role, in facilitating change than just being passive participants in it. In furtherance of this notion, from Hargreaves and Fullan (2012, p.169) organizations are urged to embrace risk taking and entrust trainers with autonomy to foster innovation collaboratively amidst constraints encountered in FE Colleges.

Among trainers who exude confidence and possess a disposition, towards exploring innovative technologies is where this phenomenon becomes apparent. Trowler (1998) in his observations points out that trainers need time to adjust and test things out; after all mastery of approaches doesn't come without a period of learning and adaptation beforehand.

This study suggests that educators who are less confident, in their AI teaching abilities may benefit from a professional development program that aims to enhance their digital AI skills and are hesitant to try out new technologies." Based on a report, by ETF (2018c, p.37) 27 percent of college individuals participated in training in 2017 with just 4 percent considering it as most valuable (ETF 2018c, p.69). "Participants unanimously emphasize the importance of improved staff training, in technologies. Additionally, those in factor 1 prioritize education, on teaching techniques.

Even though the ETF (2018 revision b version) and Jisc (2018 edition a version) frameworks came out two years after gathering data, for this study; there are similarities between my discoveries and these frameworks. In terms of highlighting the importance of industry specific and general digital teaching skills as well as learning and assessment capabilities. Beetham (2015) suggests that students digital AI skills go beyond school as digital technologies play a role, in shaping the changing world of work. Being adaptable and versatile is now crucial, for being employable in today's job market; this makes it more important for trainers to have digital AI skills in their toolkit as well.

According to Beetham (2015, p.13) colleges are grappling with decisions on whether to prioritize investing in tools or enhancing their staffs' digital skills, while focusing on infrastructure might seem like a win strategy initially. In essence though it's not about the technology itself but rather about how it's put into practice and, by whom. According to Harrison (2018) it is highlighted that there are no solutions or instant remedies; instead, the key seems to lie in how instructors and students utilise technology with confidence and competence. There are no silver bullets, no quick fixes, rather, how trainers and learners confidently and competently use technology appears to be the key.

5.8 Summary

Further education colleges play a critical role in delivering a skilled workforce that meets the changing demands of the labour market and drives growth. Digital technology, particularly AI is already delivering benefits across the UK FE sector, but adoption remains uneven. To support FE colleges on their journey to AI maturity, Jisc's new Leading AI in Colleges Strategic Framework offers FE college leaders practical advice to embed AI effectively and responsibly.

In this section of the study discussed trends and their impact, on education alongside existing sources of information. I touched upon the backgrounds of the participants briefly and how it relates to training programs, for educators at the beginning. In the next chapter I will delve deeper into Bourdieus concept of field, human nature, and assets (Bourdieu 1984;1998).

6 A discussion of FE teachers' positions

This reveals a spectrum of digital technology teaching habitus operating within the further education teaching and learning environment.

These varied dispositions shaped by experience, confidence, professional identity, and institutional culture highlight the different ways in which FE practitioners interpret, adopt, and negotiate the role of digital and AI technologies in their everyday practice.

FE teachers increasingly recognize that modern digital tools are reshaping vocational education, prompting a careful reassessment of their professional roles and responsibilities. The integration of digital technologies into teaching practices is no longer optional it is a central part of ensuring that students can access learning in ways that are engaging, flexible, and effective. Drawing on Bourdieu's (1984) concepts of field and habitus, educators' positions within the vocational education landscape significantly influence how they respond to these changes. Field refers to the structured environment of FE education, while habitus encompasses the dispositions, habits, and behaviours that individuals develop over time.

When these elements are aligned, digital transformations can be successfully incorporated into teaching practices; when they are in conflict, teachers may face challenges adapting to new expectations and technologies. Many FE teachers appreciate that incorporating digital technology into their professional practice benefits both themselves and their students. Some educators, for instance, believe that failing to embrace advancements in educational technology would be unfair to the students they serve (source; FATLR2).

This perspective is grounded in the reality that contemporary students are highly familiar with AI and digital tools, and increasingly expect access to these resources as part of their learning journey (Newman et al., 2018). Unlike previous generations, students today are immersed in a digitally interconnected culture where learning is shaped by constant connectivity and online interaction (Savin-Baden, 2015). For educators, this environment presents both challenges and opportunities: challenges in adapting pedagogical practices and maintaining meaningful trainer-student relationships, and opportunities to rethink teaching strategies in ways that actively engage students and leverage the affordances of digital technologies.

The diversity of perspectives among FE teachers reflects the variation in experiences and confidence with digital tools. Some educators see students as highly adept with technology and capable of engaging independently with online learning. Others, however, emphasize the importance of fostering digital independence gradually, particularly for students transitioning from school to college or those in lower-level courses.

This spectrum of viewpoints illustrates the nuanced ways in which educators perceive students' abilities, motivation, and engagement with digital technologies. As Bourdieu (1984, p.225) notes, an individual's position within the educational field significantly shapes how habits and behaviours develop over time. Changes in status, professional experience, or digital competencies—acquired through formal training or practical teaching experience can directly influence how educators adapt to the evolving digital landscape.

The study highlights the critical importance of supporting trainers to maximize the benefits of digital tools in teaching and learning. Trainers recognize that AI and other modern technologies are reshaping education and that students increasingly expect digitally rich learning experiences. The failure to integrate these tools thoughtfully could disadvantage students, yet doing so requires educators to possess both confidence and competence in using digital technologies effectively. This dual requirement underscores the need for ongoing professional development, mentoring, and institutional support to ensure that teachers can navigate the challenges and opportunities presented by digital transformation.

For students, the integration of digital technologies is not just a supplementary feature it is an expected part of the learning experience. In this digitally interconnected environment, students engage with information in ways that differ from traditional classroom models. They may access resources asynchronously, collaborate through online platforms, and use AI tools to support independent study. These shifts necessitate those trainers rethink their pedagogical approaches, designing learning experiences that are interactive, adaptable, and responsive to students' digital literacy levels. In practice, this could include blended learning models where face-to-face teaching is combined with online activities, interactive simulations, or AI-supported feedback mechanisms, allowing students to engage with content in multiple ways.

The implementation of T Level qualifications (Department for Education, 2018) exemplifies how FE education is evolving to meet these demands. Instructors are required to undergo training in digital skills as part of expanding their expertise, ensuring that they are equipped to guide students effectively in a technology-rich learning environment. Fullan (2013, p.68) reinforces this perspective, emphasising that the incorporation of digital teaching and learning tools is essential for both teachers and students to thrive. He advocates for a collaborative effort from educational leadership and teaching staff to create inclusive, digitally supported learning environments that enhance engagement and outcomes.

Importantly, Bourdieu's concept of habitus (Grenfell, 2014, p.45) highlights the dynamic nature of educators' dispositions. Habitus is shaped by social context, interactions with others, and exposure to new experiences. As societal conditions and technological capabilities evolve, so too must educators' approaches to teaching. Shifts in policy, curriculum expectations, and student learning behaviours can push teachers out of their comfort zones, prompting reflection, adaptation, and growth. For FE educators, this often involves reconciling existing teaching habits with the demands of a digital-first

educational environment, where the effective use of AI and other technologies becomes a core component of professional practice.

This study underscores the value of structured training, professional development, and institutional support in helping educators navigate this evolving landscape. Supporting teachers to develop digital competencies not only enhances their confidence but also empowers them to design learning experiences that are engaging, inclusive, and effective. Such support can take many forms, including targeted workshops, peer mentoring, collaborative planning sessions, and ongoing access to digital resources. By investing in these strategies, institutions can ensure that FE teachers are well-prepared to integrate AI and other digital technologies into their teaching, ultimately benefiting both educators and students.

In conclusion, FE teachers are operating within a rapidly changing vocational education landscape where digital technologies are redefining both student expectations and professional responsibilities. While the integration of AI and digital tools presents challenges, it also offers significant opportunities to enhance learning and engagement. Through a combination of professional development, structured guidance, and reflective practice, educators can adapt their teaching to meet the needs of today's students, ensuring that vocational education remains relevant, engaging, and effective in a digital age. The concepts of field and habitus provide a useful lens to understand how individual and structural factors intersect, highlighting the importance of ongoing adaptation and support in fostering both teacher and student success.

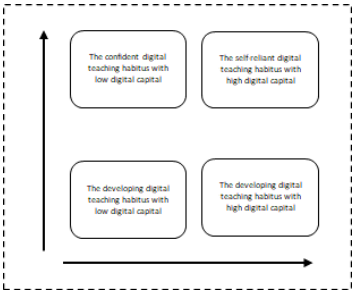


**Figure 6 illustrates the different positions held by the participating trainers in this study.*

6.1 The self-reliant digital technology teaching habitus with high digital capital within the FE teaching and learning field (factor 2)

“I feel stimulated and confident to use digital technologies for teaching and learning…”

Individuals, in this group are figures in the field of teaching and learning in education (FE) known for their well-developed digital teaching practices and extensive digital knowledge (according to Bourdieu 1984).

These teachers are independent, have faith in their responsibility to keep up to date with the advancements (forming habits). They are enthusiastic about trying out digital technologies. Often express a willingness to explore by saying things, like "Let’s give it a try and see."

It is vital to be open, to trying things because Hargreaves and Fullan (2012, p.51) as cited of their work stress how crucial innovation is for training practices of educators and instructors alike according to Beetham (15, p.9) noted in her publication. Informal or formal settings offer trainers opportunities to delve into and get hands on experience with tools for teaching and learning as mentioned by Beetham (15, p.9). Trainers who are self-sufficient in handling interactions with students also find themselves juggling between work responsibilities and personal time, due to digital technology’s increased accessibility.

The trainers discovered through formal interviews that they were actively involved in distance education programs and acknowledged the difficulties posed by the perceived lack of structure, in online learning environments where students display varied behaviours, online Trainers are required to build trust with students while giving them increased autonomy and authority, over their learning process (as mentioned in Savin - Baden 2015).

A potential area of improvement, for these teachers involves deepening their grasp of interactions, between trainers and students well as improving the learning process by encouraging peer collaboration and allowing students to actively contribute to knowledge creation (Vygotsky and Kozulin, 2012). The study suggests that independent instructors who feel capable of teaching AI tools have an understanding based only on their past encounters and access, to information technology (IT).

They could gain advantages from defined professional training methods. This category is inclined to accept and make use of technologies such, as settings and augmented or virtual reality once they are given the chance to learn and explore them. Beetham (2015) perspective suggests that trained employees feel motivated to introduce ideas into their teaching methods to improve the overall teaching and learning process, in an digital environment.

6.2 Confident teaching and learning approach with low capital investment (Factor 1)

"I am confident in using and teaching myself digital technologies for teaching and learning…"

Participants, in this group have a growing teaching style within the field of further education teaching and learning despite having lower levels of digital skills and knowledge. They acknowledge the evolving nature of their roles. Are working to enhance their competence by getting more comfortable with using digital tools for teaching and learning purposes.

These educators grasp the fact that students are immersed in an environment and are eager to learn but they also have reservations, about the effectiveness of online digital learning experiences. They are looking for ways to make sure that learning is of quality and want to be sure that students are actively participating and interested, in their education.

In this group's perspective of relationships, between trainers and students relies heavily on expectations fulfilled through shared experiences (Hattie and Yates 2014; Dewey 1938). They see technologies as digital tools in their work rather than just additional resources (mentioned by Beetham in 2015). Through conversations and discussions, within the group setting they have conveyed their conviction that digital technologies are revolutionizing all spheres of life and profession.

