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Review of the online learning and artificial intelligence education market

A report for the Department of Education

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Executive summary

The report presents the findings from a study examining the functioning of the online/ blended learning and artificial intelligence in education (AIEd) markets. It was commissioned by the Department for Education (DfE) and the research was undertaken by ICF Consulting Services Ltd between June and September 2018.

Aims, objectives and scope of the study

The study aims to understand the effectiveness of the online learning and AIEd markets in widening access to learning and supporting the development of low to intermediate skills (learning levels 2-5) in the English workforce. It does this through providing a systematic review of:

- The features of the online and AIEd markets, including the volume of learning available, the characteristics and behaviours of developers and providers, the market structure, approach to competition and providers and developer performance;
- How the market compares to an effective market, including the ease of entry, expansion and exit and the availability of information to allow learners and providers to make informed purchasing choices
- Key market failures and their causes, which can be used to identify actions the DfE and others could undertake to support the online learning and AIEd markets to provide desired outcomes for the economy.

The study examined online courses where over half the provision is delivered online. It includes provision delivered by Further Education (FE) or Higher Education (HE) providers, private training providers and Massive Open Online Courses (MOOC) platforms. It did not examine informal learning (such as viewing Youtube tutorials) or training on proprietary employer systems and processes (such as training on employers' equality and diversity and health and safety policies, or bespoke software products).

Methodology

The functioning of the market was assessed using the **Structure-Conduct-Performance (SCP)** market assessment framework. The framework is based on the hypothesis that performance (profitability and, in this context, take-up and progression) depends on firms' conduct (qualifications promoted and pricing strategies) which in turn depends on the structure of the market (firms engaged, products developed, information available).

The market is assessed against the Office of Fair Trading (now the Competitions and Markets Authority) guide to competition in public sector markets, which set out the characteristics of effective markets, including ease of market entry, exit and expansion, absence of significant monopoly powers by market actors, widespread availability of information, and achievement of public interest objectives such as social impacts.

The primary research conducted to review the online learning and AIEd market included:

- Desk-based research to map online learning and AIEd developers and providers. This consisted of a web search using pre-defined search terms, a review of a selection of public sector provider websites (FE colleges, HEIs, private training providers and community learning providers) and a search of online course directories;
- Telephone/face-to-face interviews with 21 online learning and AIEd developers. This included four specialist AIEd developers, eight e-learning developers and five that offer both;
- Telephone interviews with 21 online learning/AIEd providers. This included interviews with six MOOC platforms, ten FE and HE providers, and five smaller or specialist providers;
- Telephone/face-to-face interviews with 10 stakeholders. This comprises of five academic researchers that have undertaken considerable research on AIEd and online learning, education sector bodies and AOs; and
- A review of literature on the effectiveness and potential benefits of online learning and AIEd. An online search identified a long-list of 116 documents, of which 76 were reviewed in depth with information collected in a data capture template.

Key findings

Dimensions of the online learning and AIEd markets

The study identified over 200 providers' delivering online learning for adult learners with low-intermediate skills in England. This includes nearly 100 private training providers (comprising professional bodies, awarding organisations, specialist online learning providers, and work-based learning providers), over 50 FE colleges, and 22 MOOC platforms. HE providers deliver few online courses, but many are working in partnership with MOOC platforms.

There are nearly 400 developers of online learning (excluding MOOC platform developers). Most develop online learning products which could generally be classified as: online learning management systems (LMS); authoring software and platforms; and online content for teaching and learning.

Only six developers that explicitly produce AIEd products were identified and few providers stated they delivered AIEd courses. However, there is evidence from the researcher interviews that many developers that consider themselves online learning developers may be embedding AIEd into their existing products. Similarly, providers using LMS systems or online learning products may be using AIEd but do not consider themselves AIEd providers.

A review of the financial data for 56 developers shows that around half are small and micro businesses. The provider market is more diverse, with generally large FE/HE providers and international MOOC platforms delivering provision among predominantly SME private providers. However, it is not possible to calculate the exact size of the market as for most developers and providers online learning and AIEd are part of a wider learning offer.

The qualitative research does identify some developers and providers that largely focus on providing online learning for employers to conduct in-house training, and others that focus largely on providing online learning directly to learners or educational institutions (schools, FE providers and HEIs etc). Because of this, we have in some places in the report segmented the market into provision developed for employers and provision targeted at learners.

Structure and context of the market

The delivery of online learning is relatively well-established in the UK, with some providers delivering these courses since the 1990s. Take-up increased substantially in the 2000s and grew again in 2010 following with the expansion of MOOC platforms. During this time significant research was undertaken on AIEd, but until recently there have not been many commercial applications that use AIEd.

There have been some policy initiatives in the last 25 years to increase the use of technology in education. However, in the last eight years there has been limited interventions from Government to encourage FE providers to prioritise online learning. There has also been little consideration given to the ethics of how AIEd should be used in education, particularly in the context of ensuring transparency of AI decisions-making.

The online learning market is relatively straightforward to access. There are no regulatory or financial barriers for providers to deliver qualifications online, and the availability and affordability of online authoring tools means online or blended courses can be developed relatively quickly. Developers similarly reported few barriers to entering and expanding in the online learning market. Although there are some upfront R&D costs to develop new products, this is commonly used to create a template which allows further products to be created relatively efficiently.

Providers did however report that a lack of teacher skills in using online learning authoring tools and understanding effective online pedagogies was inhibiting their ability to expand their online offer. Some providers also reported that teachers had limited time to develop new courses which slowed developments in some subject areas.

The AIEd market was felt to be more difficult to enter. Developers reported that there were relatively high R&D costs for developing AI products, including the recruitment of AI

specialists. This coupled with lack of demand has led to the undersupply of AIEd products.

Providers and developers of online learning courses generally have ample means of distinguishing their products from their competitors. They can vary the course content/learning styles, the level of support provided to learners/employers, and the quality/interactivity of the user interface. This enables developers and providers to be rewarded for improving quality and innovating.

AIEd developers have fewer opportunities to distinguish their products, as the AIEd algorithms are not easily explained to potential customers. This presents a challenge for the market as customers have difficulty identifying quality AIEd products.

Provider market conduct

FE and HE providers do not generally regard online learning as a priority and few planned to expand their online learning offer to reach a wider geographical area. Most provision was developed organically to meet a local need rather than as part of a coordinated strategy. However, there are a wide range of private providers and MOOCs that specialise in online learning and have plans for expanding their market share.

Most providers also have little knowledge or understanding of AIEd. Some believe it would lead to less personal interactions between tutors and learners, whereas examples of best practice currently show AIEd can facilitate more interaction. Most of the organisations working with public-funded providers reported little demand for support on AIEd at present.

For common subjects such as accountancy, providers generally reported competing with up to 10 competitors. For other courses, providers in FE and HE generally promoted their courses locally and therefore generally competed with 2-3 local providers. They mostly competed in terms of the flexibility and the reputation of their online qualifications. Provision is also framed as being less expensive than classroom-based learning and can be undertaken around work and family commitments and at learners' own pace. The proliferation of free online learning courses also keeps costs low.

Few FE providers reported that they competed on the quality of their online courses. This was mainly because they felt individuals wanting to study online were confident in undertaking self-directed learning and consequently more interested in the accessibility of the course. Some also felt that learners wanting more personal support would undertake a classroom-based course.

Developer market conduct

Nearly all developers regarded online learning as a key part of their business and had plans to expand their offer. Most of the developers that were interviewed specialised in

producing online learning management systems and courses for employers. This was largely because the employer market was considered more profitable and had greater growth potential.

When selling to employers, developers generally compete on fixed value contracts. For lower value contracts price and reputation were important. For higher value contracts developers competed in terms of the usability of the product, the use of interactive content and the quality of the interface, with price considered less important than the quality of the product. Most reported that they had 10-20 competitors delivering similar products.

When selling to providers, reputation was felt to be an important consideration which informed choice. Developers felt they wanted products which they knew 'worked' in a similar large user setting. Developers also felt that there was some resistance among FE and HE providers to change LMS suppliers as there was a resource cost for transferring information to a new system.

Most online learning developers did not consider AIEd a priority. There was generally some scepticism towards the technology, with some feeling it is 'a fad'. Most also reported that there was relatively little explicit customer demand for AIEd which meant they had little incentive to develop AIEd products. Some are instead prioritising developments in Virtual Reality (VR) and Augmented Reality (AR), which they believe could have a transformative effect on the sector.

Market performance

There is no robust data on the volume of learners studying online courses at L2-5. However, in the qualitative interviews most FE and HE providers reported that online learning was a small part of their offer and FE providers typically delivered short courses at L2-3. A substantial number of learners do however study MOOCs, with most platforms having over a million users, and developers also reported that large employers also commonly provide online learning to their staff.

Online learning and AIEd programmes, particularly when delivered by MOOC platforms or private training providers, were mostly undertaken by graduates and individuals in employment. FE and HE providers however reported that their online learners generally reflected the demographics of their local area.

The general consensus among interviewees is that online learning can provide significant benefits in engaging adults in learning. It allows them to undertake learning at their own pace and at times convenient to them. The low cost of online learning courses, compared to classroom-based courses, encourages access and the proliferation of free courses also encourages learners to undertake learning.

The literature review and interviews found quality of online learning courses can be comparable or better than classroom-based learning, but only if it incorporates effective learner-learner and learner-teacher communication. The completion rates of FE colleges for online courses are largely in line with classroom-based courses, but for MOOCs they are lower than expected, which is an area of weakness.

The literature review and interviews identified examples of AIEd providing a significant enhancement of the quality of learning in supporting learner retention and motivation. However, this is primarily when AIEd is used as a teaching aid, rather than as a substitute for tutor-learner or learner-learner contact. Its main benefit was in providing richer intelligence on learner progress and in automating some marking tasks, which results in tutors being able to increase their contact time with learners.

Nearly all interviewees reported that they expected demand for online learning to increase in the next five years. Most believed there would be particularly substantial growth in the employer market, as employers have only started to recognise the value of providing online learning to upskill their workforce. Moreover, recent legislation on data protection, the Government Prevent strategy and equality and diversity were also expected to drive demand for regular mandatory employee training.

Stakeholders have more mixed views on the extent to which the learner market would grow in the next five years. Some believed it would grow substantially, as a result of learners becoming savvier in using different digital technologies and therefore more willing to study online, while others believed the market was stagnating because they felt that most of the learners that were willing to study online were already doing so. Those learners might, however, be expected to increase their use.

Conclusions

Online learning

The review found that the *structure* of the online learning market is reasonably effective. There are a diverse range of providers and developers, which includes some that specialise in particular products or in particular sectors. The developer base is large enough to provide online learning products at different price points and they have scope to differentiate their products so most invest in improving the interactivity and content of their products. It is relatively straightforward for new developers and providers to enter the market, as the upfront costs are not prohibitive, and the legislation and Ofsted inspection regime does not inhibit qualifications from being delivered online.

The review found the *conduct* of providers and developers in the online learning market was partially effective. Developers compete on the quality of their user interface, interactivity and use of media which encourages them to improve the quality of the

products available, as well as to introduce new features, such as AR and VR. Providers compete on the flexibility of their provision and their reputation. Providers are also promoting online courses as more cost-effective than classroom-based courses, which in turn should encourage more learners to undertake learning. The development and delivery of online programmes is also largely efficient.

There are elements of the *performance* of online learning that also work well. Online learners that study in FE and HE providers were reported to generally reflect the characteristics of their learners. MOOC platforms and some private providers tend to engage mostly learners that already have higher level skills. Existing research also demonstrates that there are significant benefits that online learning can provide to support learners to access and achieve learning. These benefits are mostly realised when online learning is provided alongside tutor support rather than as self-directed learning. This is particularly likely to be important for low-medium skilled adults.

There are however elements of the market that work less well. This includes:

- A gap in full courses and provision at Level 4 and Level 5, with most FE providers generally offering only short Level 2 and Level 3 courses and MOOC platforms and HEIs generally delivering courses at Level 6 and above. Private providers offer courses at most levels but deliver a limited range of courses at Level 4 to Level 5;
- In FE a lack of staff time and skills in developing online courses hinders providers from expanding their offer, while the staff time required to switch LMS also discourages FE providers from changing their systems;
- FE providers promote their online courses locally and therefore are not taking advantage of the opportunities to deliver courses across a wider area;
- FE providers are not generally competing on quality, as most believe that accessibility is the key 'selling point' of online learning. This means there is little incentive to innovate in improving the learning experience;
- The Government has made little policy intervention that incentivises providers to develop and deliver online learning. There is also little financial incentive for providers to deliver online learning, as there are no specific funding programmes that specifically target online learning, aside from the pilot Flexible Learning Fund which was rolled out in 2018;
- For developers, the higher perceived profitability and growth potential in the employer market has resulted in many developers focusing on this area. Relatively few developers reported producing products for learning providers;
- Completion rates of MOOCs are relatively low. Although some of this can be attributed to learners trying courses before deciding to commit, it is also likely that without personal contact learners feel less committed to online learning.

AIED

The structure of the AIED market is less effective. There are few AIED specialists and few online learning providers that use AIED products. This is largely because there is no significant financial incentive for developers to produce AIED products because there is poor information, little explicit learner, employer or provider demand and high development costs to develop an AI algorithm that is tailored to a particular course. Alongside this, it is also difficult for potential customers to distinguish between 'good' AIED and 'bad' AIED, as the algorithms used are not clearly visible. This prevents high quality AIED developers from distinguishing themselves from their competitors in order to increase their market share.

Another key issue is that few developers and providers appear to be making plans to develop new AIED products or embed AIED in their existing products. This was largely due to a lack of awareness by learning providers of how AIED can be used to enhance the learning experience, which is also inhibiting its use. However, for developers, it was also due to a lack of explicit demand among providers and employers for AIED products, and a perceived high development cost for producing AIED products.

This has resulted in low take-up of AIED, despite a range of literature showing that AIED can improve the quality of learning. Intelligent tutoring systems are found to be effective in raising attainment. Examples of AIED in the school sector show that it can provide benefits in terms of creating more personalised learning and also automating some learner monitoring and assessment tasks to free up tutor time. It is notable however that the main benefits of AIED appear to be when it is used as a teaching aid rather than to replace tutors.

Recommendations

The study identified the following recommendations to support online learning and AIED:

- The DfE and its partners should issue guidance and training on how HE and FE providers should use online learning and AIED to provide high quality learning;
- The Education and Skills Funding Agency (ESFA) and Office for Students (OfS), through their existing communication with HE and FE providers, should encourage providers to develop an online learning offer for subjects or courses at Level 3 to Level 5 that they specialise in;
- The DfE should fund the development of 'test bed' AIED products to be used by the FE sector;
- Future research on AIED should focus on creating products that can be easily re-used for different courses and contexts;

- The DfE should conduct research with learners to examine demand-side factors that affect the online learning and AIEd market.

To inform future online training initiatives on adult re-training, the study recommends:

- Future DfE online training policy interventions should support online learning at a mix of levels. There is a need for higher level qualifications (Level 4 and Level 5) that provide entry to particular occupations as there is relatively little of this provision delivered in FE. However, there is also a need for lower level provision, including functional skills provision, which can enhance the quality of the learner experience.
- To ensure sustainability, future interventions should also consider models where employers can pay to access services, such as access to an online portal that hosts training and allows employers to monitor take-up;
- Online learning courses funded through DfE initiatives should include collaborative learning environments and tutor communication. The evidence suggests these have greater levels of effectiveness for learners.

1 Introduction

The Department for Education (DfE) commissioned ICF Consulting to review the online learning and artificial intelligence in education (AIEd) market. The review examines the factors which affect the design and delivery of learning which is wholly or partially delivered online and/or uses AIEd and the market structure, conduct and performance. It draws on qualitative interviews with online learning and AIEd developers and providers, a review of literature on the effectiveness of online learning and AIEd, and analysis of data on Further Education (FE) learner enrolments. The research took place between June and September 2018.

1.1 Context and background

The Government's Industrial Strategy recognised that there needs to be significant investment in the development of people in order to achieve its ambition of the UK leading 'industries of the future'. This includes up-skilling existing workers to ensure they have the skills to take advantage of new technological advances, while also re-skilling workers to enter new growing industries or new occupations. This is essential for supporting growth in the economy and enabling individuals to enter and progress in a changing labour market.

At the Autumn Budget 2017, the Government announced the introduction of a National Retraining Scheme, an ambitious and far-reaching programme to drive adult learning and retraining. The Scheme, which is spearheaded by a partnership between the Government, industry and the trade unions, aims to support individuals and employers to advance as the economy changes. In October 2018, the Government further announced that the Scheme would be backed up by online learning and traditional classroom teaching to help people develop the key transferable skills for jobs of the future.

Online learning is potentially a key enabler in supporting working age adults to develop new skills. The flexibility of online learning allows individuals, and particularly those in work, to undertake learning at times that suit them. Recent technological developments mean these courses can increasingly harness multimedia content, gamification, collaborative online learning environments and online information repositories. The availability of online learning provision has also increased substantially in the last few years, particularly as a result of growth in Massive Open Online Courses (MOOCs), which are sponsored and supported by international higher education institutions (HEIs).

Alongside this, there has also been considerable development of AIEd, which has the potential to provide learners with more personalised and adaptive online learning. This includes 'deep data' developments where information gathered from learners can inform what learning is provided, as well as gathering information on learner behaviour to adapt and improve the learning experience.

However, there is little evidence at present about the capacity of the online learning and AIEd market to respond to evolving consumer demand. There are particular risks that supply-side factors, including barriers to market entry and growth, may inhibit online learning and AIEd from achieving its full potential. Moreover, policy makers also need confidence that the structure of the supply side of the market and competition is creating an environment which drives innovation, improves quality and increases positive outcomes and destinations.

1.2 The importance of competitive markets

Competition is important for private markets. It encourages firms to be responsive to their customers and places downward pressure on costs. This in turn commonly stimulates innovation and improvements to the quality of products and services, while also generating efficiencies and reducing waste. In an effective market, there should be conditions in place that help stimulate competition and choice in a way that benefits consumers and suppliers.

Public markets (defined as markets which receive significant funding from central or local government, and which are expected to achieve social objectives), operate differently from purely private markets. Customers do not always pay directly for services, and suppliers are not solely motivated to increase profits although they often have to earn to re-invest, as many also have wider public service interests. Public markets are also more likely to be influenced by legislation and funding drivers to ensure they meet social objectives.

Nonetheless, competition and choice are also important to create well-functioning public markets. Policy and funding levers, coupled with consumer choice, can encourage positive supplier behaviour which raises standards, encourages innovation and improves choice. For online learning and AIEd, this could include improving the quality, stretch and challenge of qualifications to ensure they adequately prepare learners for employment and further learning, while also ensuring learners have sufficient choice to select courses that best meet their needs.

1.3 Aim of the study

The aim of this study is to provide a systematic assessment of the supply side of the online learning and AIEd market. It specifically examines the developer and provider markets. This includes:

- Describing the features of the online and AIEd markets, including the volume, characteristics and behaviours of developers and providers, factors that affect the size and structure of the market, competition in the market and the performance of providers and developers;

- Assessing how the market compares to an effective market, including the ease of entry, expansion and exit from the market, whether there are information asymmetries detrimentally affecting purchasing decisions, and developer and provider behaviours which negatively affect quality and choice;
- Identifying key market failures and their causes, which can be used to identify actions the DfE and others could undertake to support the online learning and AIEd markets to provide desired outcomes for the economy.

The study focuses specifically on low-intermediate skills provision at Level 2 (equivalent to five good GCSE passes) to Level 5 (equivalent to a Higher National Diploma or second year of a degree programme). It includes provision delivered by state-funded providers (such as Further Education (FE) colleges, HEIs and independent training providers) as well as provision delivered by providers not receiving government funding.