They recognize the importance of training and would greatly appreciate opportunities for growth especially in the areas of using digital technology for online teaching methods and handling interactions among instructors and students along with student-to-student engagement, in virtual environments.

6.3 The developing digital technology teaching habitus with high digital capital within the further education teaching and learning sector.

"Willing teaching and learning approach with strong capital investment".

The group of trainee instructors showed varying degrees of expertise in the process of shaping their digital teaching approaches within the FE teaching and learning (as discussed by Bourdieu in 1984). Being newcomers to the profession in FE teaching sector they currently hold roles within this domain and their level of know-how and evolving teaching methods with inclusion of digital technology are still being established slowly.

Trainee instructors shared opinions about digital tools that echoed those of participants, in factors 1 and 2 implying that they are enhancing their skills. This research suggests that they incorporate technology into their teaching practices as they adapt to the digital learning environments evolution. All trainee educators expressed concerns, about the inadequacy of their teacher training programs, in equipping them for a future so dependent on digital technology.

6.4 The developing digital teaching habitus with low digital capital within the further education teaching and learning sector (factor 3)

“I enjoy incorporating digital technologies in my practice, but students are more confident than we are…”

Participants, in this group are beginners in the field of teaching and learning through technology have limited skills which makes them less sure about using technology confidently for teaching purposes. Their outdated knowledge about the industry causes stress as they find it hard to keep up with the changes happening around them.

Even though they like using tools in their classroom teaching methods they feel unsure about trying out online learning and are cautious, about using social media as an educational resource. They argue that technology has an impact, in the field of education and will likely maintain its influence in the future; however, they also believe that students possess proficiency, with digital tools compared to educators.

According to this study’s findings educators who exhibit confidence levels in using digital tools would benefit from training programs that offer clear instructions effective digital technology teaching methods and well-structured online learning formats.

From the researcher’s perspective it is crucial for educational institutions to establish digital teaching strategies, protocols and quality standards that can guide instructors in creating engaging online learning environments and enhancing student engagement. Staff should also be supported in managing students use of digital technology both in the classroom and online.

The study has shown differences, in behaviour and characteristics among trainers in various roles leading to the need for training programs for educators to focus more on preparing them for using digital tools in teaching and learning because there is a chance for growth that is being missed at present. Hargreaves and Fullan (2012, p.55) of their work say that " capabilities, skills, and qualities that lead to accomplishment build confidence." It's crucial for trainers to build a foundation, in teaching skills to enhance their digital expertise.

6.5 Summary

This section has delved into the outcomes and findings of this study while pinpointing emerging ideas and stances. The convictions, traditions, principles, backgrounds, abilities and encounters of both faculty and learners highlight the range of teaching methods to guarantee that all educators and students get the assistance they require to improve their behaviours and digital assets in the realm of FE education.

Enhancing the environment in modern day Britain involves empowering FE educators in the colleges to address students' requirements and utilise digital tools effectively within the evolving technology digital learning environment. Unlike FE teachers, students are digital savvy and do understand the skills they require to be successful in the labour market once they gain the qualifications and it is for the FE colleges collectively ensure that their staff are fully trained in the use and application of digital technology and ensure their learners are ready for the world of work and not disadvantaged.

CHAPTER 7: IMPACT OF ARTIFICIAL INTELLIGENCE ON FE COLLEGES, TRAINERS & THE FUTURE FE LANSCAPE

7 Introduction & chapter overview

The discussion highlights several important implications for practice. From this analysis, a set of recommendations has been developed for the College that formed the setting for this research. While these recommendations are grounded in the context of the participating institutions, they are equally relevant to the wider Further Education and post-16 sector, where similar challenges, opportunities, and patterns of digital engagement are emerging

7.1 Conclusions and recommendations for FE colleges

Overall, the findings from the literature review, interviews, and survey have addressed the research questions to a large extent, and many of the results align with what might reasonably have been expected given the current state of digital practice in the FE college sector. At the same time, the analysis also highlights several important issues that warrant further investigation. These include the emerging digital divide among teachers, reflecting differences in confidence, exposure to new technologies, and access to professional development opportunities. Concerns about job security as digital tools, including AI, become more embedded in vocational education were also apparent.

The absence of a consistent, sector-wide strategy for integrating digital technologies such as AI into FE teaching, learning, and assessment, alongside ongoing funding pressures, represents a critical challenge for FE colleges. College leadership teams are tasked with providing meaningful professional development and workforce upskilling in a rapidly evolving technological landscape, yet resources are often constrained. These issues underscore the need for sustained research, policy attention, and collaborative approaches to ensure that the sector can adapt effectively to digital transformation.

Digital tools, particularly artificial intelligence (AI), have emerged as some of the most disruptive technological developments of the twenty-first century, influencing multiple sectors of society. Education is arguably one of the most affected fields, given its centrality to human development and economic progress (Chace, 2020). While scholarly literature often focuses on higher education and school systems, relatively little attention has been paid to the role of AI in the UK FE sector. This gap is significant, as FE colleges occupy a unique and strategic position within the UK education and skills ecosystem, bridging schools, universities, and the labour market.

FE colleges face distinct challenges compared to universities. They serve diverse and often disadvantaged learners, deliver vocational and technical curricula aligned with employer needs, and operate under intense accountability frameworks (Ofsted, 2022). Digital tools such as AI have the potential to be transformative, but they are also highly disruptive within this context. Trainers are at the heart of this transformation; their

professional identities, workloads, and pedagogical practices are directly reshaped by AI adoption.

The study highlights the ways in which FE teachers recognize the transformative potential of digital technologies while navigating challenges associated with digital adoption. Many teachers appreciate that modern tools can enhance both teaching and learning, yet they also experience anxieties regarding the reliability of technology, digital competence, and the need for structured guidance. Drawing on Bourdieu's (1984) concepts of field and habitus, these findings illustrate how individual positions within the FE sector influence the development of professional practices. Changes in institutional expectations, digital skill requirements, and pedagogical norms can push educators out of their comfort zones, requiring adaptation, reflection, and support.

Teachers' perspectives vary widely. Some educators perceive students as highly competent with digital tools, while others emphasize the need to build students' digital independence gradually, particularly for lower-level or less confident learners. This diversity reflects the range of experiences, beliefs, and digital literacy levels among both teachers and students. In practice, these findings suggest that while AI and other digital tools can empower learners and enhance engagement, careful scaffolding, structured guidance, and ongoing support are essential to ensure equitable access and effective use.

Based on these insights, several recommendations are proposed for the College, and by extension, for the wider FE and post-16 sector:

- Continuing Professional Development for Industry-Relevant Digital Skills

Teachers recognize that digital technologies are transforming the world of work. To ensure teaching remains current, the College should implement targeted continuing professional development (CPD) focused on sector-specific digital innovations. Such CPD should develop both technical and pedagogical expertise, enabling teachers to deliver instruction aligned with contemporary workplace practices.

- Integrating Digital Teaching, Learning, and Assessment into ITE

The College's Initial Teacher Education (ITE) programme should embed digital teaching, learning, and assessment technologies in a practical and applied manner. Trainee teachers should routinely design and deliver online learning experiences, conduct virtual lessons, and explore teacher-student and student-student online interactions. Embedding these experiences in the ITE curriculum ensures that trainees build the confidence and competence needed to navigate digital learning environments effectively.

- Strategic Investment in Digital Capital

Given the pace of technological change, college leadership should develop a clear digital workforce strategy that extends beyond infrastructure, focusing on building the digital capital of both teachers and students. Ensuring that all stakeholders are digitally

competent, confident, and adaptable is essential for preparing them to thrive in a technology-rich workplace and learning environment.

- Addressing Digital Equity and Inclusion

Equity and inclusion should be central to digital strategy. The College should address multiple digital divides, including access, ownership, skills, confidence, and agency. Teachers should implement strategies to ensure all students can develop their digital capital and are not disadvantaged by differences in digital access or literacy.

- Managing Changes in Behaviour and Expectations

Digital learning requires shifts in behaviours and expectations for both students and staff, particularly regarding online interactions. Leadership should cultivate a positive teaching and learning habitus, preparing both groups to navigate disruption and change while fostering constructive, digitally mediated relationships.

- Progressive Digital Development for Staff

Staff development should support progression from novice to advanced users of teaching and learning technologies. Training should focus on the pedagogical application of digital tools, not just their technical mechanics, ensuring that technology enhances learning outcomes and supports innovative teaching practices.

- Frameworks, Standards, and Quality Assurance

College leadership should establish a clear framework, including standards, guidelines, and quality assurance processes for online teaching, learning, and assessment. Ensuring that staff understand and implement these frameworks consistently will support high-quality digital learning experiences across the institution.

- Supporting Innovation and Knowledge Sharing

Leadership should foster a culture in which teachers have time, resources, and encouragement to innovate, collaborate, and share best practices. Opportunities for reflection, experimentation, and peer learning will support continuous improvement in digital teaching, benefiting both staff and students.

In conclusion, digital technologies, particularly AI, are transforming FE colleges in profound ways. While they present significant opportunities to enhance teaching, learning, and engagement, they also introduce challenges that require careful management, professional development, and strategic planning. By addressing these challenges through targeted support, structured guidance, and a culture of innovation, FE colleges can ensure that both teachers and students are equipped to thrive in an increasingly digital educational landscape.

7.2 Institutional Impacts on FE Colleges

7.2.1 Operational Efficiency and Administrative Transformation

Digital technologies such as AI is no longer a futuristic concept, it is a present-day disruptor from adaptive learning to automated assessments, AI tool is truly reshaping the skills sector and how learners and apprentices are engaging with the content of their training and how awarding organisations are adapting and design qualifications and how FE colleges deliver it. This will give the training sector to be creative and create personalised training pathways for hands on training in many sectors.

The technology will help to provide real-time feedback and support which will benefit trainers to reflect on their approaches and how to give meaningful feedback to learners and apprentices.

The UK faces a significant AI skills shortage across all its sectors; hence the government has called for expanded education pathways into AI, including through FE and apprenticeships. This shift demands the urgent need to upskill all of us involved in designing and delivering education and skills, including employers, to confidently use and teach AI tools.

Colleges and regulators need curriculum reform to embed digital literacy and data fluency across subjects. Awarding bodies need to work closely with colleges and employers to modify qualification content and assessment at a quicker pace than we do currently, ensuring content is up to date and relatable.

In the short term, FE colleges benefit from AI-driven efficiencies in administration and learner support. Chatbots now handle routine enquiries regarding enrolment, timetabling, and course information (Jisc, 2022). Automated marking systems and predictive analytics reduce the administrative burden on lecturers, particularly in assessment-heavy programmes.

This creates opportunities to reallocate staff time towards learner-centred support and teaching innovation. However, efficiency gains come with hidden costs. Colleges require substantial upfront investment in digital infrastructure, training, and cybersecurity with smaller FE colleges risking being left behind if they lack the resources to procure and integrate AI systems (ETF, 2021). In effect, AI may widen institutional inequalities within the FE sector, privileging large, well-resourced colleges while marginalising smaller providers.

7.1.2 Quality Assurance and Data-Driven Governance

AI tools also enhances quality assurance by enabling colleges to monitor student attendance, progression, and achievement in real time. Predictive analytics can identify at-risk learners earlier, allowing for timely interventions (Hao, 2019). For inspection regimes such as Ofsted, this presents a powerful tool to demonstrate institutional accountability and performance outcomes. Yet, reliance on data-driven governance raises ethical and pedagogical risks.