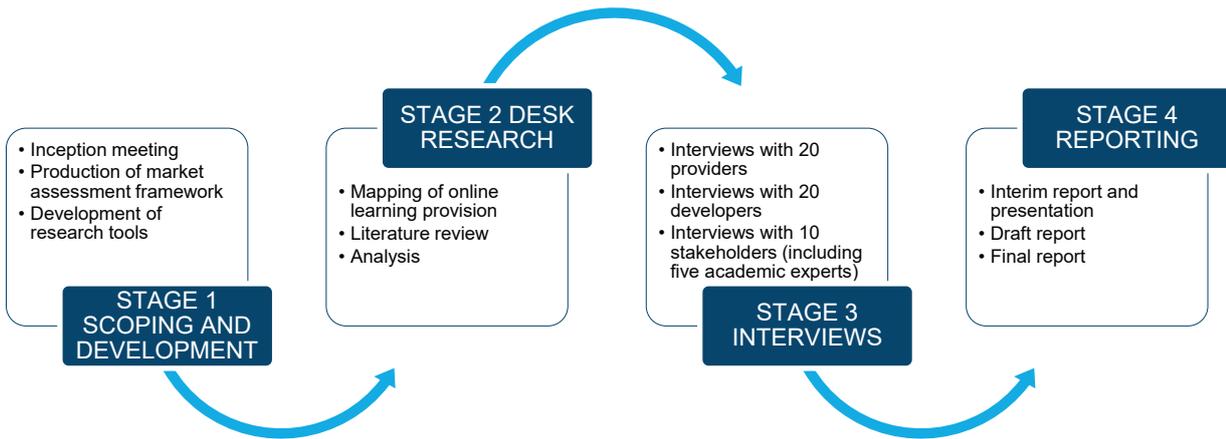
In terms of online courses, the study includes courses where over half of the learning is undertaken online, which includes self-directed learning and learning delivered with tutor support and direction. This therefore includes courses that are wholly conducted online as well as some blended learning courses where online learning is used to complement classroom-based learning. It also includes accredited and non-accredited courses, but does not include informal learning which can take place as part of daily life activities¹ (such as watching You Tube tutorials). It also does not include training on proprietary employer systems and processes (such as training on their equality and diversity and health and safety policies, or the use of bespoke software products) which are only of value to that employer, although employer training on transferable skills (such as leadership and management) is in scope.

1.4 Methodology

The study was structured in four stages, as shown in Figure 1 below. A short scoping phase was followed by an initial mapping of online learning and AIEd providers and developers, and a review of relevant research and data. Interviews then took place with a selection of providers, developers and experts. The emerging findings from the desk research and interviews were presented in an Interim Report (submitted in August 2018) and the final analysis of the research findings is included in this report.

¹ As defined by the Organisation for Economic Cooperation and Development (OECD). See: <http://www.oecd.org/education/skills-beyond-school/recognitionofnon-formalandinformallearning-home.htm>

Figure 1 Overview of the study methodology



1.4.1 Conceptual framework

The market assessment was based on the well-established **Structure-Conduct-Performance (SCP)** framework. The framework uses the hypothesis that performance (profitability and, in this context, take-up and progression) depends on firms’ conduct (course marketing and pricing strategies) which in turn depends on the structure of the market (firms engaged, products developed, information available), as shown below.

Figure 2 Structure-conduct-performance (SCP) Framework



Source: ICF

This framework was chosen because, unlike other market frameworks, it is not overly reliant on financial metrics such as profitability for measuring performance. While this may be appropriate for wholly commercial markets, it does not recognise that public sector markets often require legislation and funding incentives to ensure they achieve social goals. Consequently, the market assessment considers the need for balance between market dynamics and legislation to ensure behaviour that achieves positive outcomes for learners and employers.

Based on the SCP framework, an analytical framework was produced which set out metrics for examining the online learning and AIEd market. This is included in Annex 1.

1.4.2 Defining an effective market

The performance of the online learning and AIEd market was benchmarked against what would be expected from an effective market. It draws on the approach set out in the Office of Fair Trading (now Competition and Market Authority) guide to competition in public sector markets. This definition of effective public markets is shown below.

Characteristics of effective public markets

- **Ease of market entry, exit and expansion.** Easy access helps ensure a good range of organisations can operate in a market, which can lead to greater price competitive efficiency and encourages innovation. An effective market should also enable organisations to leave a market if they wish, which gives them flexibility, while also providing opportunities for high quality deliverers to expand their offer if they wish.
- **Absence of significant monopoly powers.** In an effective market, no organisation or group of organisations should have the power, in terms of size and market share, to dominate a market. This can restrict opportunities for smaller competitors and market entrants, which in turn reduces market pressure for competitive efficiency and innovation, while also reducing consumer choice and price competition.
- **Widespread availability of information.** An effective market requires the availability of high-quality objective information to allow customers and producers to make informed decisions. Firms need the opportunity to distinguish their products from their competitors, to ensure they can showcase quality in a way that can inform customer decisions.
- **Link between costs and fees.** An effective market requires prices to be proportionate to the costs for delivering a product, including any social costs (such as pollution). For online learning and AIEd, this means that the fees charged by developers and providers relate to their costs. This helps to ensure that fees are proportionate and fair to consumers and firms.
- **Achievement of public interest objectives.** A key indicator for an effective market is that it achieves social impacts. For online learning and AIEd, the expectation is that it improves access to high quality learning opportunities and is accessed by an appropriate cross-section of learners.

Derived from Office of Fair Trading guidance on competition in public markets

1.4.3 Research undertaken

The key research tasks undertaken for the study are described below.

Mapping of online learning and AIEd developers and providers

The mapping examined the volume and characteristics of online learning and AIEd providers and developers, and gathered information on the products that they developed or delivered. It also provided information to shape the sample and selection of the providers and developers for interview. It comprised:

- A web search of online learning and AIEd developers and private providers. This was based on a search protocol which set out inclusion/exclusion criteria, key search terms, information sources and key search terms. Key information sources included websites providing aggregated lists of education providers and courses (e.g. findcourses.co.uk; hotcourses.com; trainingpages.com) and industry directories and membership lists.
- A review of public sector provider websites (FE colleges, HEIs and independent private training and community learning providers with over 100 enrolments). These provider websites were reviewed to identify courses that were delivered wholly or partially online and the characteristics of these courses.

The web search was completed by the end of July 2018. In total, it identified **215 online learning private providers**, and **384 developers** of AIEd or online learning. A data collection template was used to ensure that systematic information was recorded from all these providers and developers.

In the mapping, providers were defined as organisations that deliver online or AIEd training courses directly to learners, either individually or through their employers. Developers were classed as organisations that produced products to deliver online learning (including platforms, software or management systems). However, the mapping uncovered some overlap, with some organisations (such as MOOC platforms) both developing platforms and providing learning directly, or developing products for employers but then hosting them on their websites so they can be accessed directly by learners. Where there is overlap, we have allocated organisations to the group which they regard as their main service. Consequently, MOOCs are classified as providers and organisations that produce and host online learning products for employers are regarded as developers.

Literature review

The study included a **review of literature** on AIEd and online learning. The literature review collected evidence on the effectiveness and potential benefits of online learning and AIEd in terms of:

- The accessibility and up-take of learning courses;
- What constitutes effective practice in delivering online learning and AIEd to support low-intermediate skills needs;

- The retention and achievement of learners on online and AIEd courses, compared to other courses.

The literature review also identified any additional information on the characteristics and functioning of the online learning and AIEd markets and the extent to which the current market and provision is operating at its optimum.

In the literature review we examined recent (less than 10 years old) peer reviewed journal articles, un-peer reviewed academic research outputs (reports; working papers; discussion papers; conference papers), UK Government commissioned research outputs, European Commission and agencies and international agency commissioned research outputs and publications of industry bodies and practitioners. The search was conducted in a three-stage approach. In the first stage, we conducted an initial search of the EBSCO, Good Scholar and Google websites, using pre-defined search criteria to identify appropriate articles. This resulted in a **long-list of 106 studies** which appeared to meet the needs of the study which were then given a high-level review to exclude those that were not relevant for the study or deemed to be based on robust primary research. This resulted in a final short-list of **76 studies** to review in depth. We then conducted an in-depth review of the studies using a data collection template.

Our selection of studies comprised:

- 42 which focused on online learning, with 23 covering AIEd and 11 covering both;
- 47 peer-reviewed articles. These studies were published in journals such as the MERLOT Journal of Online Learning and teaching, The British Journal of Educational Technology, the International Journal of Artificial Intelligence in Education and the International Journal of Research and Reviews in Applied Sciences;
- Four evaluations and eight meta-analyses;
- 15 grey literature articles, where we could verify the quality of the study;
- 24 studies which were published after 2016, and 37 studies that were published between 2011 and 2015; and
- 12 studies that focused on the UK, 25 focusing on North America, and others covering multiple countries including the UK.

Only a fifth, or 13 studies, specifically focused on adults. The remainder focused on young people or learners in general, but were included in the literature review as some of the findings on effective online learning and AIEd provision will be applicable to both adults and young people.

Provider and developer interviews

The qualitative interviews collected information on the costs and activities involved in developing and delivering provision, how providers and developers competed, and the wider factors that influenced the market. The interviews were conducted over the telephone and lasted around an hour.

Overall, 42 interviews were conducted. This comprised:

- **21 interviews with developers.** This included four specialist AIEd developers, eight e-learning developers and five that offer both. It also included a mix of Learning Management System (LMS) developers, providers of online learning authoring packages and bespoke product and platform developers. Interviews were predominantly conducted with business development leads or owner/chief executive officers for smaller developers.
- **21 interviews with online learning/AIEd providers.** This included interviews with six MOOC platforms, ten FE and HE providers, and five smaller or specialist providers.

Stakeholder interviews

The stakeholder interviews aimed to provide a broader perspective of the effectiveness of the online learning and AIEd market and the challenges and opportunities for the market. Interviews were conducted with:

- **Five academic researchers** that have specifically undertaken research on online learning or AIEd (Professor Rose Luckin, Professor Mike Sharples, Dr Wayne Holmes, Professor Benjamin du Boulay and Professor Neil Morris). The interviews examined the potential benefits of online learning and AIEd, current take up and trends, and the responsiveness of the provider and developer base to new technologies and learner/employer demand.
- **Education sector bodies** that support the FE sector (the Education and Training Foundation, JISC, AoC, AELP). These interviews explored the extent to which online learning and AIEd is a priority for the sector, the level of provider demand for support to deliver online learning and AIEd, and any barriers or enablers that may influence delivery.
- **One Awarding Organisation (AO)** that provides qualifications that are commonly delivered/supported online (NCFE). The interview explored whether there are any legislative or funding barriers that influenced the accreditation and delivery of online and AIEd provision.