Over-surveillance of learners may undermine trust and erode the pastoral dimensions of FE. Moreover, the validity of AI-driven judgments depends on the quality and inclusivity of the underlying data. If datasets are biased or incomplete, interventions may inadvertently reproduce inequalities, disproportionately affecting disadvantaged learners (Stahl and Wright, 2018).

7.1.3 Governance and Policy Gaps

Unlike higher education, where AI technology adoption is increasingly supported by national and institutional strategies, FE colleges operate in a more fragmented policy environment. While organisations such as Jisc and the Education and Training Foundation (ETF) provide guidance, there is no unified national strategy specifically addressing AI in FE. As a result, colleges often adopt tools reactively or opportunistically, leading to inconsistency and duplication across the sector (ETF, 2021). This governance gap creates risks.

Without clear policy frameworks, ethical guidance, or sector-wide standards, FE institutions are vulnerable to reputational damage, inequitable implementation, and commercial exploitation by private technology vendors. A coordinated strategy, supported by DfE and Ofsted, is therefore essential to ensure equitable and responsible adoption.

7.3 Professional Impacts on Trainers and Trainee Trainers

7.3.1 Pedagogical Practice and Classroom Dynamics

AI digital tools has begun to alter how teaching and learning are organised in FE colleges. Intelligent tutoring systems (ITS) and adaptive platforms offer personalised learning experiences tailored to student progress, enabling differentiated instruction at scale (Ocana-Fernandez et al., 2019). Trainers can integrate AI to monitor learner performance, automate routine feedback, and design assessments that target higher-order skills. Trainee trainers, in particular, are entering the profession at a moment where AI is normalised as part of the pedagogical toolkit. Their openness and digital familiarity position them as early adopters, in contrast with some experienced trainers who express scepticism about AI eroding the human relationship at the heart of teaching.

7.3.2 Workload, Stress, and Professional Identity

One of the most consistent findings from the interviews was the dual nature of AI's impact on trainer workload. On one hand, automation alleviates burdens associated with marking, attendance, and resource management. On the other hand, trainers are expected to constantly learn and adapt to emerging tools, creating new forms of pressure and professional stress. This dynamic has significant implications for professional identity. Some trainers reported feeling reduced to "facilitators of platforms," with AI overshadowing their pedagogical expertise.

Others highlighted AI's empowering potential to provide richer insights into learner progress and free them to focus on mentoring and pastoral support. The profession is therefore undergoing a contested shift, oscillating between fears of de-skilling and opportunities for enrichment.

7.3.3 CPD, Skills Development, and Ethical Literacy

The rapid pace of AI digital tools adoption underscores the urgent need for structured continuing professional development (CPD). FE trainers require not only technical competence but also critical awareness of ethical, pedagogical, and cultural implications of AI. Existing CPD provision, often focused narrowly on digital skills, must be expanded to cover issues such as algorithmic bias, data privacy, and safeguarding in digital environments (Chaudhry and Kazim, 2021).

Communities of practice, such as Jisc's AI in FE network, demonstrate how collaborative peer learning can fill this gap by allowing staff to share experiences and co-create "living guidance" that evolves with the technology. Embedding such collaborative CPD across colleges will be essential to building sector resilience.

7.4 Sectoral Impacts: The Future Landscape of FE in the UK

7.4.1 Towards Personalised and Flexible Learning

AI digital tools promises to accelerate the FE sector's shift towards learner-centred approaches. Adaptive systems can tailor curricula to individual needs, provide real-time formative feedback, and enable 24/7 access to resources. This flexibility is particularly significant for FE, which serves diverse learners including apprentices, adult returners, and those balancing study with employment. However, the danger lies in over-standardisation. While AI tools can universalise access to some forms of learning (e.g., MOOCs), it struggles to capture contextual, affective, and vocational aspects of FE pedagogy (Schiff, 2021). Therefore, AI must be framed as a supplement, not a replacement, for the relational and practice-based elements of FE teaching.

7.4.2 Skills for the AI Economy

The UK government's industrial strategy identifies AI as a key driver of future economic growth (BEIS, 2021). FE colleges will be expected to align their curricula to emerging labour-market needs, embedding digital literacy and AI competencies across vocational programmes. Trainers and trainee trainers thus play a pivotal role in preparing learners not only to use AI tools but also to critically understand their implications for work and society. The study demonstrates the need for closer collaboration between FE colleges, employer representatives, and Skills England to ensure curricula remain responsive to evolving industry demands. Without this alignment, FE colleges risks producing graduates unprepared for the AI-driven labour market.

7.4.3 Ethical and Equity Challenges

AI adoption carries significant ethical risks. Algorithms trained on biased datasets may reproduce systemic inequalities, disadvantaging certain groups of learners (Remian, 2019). The digital divide further threatens equity: learners without reliable internet or digital devices are at risk of exclusion, a problem disproportionately affecting disadvantaged FE learners. The absence of sector-wide ethical governance frameworks exacerbates these risks. Without robust safeguards, AI implementation may undermine rather than advance the inclusive mission of FE. Colleges must therefore embed ethical literacy at institutional and pedagogical levels, ensuring transparency, accountability, and inclusivity.

7.4.4 Institutional Transformation and Global Comparisons

AI is not only reshaping pedagogy but also altering institutional models of FE. Funding frameworks may shift towards outcomes-based funding supported by AI-driven metrics. Partnerships with industry are likely to deepen, as employers demand graduates equipped with AI-ready skills. International comparisons provide useful insights. Australia's TAFE

system and Singapore's WSQ framework demonstrate how national coordination can ensure AI adoption strengthens rather than fragments the vocational sector. The UK FE system must similarly adopt a strategic vision, positioning itself as a leader in socially responsible and ethically governed AI integration.

7.4.5 Synthesis and Critical Analysis

The findings highlight a dual dynamic: in the short term, AI offers efficiency gains, flexibility, and enriched pedagogy; in the long term, it raises profound challenges related to governance, professional identity, equity, and ethics. For trainers and trainee trainers, the central challenge is to reconcile the empowerment AI offers with the risk of de-skilling and professional erosion. For colleges, the challenge is to balance efficiency with equity, ensuring AI supports inclusion rather than exacerbates inequalities. At the sectoral level, the future of FE will depend on how AI is governed: whether it becomes a tool for democratising access to lifelong learning or a mechanism that entrenches systemic divides.

7.5 Summary

While some FE colleges have embraced digital technologies with enthusiasm, others remain cautious, hesitant to fully integrate these tools into their teaching and learning practices. Meanwhile, students are already using digital technologies extensively for study, research, and problem-solving. This rapid uptake highlights a crucial reality: resistance within the sector can limit learners' preparedness for technology-enhanced workplaces and hinder their future employment opportunities.

FE colleges must therefore move beyond caution, embedding digital technologies strategically into curricula and study programmes across all levels, specialisms, and vocational pathways. Doing so ensures that learners not only gain technical competence but also develop the adaptability needed to thrive in an increasingly digital world.

Since the widespread availability of sophisticated digital tools such as large language models, educational practitioners in the FE sector have been grappling with the implications of these powerful technologies. Early responses were cautious, focusing on potential risks such as assessment integrity and academic honesty. Numerous position papers and internal discussions emphasised concerns about the possibility of students misusing technology to bypass learning objectives or compromise academic standards. Over time, however, the discourse has shifted. Educators are increasingly exploring the opportunities digital technologies offer, focusing on enhancing learning, reducing administrative burdens, and personalising student experiences.

FE staff are now leveraging digital tools in multiple practical ways. For instance, technologies can support lesson planning by generating resources, suggesting content sequences, and helping structure learning objectives. They can enhance personalisation, allowing educators to tailor materials to individual student needs and provide differentiated support based on prior performance or learning style.

Digital tools also assist with administrative tasks, including marking, progress tracking, and data analysis, freeing educators to focus on higher-value teaching activities. These applications demonstrate that technology can augment rather than replace educators, allowing them to concentrate on creative and relational aspects of teaching that digital tools cannot replicate.

Despite these benefits, some FE staff worry that technology might eventually replace teachers. Current evidence suggests the opposite: the sector continues to face staffing shortages, particularly in specialised vocational areas, highlighting the indispensable role of human expertise. Digital technologies, while powerful, have limitations. Effective application requires human oversight, interpretation, and adaptation to ensure learning remains meaningful, relevant, and aligned with students' unique needs. Thus, the pressing question for FE colleges is no longer whether digital technologies will replace educators, but how they will transform professional roles, pedagogical approaches, and the broader learning environment.

To navigate this transformation successfully, FE trainers must be trained to use digital technologies effectively. Professional development programmes should focus not only on technical competence but also on pedagogical integration, ethical use, and awareness of the tools' limitations. Colleges should actively promote digital literacy among all staff through mandatory, practical upskilling programmes. By equipping educators with the skills and confidence to integrate technology into teaching, FE colleges can prepare students for a labour market where digital competence is increasingly critical. Students who understand digital tools and their applications, alongside potential limitations, will be better positioned to succeed in technologically advanced workplaces.

The impact of digital technologies on FE colleges is multi-layered. At an institutional level, technology adoption affects operational processes, course delivery models, and workforce planning. At a professional level, it influences trainer identities, pedagogical practice, and relationships with students. At a sectoral level, technology has the potential to reshape the FE landscape, redefining the skills and competencies that graduates require. Although integration is still at an early stage, the potential to transform teaching, learning, and professional practice is significant.

Short-term benefits of digital technologies efficiency, automation, and flexibility must be weighed against long-term considerations, including equity, ethical governance, and professional identity. Effective adoption requires coordinated strategies, robust frameworks, and inclusive continuous professional development (CPD) pathways. Trainers and trainee trainers will play a pivotal role in mediating the relationship between learners and technology, ensuring that digital tools enhance learning rather than undermine human engagement. For instance, while technology can provide instant feedback to students, only a skilled educator can contextualise that feedback, address misunderstandings, and encourage critical thinking.

FE colleges now face a decisive moment: they can lead in shaping an inclusive, socially responsible approach to digital technologies or risk fragmented adoption driven by external commercial interests. Digital tools are no longer emerging trends they are already embedded in professional practice across industries. This creates an opportunity to prepare students not only with technical skills but also with the adaptability and critical thinking needed in technology-enhanced workplaces. Education must move beyond treating digital tools as mere instruments and foster understanding of how technology is transforming workflows, decision-making, and creativity across sectors.

Many professionals now operate with a "digital-first" mindset, seamlessly integrating technologies into workflows to brainstorm ideas, refine thinking, challenge assumptions, and accelerate outputs. In workplaces, both approved and unofficial "shadow" tools are increasingly used to enhance efficiency and innovation. FE colleges have the opportunity to model responsible, informed use of technology, ensuring that students develop both competence and ethical awareness. Preparing students to work effectively alongside digital tools is no longer optional it is essential for maintaining employability in a rapidly evolving economy.

However, careful attention is required. FE teachers do more than deliver content they design, adapt, and contextualise learning experiences for diverse students. Many FE educators bring substantial industry experience, which informs creative and meaningful teaching approaches. Overreliance on digital technologies for content creation or lesson planning risks turning teachers from creators into curators, undermining professional identity and the relational, contextual aspects of teaching critical in FE. Technology can provide efficiency and scale, but it cannot replicate human judgment, empathy, or the nuanced understanding of student needs that experienced educators provide.

FE college leaders must therefore develop strategic approaches to technology adoption, ensuring it enhances rather than replaces professional expertise. Practical steps for embedding digital tools effectively include:

- Conducting curriculum audits to identify areas where technology integration is relevant and where its impact is growing.
- Reviewing courses to ensure qualifications reflect the role of digital technologies across technical, vocational, and business fields.
- Engaging employers to track workforce changes driven by digital technologies and emerging skill requirements.
- Partnering with industry leaders to align training with real-world applications and career pathways.
- Ensuring all FE staff have the minimum digital competencies required to embed technology effectively in teaching and learning.