The interviews were conducted by telephone and lasted 60-90 minutes, taking place between June and October 2018.

1.4.4 Limitations of the research

There were some limitations to the research that could be conducted on the online learning and AIEd market. These were:

- **Difficulties in obtaining financial data from developers and providers on turnover and size.** Some did not wish to share what they perceived as sensitive information with third parties. A few developers and most providers were also not able to disaggregate the income generated from online learning and AIEd from other parts of their business.
- **Unable to triangulate the provider views with those of customers of the service (learners and employers).** The study did not include any primary research with learners or employers, and as consequence it was not possible to identify any information asymmetries that may inhibit learners and employers from making effective purchasing decisions or the factors that influence learner/employer choice on whether or not to undertake online learning of AIEd courses.
- **Unable to access reliable data on the volume of learners undertaking online learning in FE and HE.** The data returns that HEIs submit to the Higher Education Statistics Agency does not include data fields that makes it possible to identify what HE courses are delivered online or through distance learning. In FE, the Individualised Learner Record does collect information on the proportion of learning conducted online, but as this information is not a condition for funding, the Education and Skills Funding Agency believes the data may not be robust. The lack of reliable data means it is not possible to measure the size of the market for public-funded online learning and means there is only qualitative information on the coverage of online learning in HE and FE.

1.5 Structure of this report

The remainder of the report is structured as follows:

- **Chapter 2** sets out the definition of online learning and AIEd used in the study and the relative size of the market. The chapter also explores any potential groupings or segmentations of the market that exhibit distinct behaviour.
- **Chapter 3** presents the structure of the online learning and AIEd market, in terms of the policies and legislation that influence development and delivery, the level of market concentration and the opportunity for providers and developers to enter, expand or leave the market and differentiate their products.

- **Chapter 4** describes the conduct of key market actors (developers and providers). This includes examining the approach taken to develop new online learning and/or AIEd courses and how providers and developers distinguish their products and compete.
- **Chapter 5** presents the performance of online learning and AIEd, in terms of take up and outcomes and the extent to which it is supporting a diverse range of learners to undertake up-skilling and re-skilling courses.
- **Chapter 6** provides an assessment of the structure, conduct and performance of the market, described market weaknesses and sets out recommendations for supporting the online learning and AIEd market

2 Defining the online learning and AEd markets

Key findings

- A web search and review of a sample of FE and HE provider websites identified over 200 providers delivering online learning for adult learners with low-intermediate skills in England. This includes nearly 100 private training providers, over 50 FE colleges, and 22 MOOC platforms. HE providers deliver few online courses, but many are working in partnership with MOOC platforms.
- The private providers that deliver online learning are particularly diverse. They include professional bodies, awarding organisations, specialist online learning providers and providers that predominantly deliver classroom-based learning.
- Online courses were commonly delivered to meet employed learners' training needs for regulatory requirements and promotion opportunities. Many providers commonly delivered short courses in business administration, leadership and management, ICT, health and social care and basic literacy and numeracy skills. The latter is mostly delivered as part of apprenticeship programmes
- Only six developers that explicitly produce AEd products were identified and few providers stated they explicitly delivered AEd courses. However, there is evidence from the researcher interviews that many developers that consider themselves online learning developers may be embedding AEd into their existing products. Similarly, providers using LMS systems or online learning products may be using AEd but do not consider themselves 'AEd providers'.
- The study identified nearly 400 developers of online learning (excluding MOOC platform developers). Most develop online learning products which could generally be classified as: online learning management systems (LMS), authoring software and platforms, and online content for teaching and learning.
- The most commonly delivered product was LMS, but there were also a wide range of developers that also provided online content. Relatively few developers produced authoring tools, with the market dominated by three organisations that develop well-established general online learning software, and more specialist tools for gamification and interactive content.
- A review of the developer financial data for 56 developers shows that around half are small and micro businesses. The provider market is more diverse, with generally large FE/HE providers and international MOOC platforms delivering provision among predominantly SME private providers. However, it is not possible to calculate the exact size of the market as for most developers and providers, online learning and AEd are part of a wider learning offer.

2.1 Introduction

This chapter presents the definition of online learning and AIEd that will be used in the study, and also examines the size and characteristics of online learning and AIEd products, courses, providers and developers and the extent there are any market segments that exhibit particular behaviours. The chapter draws on a mapping of online learning and AIEd providers and developers and the qualitative research.

2.2 Defining online learning and AIEd

2.2.1 Online learning

In the literature review and interviews, the term online learning was generally well-understood, but there were different views on what it included. Defined narrowly, the term 'online learning' could refer only to learning provision delivered over the Internet. However, most research studies and developers and providers tend to use a broad definition of online learning, which includes:

- Courses where learning can be accessed over the Internet;
- Courses that are not available online but are hosted on local area networks;
- Courses that have been downloaded for offline viewing.

The study uses this broader definition, as it largely reflects the way the products are organised – most are computer-based learning courses that can be delivered over the Internet, on local servers or on individual computers.

The study also includes blended learning courses, where over half of the course is delivered online, and the remainder delivered in the classroom (or other appropriate place). Blended learning which has a considerable amount of online learning was included because many online courses, and particularly courses delivered by FE or HE providers, include some classroom-based learning delivery, which would include learner inductions, tutorials, workshops and face-to-face examinations or observations. However, this direct delivery was largely supplementary to the online learning component, and consequently it was felt this should be classified as online learning.

2.2.2 AIEd

In the literature review and interviews, there was no universal definition of AIEd but it was generally recognised that the overall objective of AIEd is to use Artificial Intelligence (AI) to better-personalise the learning and support provided to learners. The study used a broad definition of AI, which contained:

- **Machine-learning**, where an algorithm allows computer systems to ‘learn’ to improve tasks, without being programmed to do so. There are various models for machine learning, which includes neural networks (based on modelling biological neural networks in the brain) as well as models based on probability and statistics. All these models require access to considerable data in order for the system to learn.
- **Rules-based learning**, where an algorithm uses pre-defined rules to respond to inputs. These rules are commonly deductions or choices, identified from large scale data mining. For example, the rules may identify that individuals that purchase certain products are more likely to purchase other particular products. Rules-based learning was generally considered by academic researchers as the most common form of commercial AI used by businesses.

A common reported goal of AIEd was reported to be ‘*personalised learning and support for each learner*’. The interviews identified a range of examples where AIEd has or could be used. These include:

- **Adaptive educational systems** – Using computer algorithms to respond with activities and resources based on learners’ individual needs. This includes online learning courses where a program assesses learners’ strengths and then provides them with additional learning materials and tailors future content to addressing their weaknesses.
- **Game-based learning** – Allowing learning to be delivered in a more engaging format. Interviewee gave examples such as simulators where the scenarios are developed that aim to ensure learners are comfortable in all possible situations.
- **Intelligent tutoring systems** – Attempting to replicate one-to-one tutoring by providing immediate tailored instructions and feedback to learners without intervention from a human tutor. Some AIEd developers gave examples of their software assessing test results and assignments to provide feedback on grammar and also identifying topics where the learner is less strong. In most cases this software is largely used as an aid to tutors.
- **Interactive learning environments** - Including software to support online exchange/discussion forums. A few interviewees reported examples of chat bots being used to mediate discussions, or software that can analyse and summarise discussions. However, this was not felt to be commonly used.
- **Open learner models** – Using data to identify correlations between learner attendance and performance and their overall achievement, and making this data available to tutors and learners. As one developer reported “*we are able to identify trends such as learners who struggle with this topic in module 1 are also likely to struggle on these topics in module 2*”. The data can be provided to tutors to inform

their interactions with learners, or may be automatically processed by online or other AI tools² to inform communication with the learner.

AIEd does not necessarily need to be delivered alongside online learning. In the literature review there were examples of AIEd being used to assess paper-based assignments and also to monitor learner attendance on classroom-based courses. However, in the qualitative interviews the academic researchers agreed that it is easier to embed AIEd in online learning courses rather than classroom-based courses. This is because it is possible to collect a wider range of data points (mouse clicks, meta data on the characteristics of topics learners are studying) from online learning courses, which adds more granularity to an AIEd algorithm.

AIEd must also utilise AI to enhance the learning experience. Even if a learning programme uses AI, unless it is used to plan and deliver learning then it is not considered as AIEd. An illustrative example is in the use of AI in games. There are some examples of games-based learning where AI is used to respond to the way it is being played, adapting to the choices and mistakes made by the learner, which is AIEd. However, there are other examples of gamification which aim to encourage engagement with learning using 'drill and practice' models. While these games may use AI, they are not considered as AIEd as the AI is not being used in the learning process.

Among the academic researchers, several were keen to stress that AIEd should not be considered a standalone 'product', but rather as a way of improving existing tools that aid the learner journey. One interviewee gave an example of a provider using AI to interpret course performance information to support tutor reviews. Another interviewee gave an example of AI being used to improve the search engine learners use to find information on virtual learning environments or online libraries. This was largely felt to reflect how AI has been used in other sectors.

2.3 Volume of online learning provision

The web search and review of a sample of half of FE and HE provider websites identified **215 organisations that provided online or blended learning at L2-5**. As shown in Table 1, over half (61%) of all the online learning providers that were identified were private sector providers. FE providers comprised around a quarter (24%) of all the online learning providers identified in the web search.

² Popenici, S. & Kerr, S. (2017). Exploring the impact of artificial intelligence on teaching and learning in higher education.

Table 1 Number of online learning providers

Provider type	% of the online/ blended learning providers identified by the study
Further Education providers	24%
Higher Education providers	4%
Private sector organisations	61%
MOOC platforms	11%
Total	100%

Source: Mapping of online learning providers (n=215)

A considerable proportion of FE providers deliver some online learning courses. In the website review, around a quarter of the FE providers stated on their website they deliver some online learning, of which two-thirds (67%) offer more than 10 online courses.