Additionally, the sector must address equity and inclusion. Digital tools can inadvertently exacerbate existing divides if not implemented thoughtfully. Trainers must be equipped to support students with varying levels of access, confidence, and skills, ensuring that all

learners benefit from technology-enhanced education. Clear guidance, structured CPD, and a focus on pedagogical integration will be key to achieving these goals.

In conclusion, digital technologies present both opportunities and challenges for the FE sector. Their effective adoption requires leadership, strategy, and professional development. If approached thoughtfully, technology can transform teaching, learning, and employability outcomes. FE colleges have a unique opportunity to lead the sector in creating socially responsible, inclusive, and pedagogically sound practices. By equipping staff and students with the skills, knowledge, and ethical frameworks necessary to navigate a digital world, FE colleges can ensure learners are prepared not only for current employment but for the future of work. Digital technologies are not a threat to FE education they are tools that, when used wisely, have the potential to enrich the learning experience, enhance professional practice, and transform vocational education for generations to come.

CHAPTER 8: CONTRIBUTION TO PRACTICE AND RECOMMENDATIONS FOR FUTURE RESEARCH

8 Introduction & overview of contribution to practice and recommendations for future research

This study offers several contributions to practice within the FE sector, particularly in understanding how teachers and trainee teachers position themselves in relation to digital and AI enhanced learning. It also identifies areas where further investigation is needed to deepen sector-wide understanding and support more informed decision-making.

8.1 Contribution to practice

This study has revealed insights, into how AI tools with the responsibilities of educators in Further Education (FE). Through a combination of research methods such as Q methodology and qualitative interviews¸ the research has showcased how educators adjust to integrating AI tools into their teaching methods¸ underscoring the necessity of offering tailored assistance to educators according to their varying levels of comfort and familiarity with AI tools¸ a targeted strategy, for cultivating a successful digital teaching setting.

Therefore, the findings of this research will help leaders, in institutions devise plans for enhancing growth and incorporating AI technology effectively into their practices. Many colleges have initiated modifications, to their development schemes by introducing training programs aimed at improving educators' abilities to seamlessly incorporate AI tools into their teaching methods.

8.2 Limitations of this Research

In research discussions, about limitations arise when we consider the shortcomings that could affect the outcomes and understanding of discoveries made during the study progression. During my research exploration insights into my viewpoints and different research methods were gained. This enabled me to evaluate research strategies. Theofnidis and Fountouki (2018) highlight that all research ventures encounter limitations like challenges, with theoretical frameworks study layout replication prospects data gathering discrepancies and measurement inaccuracies.

It's important to deal with these restrictions because researchers need to recognize their assumptions and point out any issues that could be fixed. The researcher, in this study understood these limitations. Discussed them at the beginning of the study (Price & Murnan, 2004; Wang et al., 2015).

To enhance the reliability of results and the understanding of data, in research projects it is important for researchers to be transparent about the limitations of their study as the boundaries and assumptions they have made during their investigation process, the failure

to address these aspects can weaken the trustworthiness of a study (Theofanidis & Fountouki 2018).

The impact of artificial intelligence is a contemporary issue that is affecting the education sector in general and in particular the skills sector as the driving engine of the UK economy. Thus, I believe that this will add a great deal to the limited existing literature and to the FE colleges in the UK.

The current research encountered constraints such as:

- The emphasis, on two education institutions may not accurately reflect the overall landscape of colleges, in the United Kingdom
- The limited number of participants, in the study may limit how broadly the findings can be applied.
- The study is limited to the FE colleges in the UK to better understand the wider implications of AI is having of the skills sector. The findings could be applied to other countries with an understanding of each country's cultural context and ecosystem drivers.

My past experiences, with research have shown me the restrictions of interviews that typically only reveal what participants want to disclose. This awareness prompted me to investigate research approaches and ultimately opt for Q methodology. Although the Q study offered a perspective of viewpoints, I acknowledged that incorporating supplementary qualitative techniques, like semi structured interviews and group conversations could enrich my analysis.

This method resonates with my research interests. I don't see it as a restriction of Q methodology all. Instead, the Q study produced data that led to enlightening conversations often uncovering perspectives that differed from those shared in focus groups. This setting nurtured a sense of trust allowing participants to feel at ease and less restricted by their roles, within the organisation.

Ideally, I would have conducted interviews, with all the participants after the training session but due to time limitations and scheduling conflicts, with the trainees who were leading the session I opted for a group discussion instead. This approach turned out to be effective. Had its limitations. For instance, it was challenging to delve into the reasons why some participants agreed or disagreed with statements especially when their viewpoints differed.

Q methodology proved to be a choice revealing insights that would have otherwise remained undiscovered. Attendees found the activity engaging and discovered perspectives through self-reflection that they hadn't realized before. I will take the constraints highlighted in this study and my assumptions into account when shaping research endeavours.

Throughout my research expedition I've accumulated diverse experiences and perspectives on my beliefs and the array of research methodologies I encountered.

Engaging in this study enabled me to assess research methods. Theofnidis and Fountouki (2018) suggest that every research endeavours encounters constraints and boundaries that may stem from factors such, as theories adequacy and coherence of study design for potential replication issues in data collection methods and questionnaire design to the limited sample sizes for statistical analyses along with the constraints of collecting data within specific timeframes while considering cultural nuances and addressing issues related to missing data and measurement errors, in the sample population under scrutiny is crucial for researchers to scrutinize their assumptions thoroughly and highlight any shortcomings that could be rectified. The researcher, in this study acknowledged these limitations. Dealt with them promptly (Price & Murnan, 2004; Wang et al., 2015).

8.2 Recommendations for Future Research

The Further Education (FE) sector in the UK occupies a pivotal role in preparing learners for an increasingly complex and technology-driven labour market. Digital technologies, such as artificial intelligence (AI) tools, immersive simulations, data analytics platforms, and collaborative learning software, are already embedded across global industries, presenting both unprecedented opportunities and significant challenges for FE colleges, their teachers, and their learners.

This study highlights largely positive outcomes from the adoption of digital technologies, while also emphasising the urgent need for proactive strategies in curriculum design, staff development, ethical governance, and labour-market alignment. Technologies like AI are no longer futuristic concepts they are present-day disruptors reshaping how learners engage with content, how qualifications are designed, and how teachers deliver learning.

The adoption of digital technologies opens the sector to new possibilities in vocational education. Personalised learning experiences can be developed, tailored to individual strengths, career aspirations, and learning preferences, allowing students to reach their full potential. For example, AI tools can analyse learner progress in real time, recommend personalised resources, and provide instant feedback. Advanced digital technologies are also enabling immersive simulations in areas such as healthcare, engineering, and digital media, offering learners experiences that were previously difficult or impossible to replicate in a classroom environment.

The UK faces a significant shortage of skills related to emerging technologies. Government initiatives have called for expanded and diversified educational pathways into digital skills, particularly within the vocational sector, where FE colleges are uniquely positioned to contribute alongside higher education. Awarding bodies must respond by reviewing qualifications and assessment strategies to ensure that course content remains up to date and aligned with industry needs.

Stronger partnerships between FE colleges, employers, and industry stakeholders will further help align training with workforce requirements. Such collaborations can encourage employers to invest in the sector and ensure that courses reflect the realities of the evolving labour market.

With these challenges come opportunities: the FE sector is well-positioned to lead in the UK's digital transformation, not only by teaching technical skills but by reimagining vocational education itself. Embedding both green and digital competencies across vocational pathways aligns with national priorities and prepares learners for future-focused careers.

This section outlines recommendations for future research, institutional practice, and sector-wide strategy. It also considers the implications of digital technologies for teachers, trainee teachers, and college leaders, situating findings within broader educational and sociological theories. Some areas were beyond the scope of this study but warrant further exploration for example, how disparities in access, confidence, and digital skills affect interactions between learners and trainers, and how institutions address issues of equity and inclusion.

Investigating these dynamics through the lens of Bourdieu's theories on culture and social reproduction offers a rich avenue for research. As education increasingly embraces adaptable teaching methods, it is important to consider how students' and instructors' behaviours, expectations, and interactions have shifted in online and technology-enhanced learning environments. Dewey's work on education as a means to shape habits (Dewey, 2011) is particularly relevant, as it suggests that embedding digital tools including AI can influence both teaching practices and student learning behaviours.

FE colleges must allocate resources to ongoing professional development for staff, enabling them to incorporate digital technologies effectively into teaching and learning. This ensures that both educators and learners are equipped to maximise the benefits of these tools. Policymakers and sector leaders should work collaboratively to explore how technologies, such as AI for lesson planning, personalisation, and assessment analytics, can enhance pedagogical approaches, learning experiences, and administrative processes.

One key area for consideration is how digital technologies can optimise the administrative and logistical tasks handled daily by trainers, and the subsequent effects on learner experiences. The sector must evaluate the long-term impacts of integrating AI and other digital tools on employability, career progression, and alignment with evolving job market demands. Questions around whether these technologies will replace teachers have dominated discussions, but evidence increasingly shows that tools such as AI enhance productivity, free up educator time for higher-order tasks, and support professional practice rather than supplant it.

FE leaders need to rely on valid, empirical data rather than speculation when planning for the future. Research indicates that digital technologies are already transforming workplaces, providing concrete insights into how qualifications, pedagogy, and career pathways should evolve. FE colleges must ensure graduates are not only capable of using AI tools but are prepared to work alongside them, validating and improving technology-generated outputs as part of their professional roles.

The literature highlights that middle-tier professional roles positions many FE graduates will enter are particularly affected by digital transformation, making technological literacy and adaptability critical.

FE programmes must reflect workflows augmented by digital technologies, rather than simplistic narratives of automation or replacement. While digital skills are essential, manual and human-focused professions must remain deeply human-led, emphasising decision-making, ethics, and interpersonal skills areas that technology cannot replicate. The most profound shift brought by digital technologies, including AI, is not simply which jobs may change but how work itself is fundamentally evolving. Professionals increasingly delegate routine and analytical tasks to technology, using it to enhance creativity, speed decision-making, and support complex problem-solving.

This shift raises critical questions for education:

- Who stands to benefit most from digitally augmented productivity?
- What new skills and competencies will be essential in a technology-driven workplace?
- How can qualifications evolve to remain relevant in this changing landscape?

FE colleges are uniquely positioned to take a proactive role—not simply reacting to technology's effects but actively preparing students with both technical skills and the human flexibility needed to succeed in digitally enhanced workplaces. By following these recommendations and implementing them strategically, UK FE institutions can harness digital technologies, including AI, to improve the quality of teaching and learning while mitigating risks.

Practical steps include:

- Auditing existing curricula to identify where digital technologies, including AI tools, are already integrated and where further application is possible.
- Reviewing courses to ensure that qualifications reflect the role of technology across digital, technical, and vocational fields.
- Engaging employers to track industry-driven changes and emerging skill requirements.
- Building partnerships with industry leaders to align training with real-world workflows and career pathways.
- Ensuring staff possess minimum digital competencies to embed technologies effectively in teaching and learning.

Equity and inclusion must remain central. Digital tools, particularly AI, can inadvertently exacerbate existing divides if not implemented thoughtfully. Trainers must support students with differing levels of access, confidence, and skills to ensure that all learners benefit. Clear guidance, structured CPD, and a focus on pedagogical integration will be key to achieving these outcomes.

In conclusion, digital technologies, with AI tools as a key example, present both opportunities and challenges for the FE sector. Their effective adoption requires strategic leadership, evidence-based decision-making, and robust professional development. When implemented thoughtfully, digital tools can transform teaching, learning, and employability outcomes. FE colleges have the opportunity to lead the sector in creating socially responsible, inclusive, and pedagogically sound practices. By equipping staff and learners with the skills, knowledge, and ethical frameworks needed to navigate a technology-enhanced world, FE colleges can ensure graduates are prepared not only for current employment but for the future of work. Digital technologies are not a threat to FE education they are tools that, when used wisely, enrich learning experiences, strengthen professional practice, and transform vocational education for generations to come.

8.3 How can future research support a Long-Term AI Strategy for Further Education Sector

Despite growing attention to digital technologies in higher education, research specifically focused on FE colleges remains limited. While universities have received significant scrutiny over the impact of AI and other digital tools on pedagogy and employability, FE colleges face a unique set of challenges and opportunities that are underexplored. FE institutions cater to a diverse learner population, including apprentices, part-time students, and vocational trainees, often with varying levels of digital access and confidence. Therefore, future research needs to reflect these distinctive contexts.

This study suggests several directions for further inquiry:

- **Comparative research** exploring how UK FE colleges' adoption of digital technologies, including AI tools like ChatGPT, GitHub Copilot, DALL·E, and Canva AI, compares with similar institutions globally, such as TAFE in Australia, US community colleges, or German vocational schools. Comparative insights could highlight best practices and transferable models for integrating technology in vocational education.
- **Inequalities and inclusion** examining how digital divides affect teacher–student interactions and opportunities for disadvantaged learners. Employing Bourdieu's theory of cultural and social reproduction as a critical lens, research could assess whether technological adoption reinforces or mitigates existing inequalities. This is particularly important in FE, where students often come from diverse socio-economic backgrounds.
- **Behavioural shifts in online and blended learning** building on Dewey's conception of education as habit formation. Researchers should examine how AI and other digital technologies reshape teacher and student behaviours in virtual classrooms, including changes in engagement, communication, and self-directed learning.
- **Teacher professional identity and workload** investigating whether digital tools reduce administrative burdens or inadvertently risk "de-skilling" educators by automating routine tasks. Understanding these dynamics is critical to ensuring

that technology supports, rather than diminishes, the professional status of FE teachers.

- **Employability and curriculum alignment** focusing on how FE colleges adapt curricula to prepare students for technology-augmented professional roles. Particular attention should be paid to middle-tier occupations, such as healthcare technicians, construction project managers, or administrative professionals, where automation is increasingly influential but human oversight remains essential.
- **Policy and governance** addressing the lack of systematic guidance on ethics, safeguarding, and accountability in FE contexts. Research in this area could inform sector-wide strategies for responsible technology integration.

8.4 A Curriculum that Keeps Pace with Technology

Digital technologies are already transforming entire sectors. In healthcare, AI-assisted diagnostic tools, virtual simulations, and predictive analytics enhance patient care while providing learners with immersive, practice-based experiences. In finance, algorithms optimise risk modelling and automate routine reporting, freeing professionals to focus on strategic decision-making. In the creative industries, generative tools like DALL·E and Canva AI accelerate content creation and allow for rapid prototyping of designs. These changes do not signal widespread job loss; rather, they redefine roles, create new occupations, and recalibrate professional expectations.

FE curricula must respond more rapidly to technological evolution. Curriculum refresh cycles in FE are typically measured in years, while technology advances in months, creating a risk that students graduate unprepared. To address this:

- **Adaptive learning experiences** should be co-designed with employers to ensure programmes evolve alongside industry requirements. For example, construction apprenticeships could integrate BIM (Building Information Modelling) software alongside AI-driven project management tools.
- **Embedding digital technologies** across core subjects rather than restricting them to IT or computing classes ensures digital fluency for all learners. This could include healthcare students learning to interpret AI-generated diagnostic reports or creative media learners using generative tools to enhance content creation.
- **T Levels and apprenticeships** should integrate practical applications of digital tools, ensuring learners entering the workforce gain experience in AI-augmented workflows. For instance, retail apprentices could use AI-driven inventory management platforms to understand supply chain optimisation in real time.

For teachers, this requires confidence and capability in modelling responsible technology use. Professional development must expose educators to real-life applications, allowing them to translate industry practices into classroom learning. Without this, teachers risk being positioned as passive users rather than active mediators of digital knowledge.

8.5 The Human Skills That Remain Essential

Curriculum reform alone is insufficient. While AI and other digital tools can analyse data, draft content, automate routine processes, and support decision-making, they cannot fully replicate creativity, ethical reasoning, or nuanced judgement. Research demonstrates that human–technology collaboration often plateaus creatively, whereas human-only teams continue to refine and improve ideas (Amabile, 2020).

FE colleges must emphasise skills that technology cannot replicate, including:

- **Creativity and innovation** – the ability to iterate, take risks, and engage in divergent thinking. These skills are crucial in fields such as digital media, engineering design, and entrepreneurship.
- **Ethical reasoning** – particularly in professions requiring human oversight, such as healthcare, law, or governance. Understanding the limitations and biases of digital tools is essential for responsible practice.
- **Interpersonal and leadership skills** – collaboration, empathy, and communication remain vital in unpredictable work environments. Professions involving client interaction, team coordination, or mentoring cannot be fully automated.

These are not "soft skills" but foundational capacities that will define employability in technology-augmented workplaces. FE colleges must ensure that graduates are equipped with a balance of technical proficiency and enduring human skills.

8.6 Building AI Literacy for All

Digital literacy, including familiarity with AI tools, should become as fundamental as computer literacy once was. This does not require all learners to become programmers; rather, they must develop competence in:

- Framing effective prompts and instructions for AI tools.
- Interrogating outputs for bias or error, or misleading information.
- Interpreting data and distinguishing reliable insights from flawed results.
- Considering the ethical and societal implications of automation and AI use.

For FE colleges, this means embedding technology awareness across vocational pathways. For example:

- Healthcare apprenticeships can incorporate AI-assisted diagnostic and treatment planning tools.
- Business and banking apprenticeships can use AI-driven analytics platforms to support decision-making.
- Creative media programmes can integrate generative design and content tools like Canva AI or DALL·E.

By normalising technology use within learning, colleges can build student confidence, critical digital judgement, and readiness for AI-augmented workplaces.

8.7 From Challenge to Opportunity

Public discussions and debates often frames AI as a threat to employment. Yet FE colleges are uniquely positioned to transform this challenge into opportunity. By embedding AI in teaching, assessment, and student support services, colleges can create a workforce that is not merely employable but empowered:

- Confident in questioning AI outputs.
- Fluent in ethical application of technology.
- Creative in adapting AI tools to solve emerging challenges.
- Equipped with human-centred skills that complement automation.

In this way, the FE sector can move beyond reactive adaptation and actively shape AI integration into pedagogy and workforce development.

8.8 What Policymakers and Providers Can Do Now

To seize this opportunity, progress is required on three interconnected fronts:

- **Curriculum reform** – embedding digital concepts across disciplines and ensuring alignment with industry workflows.
- **Teacher training** – prioritising CPD to build confidence and capacity in using AI and other digital tools.
- **College–employer partnerships** – strengthening collaboration to ensure training reflects real workplace practices.

These steps ensure FE provision remains relevant while safeguarding human-centered skills that underpin adaptability and employability.

8.9 Potential long-term AI strategy for the FE sector

A coordinated, sector-wide strategy is essential. FE colleges must move beyond debating whether to adopt technology, to exploring how it should be integrated responsibly. Key elements include:

- **Dedicated leadership** – appointing senior leaders responsible for digital strategy.
- **Strategic CPD** – offering continuous, tailored training and collaborative learning communities.
- **Investment in infrastructure** – upgrading legacy systems and integrating emerging digital tools and AI applications.
- **Ethical governance** – establishing clear policies on accountability, malpractice, and safeguarding.

- Pedagogical innovation – supporting flipped and learner-responsive models that use AI to enhance rather than replace teacher–student interaction.

By embedding these principles, FE colleges can ensure technology strengthens the sector rather than undermining its core mission.

8.10 Conclusion

Digital technologies are not merely tools for automation but catalysts for rethinking pedagogy, professionalism, and employability in FE colleges. Integrating these tools into curricula, assessments, and student support systems has the potential to:

- Enhance learning experiences.
- Empower teachers.
- Prepare graduates for technology-augmented workplaces.

Achieving this requires:

- Curriculum agility to keep pace with industry change.
- Teacher development to model responsible technology use.
- Embedding human skills as central to employability.
- Sector-wide strategy that balances innovation with ethics.

Proactive action ensures graduates are prepared to work critically and creatively alongside technology, blending technological fluency with timeless human skills such as curiosity, resilience, and ethical judgment.

FE colleges are uniquely positioned to lead this transition—not passively responding to change but actively shaping how digital technologies are embedded into pedagogy, assessment, and workforce preparation. Coordinated strategies, investment in teacher capacity, and prioritisation of inclusivity can ensure technology enriches learning experiences while equipping students for meaningful, sustainable careers in a technology-augmented economy.

8.11 Reflective Summary

This study began with a proposal and literature review on digital technologies in post-16 education, with a focus on FE colleges in the UK. Researching technology in this sector required deep understanding of policy, funding pressures, and widening participation agendas (DfE, 2023; Keep, 2018).

Engaging with FE trainers and trainee teachers highlighted the realities of technology adoption in vocational education, where digital transformation is uneven and shaped by local context. Methodologically, Q methodology was used to capture subjective professional beliefs, recognising the socially constructed nature of perspectives (Brown, 1980; Watts & Stenner, 2012).

Designing Q-sets, facilitating Q-sorts, and interpreting factor arrays demanded methodological sophistication and reflexive awareness, aligning with Schön's (1983) reflective practitioner model. Data collection revealed practical challenges, including staff workload, time constraints, and securing voluntary participation, reflecting wider structural pressures (Simmons & Thompson, 2021). These challenges fostered resilience, relationship-building, and ethical sensitivity, contributing to my development as an independent researcher.

Drawing on Kolb's (1984) experiential learning cycle, I observed iterative learning through engagement, reflection, and adaptation. This process extended beyond academic growth to professional transformation, reshaping my understanding of educational research as both inquiry and sector advocacy. Brookfield's (2017) critical reflection framework helped interrogate my assumptions about technology and pedagogy, grounding the research in professional realities rather than technological optimism.

Balancing full-time work in the skills sector with this study demanded careful time management, resilience, and prioritisation (Wellington, 2015). Despite moments of uncertainty in participant recruitment and thematic analysis, perseverance reinforced my identity as a practitioner-researcher in FE. Most significantly, the study deepened my commitment to socially just and ethically responsible research. Exploring algorithmic bias, teacher autonomy, and the role of human skills highlighted the moral dimensions of digital technology in education (Williamson & Eynon, 2020). Digital tools are not simply technical solutions—they are pedagogical, ethical, and societal challenges.

This journey was only possible due to encouragement from colleagues, family, and friends. As Trafford and Leshem (2009) note, doctoral research is both intellectual and emotional, requiring academic rigour alongside endurance, belief, and purpose. This experience underscored that independent research can drive meaningful sector change while fostering personal and professional growth.

Appendix 1: The 42 statements in themes corresponding with the three research questions (RQ).