There were 22 MOOC platforms identified in the mapping that are accessible to learners in the UK which had English-language courses. Around half were developed and hosted in the United States of America (USA) (such as Coursera, Coursmos, EdX and Udacity). A few (iversity, openHPI and Shaw Academy) were based in Europe and two (FutureLearn and OpenLearn) were based in the UK.

The mapping identified few HEIs that deliver standalone online learning courses, with most only delivering a few online course modules. The exception was the Open University, which is a well-established provider of distance learning courses. However, a relatively high volume of HEIs provide courses through MOOC platforms. Twenty-four England universities offer courses through the Future Learn platform, with the platform itself run by the Open University. A few UK universities are also collaborating with MOOC platforms based in the USA and Europe. For example, Imperial College London and the University of Oxford are members of EdX, Imperial College, the University of Leeds and University of Manchester are partners in Coursera and the University of Salford is a partner for iversity.

Most of the private sector organisations delivering online or blended courses did not receive funding to deliver FE or HE courses in 2016/17. These providers were diverse, comprising:

- Specialist online learning providers (study365, Simplilearn, Virtual College, ICS learn);
- Training providers with an online and classroom-based learning offer (DSM training, Learn Direct);
- Professional bodies and employer associations (Chartered Institute of Personnel and Development (CIPD), Chartered Institute of Environmental Health (CIEH), Chartered Institute of Logistics and Transport, Skills for Health);

- Awarding organisations (City and Guilds Kineo and Pearson, as well as CIPD and CIEH);
- Business sector bodies and associations (BBC Bitesize, Home Office, the Advisory, Conciliation, and Arbitration Service (Acas)).

Two-thirds of the private providers focused on one or two topic areas, most commonly business administration, ICT and health and social care. The remainder have a broader curriculum typically focusing on four or five subject areas. Around four-fifths of providers focus specifically on the UK, with the remainder delivering provision in English across multiple countries including the UK.

2.4 Type of provision delivered

2.4.1 Online courses delivered by FE and HE providers

The review of provider websites found that FE providers most commonly provided L2-5 courses in:

- **Health and social care** (such as dealing with dementia, awareness of mental health problems, certificate in preparing to work in social care);
- **Business administration** (such as a level 2 foundation certificate in accountancy, equality and diversity in the workplace, health and safety at work);
- **Leadership and management** (such as principles of team leading, ILM leadership and management);
- **Basic maths and English provision** (such as functional skills qualifications, study skills and GCSEs).

Providers reported that these courses were mostly short courses (awards or certificates) targeted at providing CPD to individuals that are in work. Providers reported that they commonly developed courses for health and social care and HR because the high degree of regulation in these areas stimulated demand for training. However, a few providers delivered courses in accountancy and ICT which aimed to support career changers. The courses also did not require a significant degree of practical learning and were therefore more straightforward to deliver online.

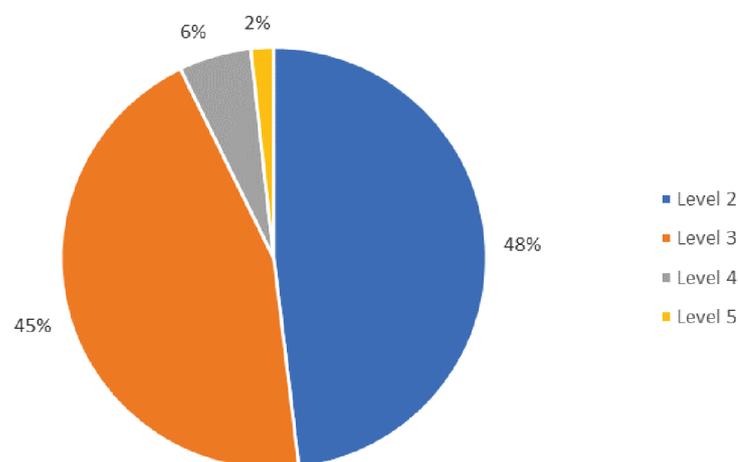
Few providers reported delivering online courses to learners aged 16-18, which make up the vast majority of their learners. This was attributed to these young people being less comfortable undertaking independent learning, and also requiring more one-to-one support. As a consequence, online learning was overall only a small part of providers' overall learning offer.

In the qualitative interviews a substantial number of providers reported providing functional skills programmes online. This was commonly delivered to learners on apprenticeships as it negated the need for them to travel to the provider to undertake the training. However, relatively few of these courses were promoted as standalone courses on provider websites. This potentially indicates that they are mostly delivered as part of an apprenticeship or work-based learning programme.

Some providers also specialised in delivering courses in a particular subject area. A few FE providers delivered HND and HNC courses in construction with online learning complementing practical learning at the college or in the workplace, and one provider delivered a range of online courses in marine biology. One HE provider delivered a range of CPD courses for teachers and trainers. Only one of the providers that were examined in depth delivered courses in a range of subject areas. This provider delivered over 100 online courses which covered academic subjects (such as Philosophy, Egyptology and English Language) as well as vocational subjects, such as hospitality management and childcare.

Figure 3 shows the breakdown of L2-5 courses by level. It shows that nearly all (93%) the blended or online courses described on FE provider websites were at Level 2 and Level 3. Only 6% of courses were at Level 4 and 2% were at Level 5. The small proportion of L4-5 courses is unsurprising given that they make up a small proportion (less than 5%) of classroom-based provision in FE³.

Figure 3 **Level of online learning courses delivered by FE and HE providers**



Source: *Mapping of online learning courses*

³ DfE (forthcoming) *Review of the Level 4-5 qualification and provider market*

FE provider courses were mostly accredited by external AOs, which include City and Guilds, NCFE, AAT, ILM and CACHE. In the interviews it was reported that some of the AOs which are more commonly used to accredit online courses provides resources to support providers to deliver their courses online. This includes providing guidelines for teachers to deliver blended learning and providing materials that teachers can use for delivering online learning.

Advertisements of online courses on provider websites suggested that most were delivered wholly online, although a few include face-to-face workshops and residential sessions. However, in the FE and HE provider interviews it was identified that some providers have courses that were promoted as classroom-based courses on their website and prospectus but where a significant proportion of the learning was conducted online.

Where HEIs offer wholly online courses, they were commonly delivered as modular courses, with learners undertaking individual online modules. These courses are generally all accredited by the HEI. Modules from year 1 of a degree programme were at Level 4 and modules in year 2 were at Level 5.

2.4.2 MOOC platforms

MOOC platforms commonly provided courses in a mix of academic and technical subjects⁴. In the qualitative interviews, it was reported that academic courses were primarily targeted at 'leisure learning', where individuals chose to study the subject because they were interested in the topic area. However, all the MOOC platforms provided a range of personal development courses, such as courses in language learning, financial management and nutrition.

All the MOOC platforms also offered a broad range of technical learning courses. These were most commonly in:

- Business and management. This included courses in presentation skills, book-keeping, people management, management and leadership essentials;
- ICT. This included a range of courses on software development, mobile phone apps development, cyber security and using 3-D design software;
- Engineering. This included courses in green technology, the basics of electrical circuitry, robotics and micro and nano-fabrication.

⁴ Technical education is defined as employment-focused training, which typically relate to particular occupations or sectors. It includes training programmes on business administration, health and social care, construction, manufacturing and engineering, agriculture, retail and hospitality

The high volume of ICT and engineering courses may reflect that some MOOC platforms, most notably Udacity, are supported by large ICT companies such as Microsoft, Google and Facebook.

The courses delivered by MOOC platforms are generally short courses. Most range from three to sixteen weeks, with learners expected to study between three and six hours a week. The mapping also identified a mix of roll-on-roll-off courses and courses that had a specific start and end time. Courses in the latter category generally included some group work and presented learning which required a group of learners to study together.

None of the MOOC platforms we examined specified the level of the courses, nor stated any prior qualifications that learners needed to undertake the course. This meant it was difficult to discern which courses were within the scope of the study (L2-5). However, in the qualitative interviews, researchers on online learners suggested many were modules or smaller components of degree or masters' programmes, and therefore most courses would range from L4-6.

2.4.3 Private learning providers

The online learning subjects delivered by private providers are largely the same as those offered by FE providers. However, a considerable number also offered ICT courses and project management courses, including vendor qualifications such as Cisco systems qualifications, ECDL and Prince2. A significant number also offered the AAT accountancy qualification.

In the qualitative interviews, private learning providers similarly stated that they focused on providing CPD to in-work learners. However, some providers stated that their key market was career changers who wanted to change job but wished to continue working while they retrained. This was a particularly common target group for private providers that specialise in delivering online learning. These providers generally delivered longer-courses (courses lasting over six months) qualifications that can provide career entry to other sectors.

An initial review of a sample of provider websites found that only a few offered blended learning, with most provision delivered wholly online. Most provided accredited courses, which were generally accredited by external AOs or vendors.

Private learning providers delivered courses at a range of levels. Courses on presentation skills, health and safety, equality and diversity, and bookkeeping were mostly at Level 2 and 3. In addition, many private providers offered courses at Level 4 and Level 5, although these were mostly in a few subject areas (typically IT, leadership and management and accountancy).

2.5 Delivery and use of AIEd in learning courses

The web search identified very few providers that explicitly stated they delivered AIEd courses. The exception was the Minerva project (see box below), which was designed specifically to test approaches for delivering an 'AIEd enabled' course. Although most courses delivered by the Minerva project are at Level 6 or above, and therefore out of scope for this study, the project is well-established and therefore demonstrates potential approaches for AIEd that can be used to support the development of low-intermediate skills.

Minerva project

Minerva is a for-profit university that aims to deliver a new form of higher education. It has been running for the last seven years with the principle that *“teaching should be informed by the science of learning”*. It provides learning to small class sizes using advanced technologies and AIEd to deliver degree programmes in a more tailored way.

Minerva offers an advanced interactive learning environment to provide an engaging class experience. Provision is delivered through an Active Learning Forum which facilitates rapid mode changes, including moving from live, video-based seminars to full group discussion to smaller breakout groups, one-on-one and team debates, collaborative document sharing and editing, as well as dynamic polling and real-time simulations.