No	Statement	RQ
1	I think the relationship with the student needs to be face-to-face	2
2	I am concerned that the quality of learning will go down if students are expected to learn online	2
3	I have real concerns with large chunks of learning being delivered online	2
4	I believe students are digital natives and feel more comfortable learning online	2
5	I think through online support, the student, trainer relationship can be as effective as face-to-face	2
6	Using technology, you can resolve issues quickly and motivate students exactly when they need it	2
7	Digital technology enables students to take ownership of their learning	2
8	I don't think students have the skills or motivation to learn online	2
9	Students are leading change as they make a definite choice to use digital resources over print	2
10	I think technology brings many opportunities for both the trainer and student	2
11	AI technologies are a distraction for students' learning	2
12	AI in education needs to be carefully supported by trainer and student ground rules	2
13	Learners' attitude to learning must change before they will be able to learn online	2
14	Solely online education will become more impersonal between student and trainer	2
15	If we don't use digital technology with students, we will be doing them a disservice	2
16	I am nervous about being a virtual AI online trainer; it's not for me	3
17	I feel confident with AI in education technologies	3
18	Students are more confident than we are to use AI technology	3
19	If I were to teach online, I would need training for this	3
20	I am confident in teaching myself how to use different AI technology	3
21	It is a pressure to keep up with constantly changing digital technology	3
22	I feel stimulated and confident to use digital technology for teaching and learning	3
23	There needs to be more staff development for digital technologies to improve digital literacy	3
24	Trainers need more training for online pedagogy	3
25	I enjoy incorporating different digital technology to suit my delivery	3

26	I feel unprepared for a digital education future	3
27	I see the future role of the trainer as a coach or facilitator, someone who guides the student through online learning	1
28	I worry that AI technology creates an expectation of immediacy of response for trainers	1
29	I believe there is a requirement to change my teaching practices because of AI technology	1
30	AI technology will dehumanise and de-professionalise the trainer	1
31	It is the responsibility of the trainer to stay up to date, particularly in relation to sector specific AI technology	1
32	There is a danger to trainers being always accessible; you don't get the time back or the energy	1
33	I think technology will have a negative impact on the future role of the trainer	1
34	AI Technology developments have led to a blurring between work, education time and social time	1
35	I use social media and feel it is a great way to engage with students	1
36	AI technology offers better opportunities for staff to develop communities of practice	1
37	We need to understand what a quality online experience looks like; what is outstanding?	1
38	Technology is a way of saving money	1
39	Teaching will certainly change as digital education takes a more predominate role	1
40	Vocational education is practical; you can't do that online	1
41	Classroom trainers will become extinct	1
42	AI in education is the future for trainers, we need to embrace it	1

Appendix 2: Q-sort instruction script

Dear Participant,

Thank you for your valuable contribution to my research on trainers' positions and viewpoints on impact of AI in further education colleges and trainers' role. I appreciate your willingness to participate in this activity.

As you have already been informed, you have been provided with a distribution grid ranging from -4 to +4, where +4 represents the statements, you most agree with, and -4 represents the statements you most disagree with or least agree with.

kindly I ask that you read through all the preset statements made available to you carefully and sort them into three categories: one for the statements you agree with, one for the statements you disagree with, and one for the statements you are unsure about.

Once you have your three categories ready, please proceed to place the statements on the distribution grid. Arrange the statements you most agree with on the positive (+) right-hand side, and the statements you disagree with or least agree with on the negative (-) left-hand side. Please ensure that you are satisfied with the placement of all the statements before writing the number of each statement in the corresponding box on the grid.

Your feedback will provide valuable insights to will help me better understand the perspectives of trainers in a response to use of AI technology.

Thank you again for your time and contribution. If you have any questions or concerns, please do not hesitate to reach out.

Best regards,

Appendix 3

APPENDIX 3a: The colour coded view of the TED students' Q-sorts							
	Statement	FTED2	MTEDE3	MTEDE4	MTEDE5	FTED6	FTED7
1	I think the relationship with the student needs to be face-to-face	0	1	4	0	-1	1
2	I am concerned that the quality of learning will go down if students are expected to learn online	-1	-2	1	-3	-3	-1
3	I have real concerns with large chunks of learning being delivered online	0	-1	-1	0	-1	-2
4	I believe students are digital natives and feel more comfortable learning online	1	-1	-1	0	-2	4
5	I think through online support, the student, teacher relationship can be as effective as face-to-face	-3	-2	2	0	0	-3
6	Using technology, you can resolve issues quickly and motivate students exactly when they need it	-2	0	-1	-2	-1	-1
7	Digital technology enables students to take ownership of their learning	1	-2	-1	3	-1	3
8	I don't think students have the skills or motivation to learn online	-3	-2	-2	-3	-1	-2
9	Students are leading change as they make a definite choice to use digital resources over print	0	0	0	0	0	1
10	I think technology brings many opportunities for both the teacher and student	-1	1	-4	0	3	1
11	Digital technologies are a distraction for students' learning	0	0	2	-2	0	1
12	Digital education needs to be carefully supported by teacher and student ground rules	4	0	4	1	4	3
13	Learners' attitude to learning must change before they will be able to learn online	-1	-3	1	1	-2	-1
14	Solely online education will become more impersonal between student and teacher	2	-2	3	-3	3	2
15	If we don't use digital technology with students, we will be doing them a disservice	1	-4	0	1	-1	-1
16	I am nervous about being a virtual online teacher; it's not for me	0	3	-4	-3	-1	3
17	I feel confident with digital education technologies	-2	-1	-1	1	2	1
18	Students are more confident than we are to use technology	2	3	0	-1	-2	4
19	If I were to teach online, I would need training for this	2	3	1	1	-2	0
20	I am confident in teaching myself how to use different digital technology	0	2	-2	3	2	-2
21	It is a pressure to keep up with constantly changing digital technology	4	1	0	2	3	0
22	I feel stimulated and confident to use digital technology for teaching and learning	1	2	-2	-4	1	-1
23	There needs to be more staff development for digital technologies to improve digital literacy	-1	1	-3	2	1	0
24	Teachers need more training for online pedagogy	2	4	2	-3	4	0
25	I enjoy incorporating different digital technology to suit my delivery	0	0	4	-2	2	3
26	I feel unprepared for a digital education future	-2	-2	-4	-3	-3	-4
27	I see the future role of the teacher as a coach or facilitator, someone who guides the student through online learning	0	-1	0	-2	1	-1
28	I worry that digital technology creates an expectation of immediacy of response for teachers	-3	0	1	-3	0	1
29	I believe there is a requirement to change my teaching practices because of digital technology	2	0	1	1	1	0
30	Digital technology will dehumanise and de-professionalise the teacher	2	-2	1	0	-3	-3
31	It is the responsibility of the teacher to stay up to date, particularly in relation to sector specific technology	1	2	-3	2	-2	2
32	There is a danger to teachers being always accessible; you don't get the time back or the energy	0	-1	0	0	-4	2
33	I think technology will have a negative impact on the future role of the teacher	-2	-3	-2	-3	0	0
34	Technology developments have led to a blurring between work, education time and social time	0	1	-3	0	0	-2
35	I use social media and feel it is a great way to engage with students	-1	1	-3	2	2	-4
36	Digital technology offers better opportunities for staff to develop communities of practice	-1	-1	1	1	0	0
37	We need to understand what a quality online experience looks like; what is outstanding?	3	3	3	2	1	2
38	Technology is a way of saving money	3	0	2	-1	2	0
39	Teaching will certainly change as digital education takes a more predominate role	4	2	1	2	1	-3
40	Vocational education is practical; you can't do that online	2	-3	-2	1	-4	-2
41	Classroom teachers will become extinct	3	-3	2	-4	0	-3
42	Digital education is the future for teachers, we need to embrace it	1	3	2	1	3	2

APPENDIX 4 Q-sort semi-structured interviews – a sample of questions and answers with participant

Question – "When asked the question about how your teaching is changing because of digital technologies and whether trainers are better suited as coaches and (or) facilitators. What do you think?

" FATLR6 – "I feel it is positive because if you have the digital technologies that support you as a trainer, I feel it can free up time if everything is online. The marking side can be a lot easier. I think student tracking is easier using digital technologies because I am already doing it, and I think it works really well. I think it is going to enhance teaching and learning rather than make it a negative thing. I think you still need face to-face but there are different ways of doing that, using different digital technologies."

Question – "Do you think your teaching has changed over recent years because of digital technologies?" FATLR6 – "For me personally and with all the flipped classroom stuff we do in beauty therapy I think it has made it more accessible to the students. They can access learning whenever they want to, especially with videoing all the different techniques that we use in our practical lessons. From a teaching perspective I know that for some of the team it has been great to be able to watch the videos before actually delivering the lesson, to make sure they know exactly what they are doing."

Question – "So you have a natural community of practice and sharing of good teaching practices." FATLR6 – "Yes that's it, there is standardisation, accessibility for the students and giving ownership to them so they can prepare themselves before coming into the lesson, which is the idea of flipped classroom anyway. It is how we, as trainers, manage it that is important."

Question – "Are your students confident in using digital technologies for learning?

" FATLR6 – "Our students are switched on, straight from school, at home, they all have technology, and they are in it all of the time. Definitely, yes – all my students have Internet connection, only two students have come and said they needed a bit of help to use technology, and I think that they were just not as confident as the other students."

Question: "You scored statement 22: 'I feel stimulated and confident to use digital technology for teaching and learning' +3 which indicates you have a strong position on this point; can you tell me why?

" FATLR6: "We flip the areas we know our students forget and it works well. I use flipped classroom personally and it is more accessible to students. We video our more technical techniques."

Question: "You find that helps the students.

” FATLR6: “They all have Internet connection and most can use the technology. Our 16–18-year-old students will also support the adult students. That peer support has worked really well.”

Question: “The younger students are happy to support the adult students.

” FATLR6 “Yes they enjoy it”

Question: “The next theme is about how effective is the trainer-student relationship when using digital technologies?

” FATLR6: “Yes, I have experienced this first hand this year with my distance learning programme. As time has gone by, they have lost their confidence using the VLE, and for their last assignment students were emailing me rather than uploading their work to the VLE. I think I will give them more responsibility next year, it is about getting the balance right.”

Question: “So have you found an issue with motivation for the students to go online?

” FATLR6: “I don’t think it is lack of motivation, they are all youth workers and busy, and so it is getting the time, and then there is the family and other things. They completed the work it was just not how I had planned.

” FATLR6 “I made the mistake of doing too much for them. The setting up and delivery of the course worked really well, but when I handed it over to them, I had to be a little more flexible than I thought I would have to be.”

Question: “But that flexibility worked well for the students.

” FATLR6: “Oh yes.”

Question: “Do you find that the learners are leading change?

” FATLR6: “The younger students are, they expect it because they are so use to it, and they are not fazed by it.”

Question: “So how do you use blended online learning?

” FATLR6: “It is about getting the percentage of online activity to face-to-face right for blended learning. I use blended learning with students, for example students who use flipped learning prepare themselves before attending their lesson, and they love it.”

FATLR6: “I am not sure my 16–18-year-old students are motivated to complete solely online with no face-to-face. Like I say I have experienced students’ disengagement on my distance learning programme.”

Question: “Do you think digital technologies can be a distraction to students in the classroom?

” FATLR6: “Yes, I think it is, but students also use social media really well. I have students who use Instagram to create their portfolios. My students get work through Instagram.

” FATLR6: “We are using mobile phones in the classroom more and more because of students taking pictures for their professional online portfolio.”

Question: “Do you think we would be doing students a disservice if we did not use digital technologies with them?

” FATLR6: “Yes I do, all the positive things we do with digital technology, students being able to watch a video over and over again until they know it.”

Question: “The final theme is about how confident staff are in using digital teaching and learning technologies.

” FATLR6: “If I see technology and like it, I have a go, and if there is anything I don’t know I will ask, and then I practice.”

APPENDIX 5: Concept map of teachers' semi-structured interviews – sample of the comments from participants for a particular theme

"Technology can be scary for some learners. We use email routinely and we don't always realise students don't." FATLR2

"I would like to explore using technology much broader to engage students." FATLR4

"They have all used technology at school so they expect it." FATLR5

"Students live in the computer age, so they like it; they do expect and prefer electronic versions." FATLR5

"If we are not careful we can lose the interpersonal relationship with our students and each other. Just like the way you see people sitting next to each other texting." FATER8

"Online learning is not an ideal strategy if you are trying to engage at a deep level." FATLR2

"There is the notion that young people are digital natives, most of our students would prefer face-to-face." FATLR4

Tainer and Trainee Practice

I am not sure students are motivated to complete solely online with no face-to-face. I have experienced students' disengagement on my distance-learning programme. " FATLR6

"Discussions and activity allow every individual student the opportunity to answer. This is very inclusive practice." FATLR4

"It is getting the percentage of online activity to face-to-face right for blended learning." FATLR6

"I made the mistake of doing too much for the students." FATLR6

"It is not a distraction, it just needs managing correctly. If a student is working, engaged and doing their work, if they reply to a text message, then who is it hurting?" FATER8

"Technology sometimes feels awkward when you are filling in forms in for the learner. We would have done the same with paper but it feels strange." FATER8

"I am fine with blended learning but feel we should be cautious about distance learning. It depends on what you are trying to do." FATLR2

"Mobile phones can distract but students can also use them effectively in class, we use Instagram a lot." FATLR6

"How do you know the students have not gone down the wrong avenue or have hit a problem that they don't know how to solve? They lose their safety blanket." FATLR2

"We have to be careful about perceptions, we have the technology on an app, which is fantastic but when you start using your phone people don't think you are doing your job." FATER8

Face-to-face is also necessary with my group of students." FATLR6

Appendix 5a: Concept map teacher education students' discussion group – sample of the comments

"Students get bored and technology is a distraction. If they go on the computer they access social media"

"I think we already use digital technology, because I use QR codes and different types of technology."

"You would automatically think that students are growing up with technology, some of our students don't even have a smart phone, some have basic phones and no Internet access."

"My level 3 students are doing really well using technology and have progressed well."

"I don't think you can be a facilitator if you were a virtual teacher, I don't think it would be as effective as the classroom."

"I think we need to think about health and wellbeing. You can hardly teach PE and promote health and wellbeing watching a video."

"Watching a video is surely better than a book."

"Technology is always changing, and it is difficult to keep up with the changes."

"There is a big fear that teaching will be replaced by robots, bit I don't think that will happen, most students want a relationship with their teacher."

"Students are used to using technology in everyday life."

Teacher in and Trainee Practice

"Students know how to use social media but not necessarily anything else."

"It is about variety, I use the first hour to engage and interact with my students and then set them up for research for the second hour."

"The evening groups of students are really up to date and expect us to be right up to date in the subject."

"I mean with flipped learning how do you know the students have watched the video and what if some don't."

"The different subject areas are different, each have a different need for a community of practice."

"We are also finding that students are losing their skills to write."

"In some subjects students will not like technology, it ostracises them."

Appendix 6:

CONFIDENTIALITY AGREEMENT (for PhD Research)

This Confidentiality Agreement ("Agreement") is entered into by and between:

Disclosing Party:

[Your Full Name], PhD Researcher at [University Name], [Department Name]

AND

Receiving Party:

[Name of Collaborator/Advisor/Participant/Institution]

[Title/Role]

[Organization Name]

1. Purpose

The purpose of this Agreement is to protect the confidentiality of information disclosed in relation to the PhD research project titled:

"[Title of PhD Project]".

2. Definition of Confidential Information

Confidential Information includes, but is not limited to:

- Research data (raw or processed)

- Methodologies or unpublished findings

- Technical or scientific information

- Interview transcripts or participant information

- Drafts of academic work, including theses and papers

- Any proprietary software, tools, or algorithms

3. Obligations of Receiving Party

The Receiving Party agrees to:

- Maintain all Confidential Information in strict confidence

- Not disclose the Confidential Information to any third party without prior written consent

- Use the Confidential Information solely for the purposes of the research collaboration, review, or advisory role

4. Exceptions

Confidentiality does not apply to information that:

- Is already publicly available or becomes publicly available through no fault of the Receiving Party

- Is rightfully obtained from another source without restriction

- Is required to be disclosed by law, regulation, or court order (with notice to the Disclosing Party)

5. Term

This Agreement shall remain in effect for a period of [X] years from the date of signature, or until the research is formally published or publicly disclosed, whichever occurs first.

6. Return or Destruction

Upon completion of the research or upon request, the Receiving Party shall return or destroy all Confidential Information, including any copies or derivative materials.

7. Governing Law

This Agreement shall be governed by and construed in accordance with the laws of [Jurisdiction or University's Country].

IN WITNESS WHEREOF, the parties have executed this Agreement.

_____

[Your Full Name]

PhD Researcher

Date: _____

_____

[Receiving Party Name]

[Title/Institution]

Date: _____

Appendix 7

How do you feel about your role in digital education enviroment? (Factor 1)

-4	-3	-2	-1	0	1	2	3	4
I am nervous, about being a virtual online trainer, it's not for me	Using technology, you can resolve issues quickly and motivate trainees exactly when the need it	I am concerned that the quality of training will go down if trainees are expected to learn online	Digital technologies are a distraction for trainees' learning	I think the relationship with the trainees needs to be face-to-face	Solely online trainingng will become more impersonal between trainee and trainer	I think technology brings many opportunities for both the trainer and trainee	I feel confident withj digital learning technologies	I am confident in teaching myself how to use different digital technology
I feel unprepared for a digital education future	I don't think trainees have the skills or motivation to learn online	I have real concerns with large chuncks of learning being delivered online	Trainees are more confident than we are to use technology	Online training alone will induce the personal touch between the trainee and the trainer	If we don't use digital technology with trainees, we will be doing them a disservice	Digital learning needs to be carefully supported by trainer and trainee ground rules	I feel stimulated and confident to use digita technology for training and learning	I enjoy incorporating different digital technologies to suit my delivery
2	There is danger to trainees being always accessible, you don't get the time back or the energy	I believe trainees are digital native and feel more comfortable learning online	If I were to teach online, I would need training for this	Digital technology enables trainees to take ownership of tehir learning	I believe there is a requirment to change my teaching practices because of digital technology	There needs to be more staff development for digital technologies to improve digital literacy	Trainers need more training for online pedagogy	2
	Classroom trainers will become extinct	Trainees are leading change as they make a definite choice to use digital resources over print	I worryt that difgital technology creates expectation of immediacy of response for trainers	Trainees attitude to learning must change before they will be able to learn online	It is the responibility of the trainer to saty up to date, particularly in relation to sector specific technology	We need to understand what a quality online experience looks like, what is outstanding?	Training will certainly change as digital training takes a more predominant role	
	4	It is a pressure to keep up with constantly changing digital technology	I think technology will have a negative imapct on the future role of the trainer	I see the future role of the trainer as a coach or facilitator, someone who guides the trainee through online learning	Technology is a way of saving money	Digital education is the future for trainers, we need to embrace it	4	
		5	Digital technology offers better opportunities for staff to develop communities of practice	Digital technology will dehumanise and de-professionalise the trainer	Vocational education is practical, you can't do that online	5		
			6	Technology developments have led to a blurring between work, education time and social time	6			
				I used social media and feel it is a great way to engage with students				
				8				
		Most disagree	←	Nuetral	→	Most agree		

How do you feel about your role in digital education enviroment? (Factor 2)

-3	-2	-1	0	1	2	3	4
Digital technology will dehumanise and de-professionalise the trainer	I think the relationship with the trainees needs to be face-to-face	I have real concerns with large chunks of learning being delivered online	Digital learning needs to be carefully supported by trainer and trainee ground rules	Digital technologies enables students to take ownership of their learning	I believe trainees are digital native and feel more comfortable learning online	I think technology brings many opportunities for both the teacher and student	I feel stimulated and confident to use digita technology for training and learning
Digital education needs to be carefully by teacher and student ground rules	I am concerned that the quality of learning will go down if students are expected to learn online	I don't think students have the skills or motivation to learen online	Using technology, you can resolve issues quickly and motivate students exactly when they need it	Students are leading change as they make a definite choice to use digital resources over print	I feel confident with difgital education technologies	I see the future role of the trainer as a coach or facilitator, someone who guides the trainee through online learning	It is the responibiliaty of the trainer to saty up to date, particularly in relation to sector specific technology
Solely online education will become more impersonal between student and teacher	Students attitude to learning must change before they will be able to learn online	If I were to teach online, I would need training for this	I am nervous, about being a virtual teacher, it is not for me	If we don't use digital technology with students, we will be doing them a disservice	I am confident in teaching myself how to use different digital technology	I believe there is a requirment to change my teaching practices because of digital technology	2
I think technology will have a negative imapct on the future role of the teacher	Teachers need more tarining for online pedagogy	I worryt that difgital technology creates expectation of immediacy of response for teachers	Students are more confident than we are to use technology	The needs for more staff development for digital technologies to improve digital literacy	I enjoy incorporating different digital technology to suit my delievry	I use socila media and feel it is a great way to engage with students	
4	Digital technology will dehumanise and de-professionalise the teacher	There is a danger to teachers being always accessible, you don't get the time back or the energy	It is a pressure to keep up with constantly changing digital technology	Technology developments have led to a blurring between work, education time and social time	Digital education is the future for trainers, we need to embrace it	4	
	5	Teaching will certainly change as digital education takes a more predominate role	I feel unprepared for a digital education future	Digital technology offers better opportunities for staff to develop communities of practice	5		
		6	We need to understand what a quality online experience looks like, what is outstanding	6			
			Technology is a way of saving money				
			8				
	Most disagree	←	Nuetral	→	Most agree		

How do you feel about your role in a digital education environment (Factor 3)

-4	-3	-2	-1	0	1	2	3	4
I use social media and feel it is a great way to engage with students	I think through on line support, the student, teacher relationship can be as effective as face-to-face	I am concerned that the quality of learning will go down if students are expected to learn on line	Using technology, you can resolve issues quickly and motivate students exactly when they need it	Students are leading change as they make add finite choice to use digital resources over print	I think the relationship with the student needs to be face-to-face	I believe students are digital natives and feel more comfortable learning online	Digital education needs to be carefully supported by teacher and student ground rules	Students are more confident than we are to use technology
Classroom teachers will become extinct	I don't think students have the skills or motivation to learn online	I have real concerns with large chunks of learning being delivered online	I feel confident with digital education technologies	I think technology brings many opportunities for both the teacher and student	Solely on line education will become more impersonal between student and teacher	Digital technology enables students to take ownership of their learning	I am nervous about being a virtual online teacher; it's not for me	I enjoy incorporating different digital technology to suit my delivery
2	Learners' attitude to learning must change before they will be able to learn online	If we don't use digital technology with students, we will be doing them a disservice	I feel unprepared for a digital education future	Digital technologies are a distraction for students' learning	Teachers need more training for online pedagogy	If I were to teach online, I would need training for this	We need to understand what a quality online experience looks like; what is outstanding?	2
	Digital technology will dehumanise and de-professionalise the teacher	I am confident in teaching myself how to use different digital technology	I see the future role of the teacher as a coach or facilitator, someone who guides the student through online learning	It is a pressure to keep up with constantly changing digital technology	Digital technology offers better opportunities for staff to develop communities of practice	There needs to be more staff development for digital technologies to improve literacy	Digital education is the future for teachers, we need to embrace it	
	4	Technology developments have led to a blurring between work, education time and social time	I worry that digital technology creates an expectation of immediacy of response for teachers	I feel stimulated and confident to use digital technology for teaching and learning	Technology is a way of saving money	It is the responsibility of the teacher to stay up to date, particularly in relation to sector specific technology	4	
		5	I believe there is a requirement to change my teaching practices because of digital technology	There is a danger to teachers being always accessible, you don't get the time back or the energy	Teaching will certainly change as digital education takes a more predominate role	5		
				I think technology will have a negative impact on the future role of the teachers	6			
				Vocational education is practical, you can't do that online				
				8				
		Most disagree	←	Nuetral	→	Most agree		