AIEd is used to monitor learners' engagement and involvement in the programme. Information is collected through software monitors that identify learner interactions, based on mouse clicks and video analysis (for example, it measures the number of learners that raise their hands to answer a question). AIEd is used to interpret this information to provides the tutors with deeper and more frequent data-rich feedback on learner progress, while also ensuring learners are actively participating in the course.

In the qualitative interviews, most academic researchers believed that where AIEd was used in learning courses, it was likely to be embedded rather than as a standalone 'AIEd course'. Some gave examples of MOOC platforms employing systems where attendance and use of the portal was monitored and analysed to provide tailored follow-up emails. An AIEd developer also gave examples of their products being used to review learner assignments to identify grammatical mistakes and areas of weakness. This was then reported to the tutors to take action.

The interviewees reported that AIEd is more commonly used in science subjects and mathematics. This was because knowledge could be more easily tested in these subjects, as answers were primarily numeric or single word-phrases. This made it easier

for AI algorithms to gather data on learner progress and their strengths and weaknesses. AIEd was used less commonly in subjects, such as English and history, where assessments was largely through essays, although there were examples of it being used in these subjects to assess grammar and sense.

Overall however, the research found that very few providers appear to be using AIEd in their courses. In the provider interviews, only two reported using any form of AIEd in their learning courses, and those that did primarily used it to monitor learner attendance. Stakeholders also generally believed that few providers were using AIEd, with some agencies supporting the sector reporting there was little demand for AIEd products.

2.6 Online learning and AIEd developers

Online learning

The mapping identified 384 developers of online and AIEd products. The websites of the developers showed that they delivered three main services. These were:

- **Software products to support the design of online learning AIEd.** This includes general online authoring tools as well as more specialist authoring products that allow customers to develop interactive games and animation for online courses. They are designed to be used by individuals without specialist computer expertise.
- **Learning Management Systems.** LMS are platforms that host online content and allow communication between tutors and learners. Most LMS are also able to record learner registrations and log-ins, and track the progress of online assignments.
- **Providing online course content.** This includes organisations that provide online courses for particular qualifications, as well as consultants that develop bespoke content in discussion with providers.

In the mapping, the most common service provided by developers were LMS. Nearly half (45%) of the organisations reported on their website this was a core service offer. LMS was a particularly common service for developers that providing services for employers. Developers felt there was high demand for systems that allow employees to access learning remotely and can also track how many employees have undertaken the training. However, some developers also reported that FE and private providers also had specialist online learning LMS which worked in conjunction with the Virtual Learning Environments (VLEs) they use in their institution.

There were relatively few developers that produced software products for online learning. In the mapping, there were only 20 organisations that provided these tools. They

included organisations such as Adobe Captivate, Nimble Author, Eludidat, Articulate 360, which provide software for developing general online courses, and specialist organisations such as Mindflash, which provide multimedia content, and 3Radical which provide game learning templates.

Over a third (40%) of developers also reported on their website that they produced online learning content. Some developers, and particularly those that provided services to employers, produced off-the-shelf learning products on topics such as GDPR and health and safety which were then tailored to employers' needs when they purchased them. Others developed bespoke material based on contract specifications and consultation with employers or providers. For FE providers, some organisations also helped convert teaching materials used for classroom-based courses to online content.

There are however likely to be more developers that produce learning content than the mapping has identified. In the qualitative interviews, providers reported employing independent consultants, and developers often reported using sub-contractors to produce learning content. These consultants were generally employed to use employer data, such as policies and procedures or information on their product line, and convert them into online learning courses. Relatively few of these self-employed individuals were identified in the mapping.

The qualitative interviews found that there was considerable fluidity between these types of service. Most LMS providers for example also provide off-the-shelf learning products and would also provide tailored learning content for clients if requested. Some LMS providers also embedded within their platform authoring tools (either independent products or their own courses) that allow their customers to tailor or develop new content.

AIEd

The mapping identified only 6 developers that explicitly reported developing AI products that can be used in education (Century Tech, Seneca, Volley, Filtered, Maths Whizz, Peak), of which most are based in the US and specialise in developing products for schools. However, in the qualitative interviews researchers reported that the number of AIEd developers is likely to be higher as they believed that other online learning developers use AI but do not market themselves as 'AIEd developers'. One researcher gave an example of an online learning developer including AIEd in their LMS product to monitor learner attendance and check the grammar in assignments. Another researcher reported a provider of games-based learning using AI to develop simulations based on learners' strengths and weaknesses.

Most of the AIEd developers interviewed similarly reported that they had relatively few competitors in the UK. However, a few academic researchers reported that there are a

broad range of AI products available in the USA and China which are not yet available in the UK but may enter the market and be used in education in the next few years.

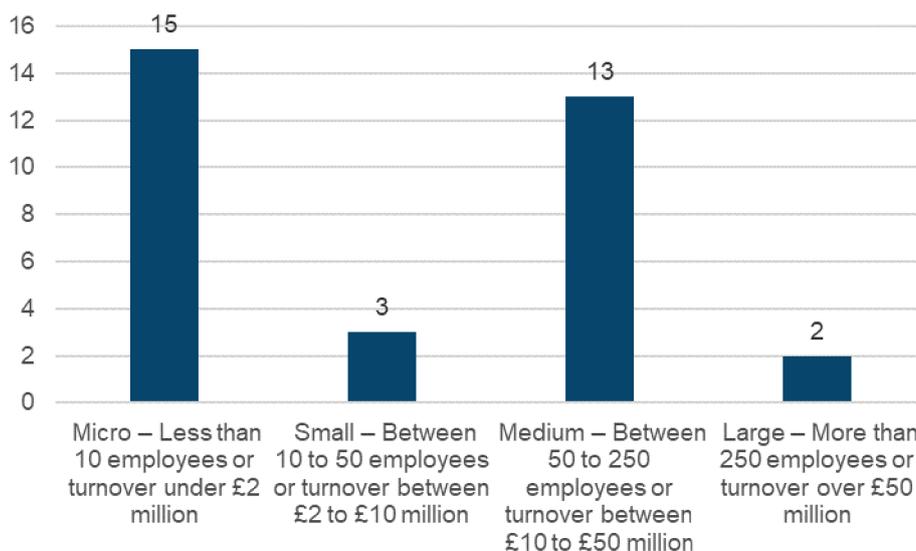
2.7 Size of online learning and AIEd developers and providers

This section examines the size of online learning and AIEd developers and providers. It draws on data from Companies House and business directories on employer turnover and number of employees. The data was available for 56 organisations.

2.7.1 Developers

The data suggests that most developers of online learning and AIEd are small or micro businesses. As shown in Figure 3, nearly half (46%) of developers have fewer than 10 employees or turnover under £2 million and a further 9% had between 10 and 50 employees or a turnover of between £2 million and £10 million. Only 6% of the developers were large employers. However, the data does not include self-employed individuals, so the volume of micro-businesses may be higher.

Figure 4 Size of online learning and AIEd developers



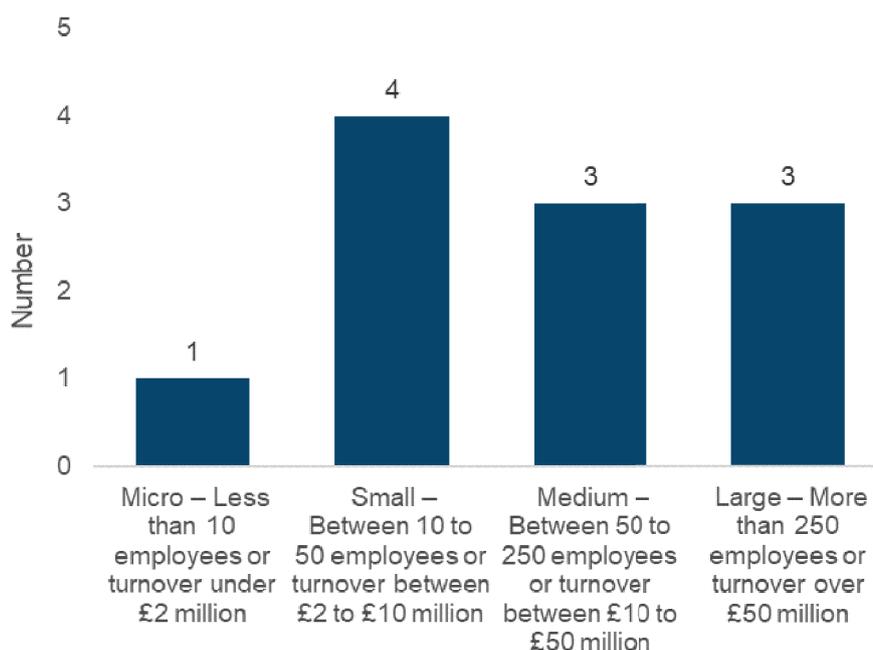
Source: Companies House and Business Directory data (n=33)

The market does however include some large organisations, such as Adobe, City and Guilds (which own Kineo) and Pearson. However, it is not possible to identify their turnover that is generated from online learning and AIEd since this is only a small part of their overall business offer.

2.7.2 Providers

The provider market is equally diverse. Turnover data on 11 MOOC platforms (presented in Figure 5) shows that over half are medium or large organisations, with a turnover of over £10 million. Among the remainder just over a third have a turnover of between £2 million and £10 million. MOOC platforms are generally stable as most are supported by large HEIs in the USA and England. A breakdown of the size of particular MOOC platforms is included in Annex 2.

Figure 5 Size of MOOC platform providers



Source: Companies House and Business Directory data (n=11)

The market also contains nearly 100 private providers, of which two-thirds (67%) are micro-businesses. The private providers delivering online learning also include a mix of professional bodies and training providers with classroom-based courses and other business activities.

The market also contains a range of FE and HE providers which typically have a turnover of over £10 million. This is generated mostly from funding provided by the Education and Skills Funding Agency (ESFA) and/or the Office for Students, as well as funding generated from learners either directly or through Government supported loans. However, in the qualitative interviews providers reported that only a fraction of this turnover was generated specifically from online learning.