Appendix 8

Q-study data produced

The role of the teacher in a digital education environment														
Path and Project Name: C:\PQMethod\projects\digital/teachers														
Correlation Matrix Between Sorts														
SORTS	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
FATLR1	100	4	22	18	26	-12	-13	10	14	-5	3	18	6	-25
FATLR2	4	100	24	52	-22	47	30	35	31	25	-23	52	34	23
MATLR3	22	24	100	55	-17	32	9	13	26	-4	2	46	50	12
FATLR4	18	52	55	100	-21	37	39	36	32	18	5	52	51	15
FATLR5	26	-22	-17	-21	100	-37	-22	-20	13	5	30	1	-11	-2
FATLR6	-12	47	32	37	-37	100	52	35	-5	9	-18	44	28	17
MATLR7	-13	30	9	39	-22	52	100	48	9	20	-45	28	18	13
FATLR8	10	35	13	36	-20	35	48	100	20	23	-47	9	21	24
FTED2	14	31	26	32	13	-5	-4	23	23	34	7	37	11	44
MTEDEx3	-5	25	-4	18	5	9	20	23	34	100	-11	19	11	36
MTEDEx4	3	-23	2	5	30	-18	-45	-47	7	-11	100	5	-2	7
MTED5	18	52	46	52	1	44	28	9	37	19	5	100	22	13
FTED6	6	34	50	51	-11	28	18	21	11	11	-2	22	100	10
FTED7	-25	23	12	15	-2	17	13	24	44	36	7	13	10	100

Unrotated Factor Matrix								
SORTS	**FACTORS**							
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
FATLR1	0.0651	0.4506	-0.3193	0.7022	0.0078	-0.0760	-0.0370	-0.0501
FATLR2	0.7398	0.0112	0.0523	0.0060	0.1971	-0.1967	0.3389	0.4471
MATLR3	0.5769	0.3651	-0.4232	-0.1218	-0.2729	-0.0888	-0.1654	-0.3009
FATLR4	0.7775	0.2510	-0.2095	-0.0222	-0.0657	0.0943	0.0134	-0.0251
FATLR5	-0.3292	0.5250	0.2254	0.3361	0.2420	0.4479	-0.2105	0.2094
FATLR6	0.6721	-0.3124	-0.1955	-0.2536	0.3121	0.0474	-0.1592	0.0362
MATLR7	0.5933	-0.5022	0.0359	0.1345	0.2370	0.3061	-0.2474	-0.1388
FATLR8	0.5939	-0.3354	0.1977	0.4147	-0.2712	-0.0058	-0.2639	0.1647
FTED2	0.4142	0.5298	0.4793	0.1138	-0.1309	-0.3417	-0.0563	-0.0084
MTEDEx3	0.3618	0.0642	0.6414	0.1057	0.5080	0.2754	0.4274	-0.3616
MTEDEx4	-0.2808	0.6586	-0.0492	-0.4626	0.1291	0.1701	-0.1239	0.0757
MTED5	0.6516	0.3636	-0.1127	-0.0305	0.5209	-0.1216	0.0104	-0.1098
FTED6	0.5526	0.1709	-0.2911	-0.1302	-0.4461	0.4468	0.2219	0.1795
FTED7	0.3737	0.1267	0.6579	-0.351	-0.1826	-0.033	-0.3144	0.0608
Eigenvalues	4.0046	2.0333	1.6308	12549	0.934	0.7949	0.6937	0.5696
% expl.Var.	29	15	12	9	7	6	5	4

Unrotated Factor Matrix								
SORTS	FACTORS							
	1	2	3	4	5	6	7	8
FATLR1	0.0651	0.4506	-0.3193	0.7022	0.0078	-0.0760	-0.0370	-0.0501
FATLR2	0.7398	0.0112	0.0523	0.0060	0.1971	-0.1967	0.3389	0.4471
MATLR3	0.5769	0.3651	-0.4232	-0.1218	-0.2729	-0.0888	-0.1654	-0.3009
FATLR4	0.7775	0.2510	-0.2095	-0.0222	-0.0657	0.0943	0.0134	-0.0251
FATLR5	-0.3292	0.5250	0.2254	0.3361	0.2420	0.4479	-0.2105	0.2094
FATLR6	0.6721	-0.3124	-0.1955	-0.2536	0.3121	0.0474	-0.1592	0.0362
MATLR7	0.5933	-0.5022	0.0359	0.1345	0.2370	0.3061	-0.2474	-0.1388
FATLR8	0.5939	-0.3354	0.1977	0.4147	-0.2712	-0.0058	-0.2639	0.1647
FTED2	0.4142	0.5298	0.4793	0.1138	-0.1309	-0.3417	-0.0563	-0.0084
MTEDEx3	0.3618	0.0642	0.6414	0.1057	0.5080	0.2754	0.4274	-0.3616
MTEDEx4	-0.2808	0.6586	-0.0492	-0.4626	0.1291	0.1701	-0.1239	0.0757
MTED5	0.6516	0.3636	-0.1127	-0.0305	0.5209	-0.1216	0.0104	-0.1098
FTED6	0.5526	0.1709	-0.2911	-0.1302	-0.4461	0.4468	0.2219	0.1795
FTED7	0.3737	0.1267	0.6579	-0.351	-0.1826	-0.033	-0.3144	0.0608
Eigenvalues	4.0046	2.0333	1.6308	12549	0.934	0.7949	0.6937	0.5696
% expl.Var.	29	15	12	9	7	6	5	4

The role of the teacher in a digital education environment								
Path and Project Name: C:\PQMethod\projects\digital/teachers								
Cumulative Communalities Matrix								
Factors 1 Thru..								
SORTS	1	2	3	4	5	6	7	8
FATLR1	0.0042	0.2072	0.3092	0.8023	0.8023	0.8081	0.8095	0.812
FATLR2	0.5472	0.5474	0.5501	0.5501	0.589	0.6277	0.7425	0.9424
MATLR3	0.3329	0.4662	0.6452	0.6601	0.7346	0.7424	0.7698	0.8603
FATLR4	0.6045	0.6675	0.7114	0.7119	0.7162	0.7251	0.7253	0.7259
FATLR5	0.1083	0.389	0.4347	0.5477	0.6063	0.8069	0.8512	0.895
FATLR6	0.4517	0.5493	0.5875	0.6518	0.7492	0.7514	0.7768	0.7781
MATLR7	0.3521	0.6042	0.6055	0.6236	0.6798	0.7735	0.8347	0.854
FATLR8	0.3527	0.4652	0.5043	0.6762	0.7498	0.7498	0.8195	0.8466
FTED2	0.1716	0.4523	0.682	0.6949	0.712	0.8288	0.832	0.8321
MTEDEx3	0.1309	0.135	0.5465	0.5576	0.5602	0.636	0.8187	0.9494
MTEDEx4	0.0789	0.5126	0.515	0.729	0.7457	0.7747	0.79	0.7957
MTED5	0.4246	0.5568	0.5695	0.5704	0.8417	0.8565	0.8566	0.8687
FTED6	0.3054	0.3346	0.4194	0.4363	0.6353	0.8349	0.8841	0.9164
FTED7	0.1397	0.1557	0.5885	0.7116	0.745	0.7461	0.8449	0.8486
cum%	29	43	55	64	70	76	81	85
expl.Var.								

		Factors		
No	Statement	1	2	3
1	I think the relationship with the student needs to be face-to-face	0	-2	1
2	I am concerned that the quality of learning will go down if students are expected to learn online	-2	-2	-2
3	I have real concerns with large chunks of learning being delivered online	-2	-1	-2
4	I believe students are AI natives and feel more comfortable learning online	-2	2	2
5	I think through online support, the student, trainer relationship can be as effective as face-to-face	0	0	-3
6	Using AI technology, you can resolve issues quickly and motivate students exactly when they need it	-3	0	-1
7	AI technology enables students to take ownership of their learning	0	1	2
8	I don't think students have the skills or motivation to learn online	-3	-1	-3
9	Students are leading change as they make a definite choice to use digital resources over print	-2	1	0
10	I think AI technology brings many opportunities for both the trainer and student	2	3	0
11	AI technologies are a distraction for students' learning	-1	-3	0
12	AI in education needs to be carefully supported by teacher and student ground rules	2	-3	3
13	Learners' attitude to learning must change before they will be able to learn online	0	-2	-3

14	Solely online education will become more impersonal between student and teacher	1	-3	1
15	If we don't use AI technology with students, we will be doing them a disservice	1	1	-2
16	I am nervous about being a virtual online trainer; it's not for me	-4	0	3
17	I feel confident with digital education technologies	3	2	-1
18	Students are more confident than we are to use technology	-1	0	4
19	If I were to teach online, I would need training for this	-1	-1	2
20	I am confident in teaching myself how to use different digital technology	4	2	-2
21	It is a pressure to keep up with constantly changing AI technology	-2	0	0
22	I feel stimulated and confident to use AI technology for teaching and learning	3	4	0
23	There needs to be more staff development for digital technologies to improve AI literacy	2	1	2
24	Teachers need more training for online pedagogy	3	-2	1
25	I enjoy incorporating different AI technology to suit my delivery	4	2	4
26	I feel unprepared for a digital education future	-4	0	-1
27	I see the future role of the trainer as a coach or facilitator, someone who guides the student through online learning	0	3	-1
28	I worry that AI technology creates an expectation of immediacy of response for trainers	-1	-1	-1

29	I believe there is a requirement to change my teaching practices because of digital technology	1	3	-1
30	Digital technology will dehumanise and de-professionalise the trainer	0	-2	-3
31	It is the responsibility of the trainer to stay up to date, particularly in relation to sector specific technology	1	4	2
32	There is a danger to trainers being always accessible; you don't get the time back or the energy	-3	-1	0
33	I think technology will have a negative impact on the future role of the trainer	-1	-3	0
34	Technology developments have led to a blurring between work, education time and social time	0	1	-2
35	I use social media and feel it is a great way to engage with students	0	3	-4
36	Digital technology offers better opportunities for staff to develop communities of practice	-1	1	1
37	We need to understand what a quality online experience looks like; what is outstanding?	2	0	3
38	Technology is a way of saving money	1	0	1
39	Teaching will certainly change as digital education takes a more predominate role	3	-1	1
40	Vocational education is practical; you can't do that online	1	-4	0
41	Classroom trainers will become extinct	-3	-4	-4
42	Digital education is the future for trainers, we need to embrace it 4.476 St Dev. = 2.116 Variance =	2	2	3

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