2.8 Market segmentation/groupings

There are a range of potential approaches for segmenting the online learning and AIEd market. This includes segmenting developers by whether they provide online learning or AIEd and what types of products they produce (LMS, course content and authoring tools).

The research identifies however that there appears to be considerable overlap in terms of the services that developers provide. For example, many of the developers who provide LMS also produce course content and some developers of software products for providers to develop online learning courses also produce some course content themselves. Therefore, they do not appear to be separate sub-markets.

The research also suggests that AIEd and online learning are not distinct markets. Although there are some developers that explicitly state they produce AIEd products, there is evidence from the researcher interviews that many developers that consider themselves online learning developers may be embedding AIEd into their existing products. Similarly, providers using LMS systems or online learning products that contain AIEd do not generally consider themselves 'AIEd providers'.

The providers of online learning courses can be classified as MOOC platforms, public sector providers (FE and HE providers) and private sector providers. There appear to be inherent differences between the drivers and characteristics of the three types of provider. For example, HE and FE providers can access funding to deliver online courses, and learners studying at these institutions can also access loans, unlike other providers. MOOC platforms also differ from other providers as they are primarily transnational in focus, and most are based outside the UK. As shown above, some providers also specialise in delivering particularly types of course or in supporting particular target groups. However, there is also considerable overlap in the learners that they support, and consequently it does not appear that there is an obvious segmentation of the market. A learner may for example do an IT course at a MOOC instead of a private provider. Some HEIs also deliver online courses comparable to MOOCs. This means we do not feel the market can be segmented.

The qualitative research does identify some developers and providers that largely focus on providing online learning for employers to conduct in-house training, and others that focus largely on providing online learning directly to learners or educational institutions (schools, FE providers and HEIs etc). Because of this, we have in some places in the report segmented the market for provision developed for employers and provision targeted at learners.

3 Market structure

Key findings

- Online learning is relatively well-established in the UK, with some providers delivering these courses since the 1990s. Take-up increased substantially in the 2000s and grew again in 2010 following the roll out of MOOC platforms. There has also been significant research undertaken on AIEd but until recently there have not been many commercial applications that use AIEd.
- There have been some policy initiatives in the last 25 years to increase the use of technology in education. However, in the last eight years there have not been little Government incentive for FE providers to prioritise online learning. There has also been little consideration to the ethics of how AIEd should be used in education, particularly in the context of making AI decisions transparent to learners.
- Providers did not report any major barriers that prevented them entering the online learning market. The availability and affordability of authoring tools allowed courses to be developed relatively efficiency, and most were also aware of consultants that could support them to develop new online courses.
- Some providers did however report that a lack of capacity in tutors' skills in using online learning authoring tools and understanding effective online pedagogies was inhibiting their ability to expand their online offer. Some also reported that tutors had limited time to develop new courses which slowed developments.
- Developers also reported few barriers to entering and expanding in the online learning market. Although there are some upfront R&D costs to develop new products, most then create a template which allows new products to be created.
- Developers did however report that it was more challenging to enter the AIEd market because it required higher R&D costs including the recruitment of AI specialists. This coupled with lack of demand had led to undersupply.
- Providers and developers of online learning courses generally have ample means of distinguishing their products from their competitors. They can vary course content/learning styles, support provided to learners/employers, and the quality/interactivity of the user interface.
- AIEd developers have fewer opportunities to distinguish their products, as the AIEd algorithms are not easily explained to potential customers. This presents a challenge for the market as customers have difficulty identifying quality.

3.1 Introduction

This chapter examines the structure of the online learning and AIEd market. It particularly explores:

- The relative maturity of both online learning and AIEd in the UK;
- The policies and funding related to online learning AIEd;
- The regulation and inspection of online learning and AIEd;
- Entry, exit and expansion in the market;
- Scope for product differentiation and switching.

The chapter draws on an analysis of recent policy, funding and inspection documentation and analysis of the qualitative research.

3.2 Establishment of online learning and AIEd

The use of distance learning has been relatively well established in the UK, with the Open University operating for nearly 50 years with a blended learning approach that combines self-directed distance learning with some face-to-face tutorials and practical assignments. Initially, communication took place by mail, but since the 1980s technology, in the form of interactive 'digital blackboards' and tele-wiring was used in distance learning courses, followed in the 1990s by the provision of learning resources through the Internet and electronic communication.

In the early 2000s the availability of online learning provision in the UK increased drastically⁵, as internet cafes opened, personal computers were more widely used, and an increasing number of the population gained access to high-speed Internet. The increasing availability of VLEs in schools and colleges also enabled a greater amount of communication and document sharing to take place online. The last five years or so have seen developments in the introduction of MOOC platforms which have rapidly expanded the availability of online learning programmes⁶. There have also been significant

⁵ White, D., Warren, N., Faughnan, S. and Manton, M. (2010). *Study of UK Online Learning*. HEFCE/University of Oxford.

⁶ St Clair, R., Winer, L., Finkelstein, A. Fuentes-Steeves, A., and Wald, S. (2015). Big Hat and No Cattle? The Implications of MOOCs For the Adult Learning Landscape. *The Canadian Journal for the Study of Adult Education*, 27(3), pp. 65-82.

developments in the use of videos, interactive graphics and gamification in the delivery of online programmes⁷.

The use of AIEd has also been the subject of academic research for over 30 years⁸. In the 1970s intelligence tutoring systems such as SCOLAR and BIP were developed to test potential models for AI-enabled learner interactions. This was followed by the development of broader interactive learning environments in the 1980s and 1990s, although many of these developments tended to focus on STEM subjects⁹ and continued to mainly be developed and driven by academia. In recent years, the availability of 'Big Data' has resulted in AIEd being used to support learning analytics. The use of chatbots¹⁰ and predictive algorithms, extensively used in e-commerce, are beginning to be applied to education¹¹.

Most providers and developers we interviewed still however regarded AIEd as a nascent technology. While interviewees understand the term, there was a general lack of clarity on what it entails, and few interviewees were able to provide practical examples of the use of AIEd.

3.1 Policies and initiatives related to online learning and AIEd

3.1.1 1989 to 2009

Successive governments have aimed to support the use of technology for the delivery of learning. In 1989 the Government established the National Council for Educational Technology to support the use of ICT in schools. This was then reconstituted as the British Educational Communications and Technology Agency (Becta) in 1998 with its remit expanded to cover FE. Additionally, in 1993 the Government established the Joint Information Systems Committee (Jisc) to support the use of ICT in FE and HE, with the aim of providing advice to providers on using technology, developing IT infrastructures, and supporting collective commissioning for IT solutions.

In 2000 the government announced funding of £62 million for a national e-university known as UKeU, with the aim of encouraging HEIs to work together and make the

⁷ Yu, H., Miao, C., Leung, C., and White, T. J. (2017). Towards AI-powered personalization in MOOC learning. *npj Science of Learning*, 2(15) pp. doi:10.1038/s41539-017-0016-3, 2017.

⁸ Luckin, R., Holmes, W., Griffiths, M., and Forcier, L. (2016). *Intelligence Unleashed: An Argument for AI in Education*. London: Pearson.

⁹ Wenting et al (2014). *Intelligent Tutoring Systems and Learning Outcomes: A Meta-Analysis*

¹⁰ Rus, V., D'Mello, S., Hu, X., Graesser, A. (2013). Recent Advances in Conversational Intelligent Tutoring Systems. *AI Magazine*, 34(3), pp. 42-54.

¹¹ Luckin, R., Holmes, W., Griffiths, M., and Forcier, L. (2016). *Intelligence Unleashed: An Argument for AI in Education*. London: Pearson.

development of e-learning more affordable by sharing the development costs of e-learning materials to reduce market entry barriers. However, four years later the government announced the project had failed to attract sufficient learner demand and was discontinued in its present form. This was attributed to developments being technology rather than learner-driven, and due to a lack of initial scoping on the scale of demand and research on the pedagogy of e-learning and needs of online learners¹².

In 2003 one of the government's proposals in *The Future of Higher Education* was to encourage more flexible and inclusive provision in HE, including e-learning. It outlined the intention for HEFCE to "work with partners on plans to embed e-learning in a full and sustainable way within the next ten years"¹³. HEFCE subsequently published its ten-year *Strategy For e-learning* in 2005, which included supporting institutions in the strategic planning, change management and process development that are necessary to underpin their development and embedding of e-learning¹⁴. However, in HE, the 2008 review of the Strategy for E-learning found limited impact, with most HEIs at an early stage of benchmarking of their current practice to produce development of improvement plans.

These initiatives have had some impact on the use of technology in FE and HE. In FE, the 2006 Becta review¹⁵ found computer stocks had risen and practitioners were becoming familiar with using technology to assist in teaching. Jisc has also resulted in most FE providers having access to high-speed broadband.

3.1.2 2009 to present

The 2010 UK Government Skills Strategy: *Skills for Sustainable Growth* recommended the establishment of a Further Education Learning Technology Action Group (FELTAG) to examine the potential role technology could play in supporting FE. The subsequent 2013 FELTAG report¹⁶ recommended that Ofqual work with AO representative bodies to ensure qualification regulations do not hinder the use of technology in learning, and that providers have a learning strategy in their teaching, learning and assessment plan, which should form part of Ofsted's inspection framework. The group also recommended training for FE staff on using technology and for providers to work collaboratively with learners and employers to develop effective new innovative uses of technology in education.

¹² House of Commons Education and Select Committee (2005), UK e-University Report. Available at: <https://publications.parliament.uk/pa/cm200405/cmselect/cmmeduski/205/205.pdf>

¹³ Department for Education and Skills (2003) *The Future of Higher Education*. Available at: <http://webarchive.nationalarchives.gov.uk/20040117000548/http://www.dfes.gov.uk/highereducation/hestategy/>

¹⁴ HEFCE (2005), *Strategy for e-learning*. Available at: https://www.immagic.com/eLibrary/ARCHIVES/GENERAL/HEFCE_UK/H050300E.pdf

¹⁵ Becta (2006), *The Becta Review 2006: Evidence of the progress of ICT in education*

¹⁶ Available at: <http://feltag.org.uk/wp-content/uploads/2012/01/FELTAG-REPORT-FINAL.pdf>

Some of this training has subsequently been delivered by the Education and Training Foundation and Jisc

Since 2010, there have not been any particular developments that have aimed to expand the availability of online learning specifically. Government skills strategies in 2010 and 2016 have not explicitly set out proposals for expanding the availability of online learning. In 2011 the Government ceased providing core and capacity building funding for the University for Industry (Ufi), which delivered a range of online courses at Level 3 and below through a network of Learndirect centres. While the Learndirect centres were sold, they continued to hold a contract to deliver ESFA funded programmes up to 2017. The Ufi became the Ufi Charitable Trust with an endowment of £50million to provide grants for developing digital learning for adults in place of its direct provision.

The recent policy developments described above have also promoted the use of education technology more broadly, rather than explicitly referring to AIEd. For example, there has been no explicit mention of AIEd in the FELTAG report or in guidance on education technology issued by Government agencies. In higher education, the scope of the recently introduced *Teaching Excellence Framework* includes all modes of delivery including distance and blended learning at levels 4 and 5¹⁷.

However, the 2013 Whitehead Review of Adult Vocational Qualifications in England¹⁸ found that there continued to be little incentive in the FE system to deliver learning quickly, flexibly and affordably through digital technology and a lack of consistency in approaches to technology by FE providers.

3.2 Funding for online learning and AIEd

3.2.1 Funding for Further Education

The ESFA guidance on funding rates and formula for young people¹⁹ and the Adult Education Budget funding rules do not mention of any specific provider restrictions for delivering online learning. Similarly, there are also no restrictions for learners to use Advanced Learner Loans (ALL) for online or distance learning²⁰. However, learners only

¹⁷ Department for Education (2017) *Teaching Excellence and Student Outcomes Framework Specification*. Available at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/658490/Teaching_Excellence_and_Student_Outcomes_Framework_Specification.pdf

¹⁸ UKCES (2013), Review of Adult Vocational Qualifications in England, led by Nigel Whitehead

¹⁹ Education and Skills Funding Agency (2018) *Funding guidance for young people 2018 to 2019: Funding rates and formula*. Available at: http://dera.ioe.ac.uk/31599/1/Funding_rates_and_formula-1.pdf

²⁰ Education and Skills Funding Agency (2018) *Advanced learner loans prospectus 2018 to 2019: designating qualifications*. Available at:

https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/692916/AO_Prospectus_v1.0_1819.pdf

qualify if their course is a level 3, 4, 5 or 6 qualification at an approved college or training provider in England. This means it cannot be used for the courses delivered by MOOC platforms or some international organisations, which are not approved qualifications and are delivered by providers outside the UK. However, it should be noted that most MOOC platform courses are free and therefore do not require ALL funding.

Learners on online or distance learning courses also cannot gain a 16 to 19 bursary. The ESFA bursary guidance states that this is because the ESFA *‘does not expect learners on distance learning provision to need help from the bursary fund because they do not have the kinds of costs the bursary fund is intended to cover (for example, transport, equipment and uniforms)’*. This includes learners that would otherwise qualify for a bursary as being in a vulnerable group²¹.

In the last five years there has been no particular funding incentive for providers to deliver online learning. However, in 2017 the DfE announced a *Flexible Learning Fund*, which provides grants of up to £1 million for projects that develop flexible learning at L2-4. The fund is a pilot and had a total budget of £11.4 million for allocation. One of the fund’s four categories is “making online and blended learning work for adults”²². Providers of adult learning, employers and other organisations were invited to submit project proposals that could include activities designed to use online and blended learning to alleviate barriers to learning such as having lower digital skills.

3.2.2 Funding for Higher Education

For HEIs, there are no restrictions to delivering online learning. The latest Office for Students guide to funding does not mention online, distance or blended learning²³. HEIs therefore have flexibility to determine the approach they wish to deliver HE programmes.

Guidance states that HE learners who are studying on a full-time distance learning course at a publicly-funded institution that began on or after 1 September 2012 are eligible to apply for a tuition fee loan of up to £9,250. Learners studying on a full-time distance learning course at a privately-funded institution that began on or after 1 September 2012 are eligible to apply for a tuition fee loan of up to £6,165. Learners who are studying on a full-time course by distance learning because they have a disability that

²¹ ESFA (2018). *16 to 19 Bursary Fund guide: 2018 to 2019 academic year*

²² DfE (2017) *The Flexible Learning Fund: Specification for project proposals*.

²³ Office for Students (2018) *Guide to funding 2018-19: How the Office for Students allocates money to higher education providers*. Available at: https://www.officeforstudents.org.uk/media/42d81daf-5c1d-49f6-961b-8b4ab1f27edc/ofs2018_21.pdf

prevents them from attending their course may be eligible for the full-time package of support and extra help in the form of Disabled Students' Allowances.

The ESFA does however have restrictions for FE providers delivering HE programmes solely as self-directed online learning, such as MOOCs. The funding regulations guidance states that *“provision must involve an appropriate amount of teaching or appropriate distance learning; it would not be acceptable for HE provision to be undertaken purely as private study.”*²⁴ It also states that *“where distance or online learning is involved, there must be no charge to the student for course materials, supporting books, access to IT and similar activities or matters.”*

3.3 Regulation and inspection of online learning and AEd

3.3.1 Further Education

The Ofsted inspection framework includes no explicit measures for quality assurance in online learning courses. However, it does consider online or distance learning in some of its inspection judgment criteria. For example, the latest Ofsted further education and skills inspection handbook states:

- When judging personal development, behaviour and welfare, inspectors are to consider, where relevant and appropriate, *“how well learners attend learning sessions and/or work regularly and punctually, including through participating in any distance learning activities, such as online learning and the use of VLEs.”*²⁵
- The views of learners captured during inspections can happen remotely rather than face-to-face, for instance through a webinar to provide an opportunity for the views of online learners to provide feedback on their learning experience.

In 2014, the *Government Response to FELTAG* rejected the recommendation for the use of learning technology to be separately judged by Ofsted because the inspectorate "does not have a preferred learning style"²⁶.

²⁴ ESFA (2018) *Funding guidance for young people 2018 to 2019: Funding regulations*.

²⁵ Ofsted (2018) *Further education and skills inspection handbook*.

²⁶ *Government Response to the recommendations from FELTAG*. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/320242/bis-14-841-government-response-to-recommendations-from-the-FELTAG-action-plan.pdf

3.3.2 Higher Education

The recent Higher Education and Research Act 2017 aimed to introduce more competition and a wider variety of providers into the market. The House of Commons Committee of Public Accounts (2018) stated this this could be expected to increase the availability of online courses, which may be more attractive for part-time learners²⁷.

The new regulatory framework for HE produced by the Office for Students does not make explicit reference to online learning²⁸. While this means is that it does not restrict HEIs from delivering online learning, but neither does it promote the use of online learning or set specific quality metrics for ensuring HEIs deliver high quality online provision. For example, online, distance or blended learning is not explicitly mentioned in the teaching excellence and student outcomes framework²⁹. However, the underpinning learning and teaching criteria for authorising taught degree awarding powers does state an expectation that *“robust arrangements exist for ensuring that the learning opportunities provided to those of its students that may be studying at a distance from the organisation are effective.”*³⁰

3.4 Ethics

There is no clear ethical guidance on how AI can be used in technology. A few academic experts believed that this was a risk, as across all sectors there is concern about how personal data is being used in AI to inform decisions. This was a particular concern among AI algorithms that use machine learning, as the way the data is used is not transparent.

A few stakeholders reported that there was a risk that a lack of control over how data is used may undermine public trust in AIED. Consequently, it was suggested that AIED technologies should use a mix of machine-learning and rules-based AI, where the rules can be used to provide some transparency on the way data is used.

²⁷ House of Commons Committee of Public Accounts (2018) *The higher education market: Forty-fifth report of session 2017-19*. Available at:

<https://publications.parliament.uk/pa/cm201719/cmselect/cmpubacc/693/693.pdf>

²⁸ Office for Students (2018) *Securing student success: regulatory framework for higher education in England*. Available at: https://www.officeforstudents.org.uk/media/1406/ofs2018_01.pdf

²⁹ Office for Students (2018) *The Teaching Excellence and Student Outcomes Framework (TEF): A short guide to the 2018 awards*.

³⁰ Office for Students (2018) *Securing student success: regulatory framework for higher education in England*. Available at: https://www.officeforstudents.org.uk/media/1406/ofs2018_01.pdf

3.5 Entry, exit and expansion of online learning and AIEd

The section examines the regulations and market factors that affect developers' and providers' ability to enter, exit and expand the online learning and AIEd markets. An effective market will have few barriers to inhibit entry to the market, as this helps result in a broad range of firms which increases choice. High quality suppliers should also have opportunities to grow so they can increase their market share and there should be few barriers to exiting the market or innovating with new products or services.

3.5.1 Entry to the market

Online learning and AIEd providers

Providers interviewed did not believe there were any significant structural barriers that inhibited the delivery of online learning courses, compared to classroom-based courses. This in part was due to the widespread availability of online learning authoring tools, such as Articulate 360 storyline and Adobe Captivate, which can be used to develop bespoke online courses. Providers viewed the tools as being reasonably priced (£1,000-£2,000 per licence), and did not require considerable technical skills to use. Some providers also reported that it was straightforward to identify consultants (individuals or businesses) that were able to develop or convert teaching content in a format for online learning or buy off-the-shelf course content for particular qualifications.

The only challenges reported were around:

- Teaching staff having time to create the content for online courses. This can be challenging as this was considered to be more time-consuming than developing lesson plans and slides for lessons;
- Teaching staff that did not have sufficient experience of using online authoring tools and understanding of 'online learning pedagogy' to produce engaging content;
- Having sufficient budgets to produce voice-overs and construct videos and animations as part of the content.

However, none of the providers reported that these upfront costs prohibited them from delivering online courses, as the availability of consultants and off-the-shelf products allowed providers to circumvent any capacity restrictions. Most providers reported that the quality of products developed through consultants and software products was good, which meant they could be delivered to the same standard as their classroom-based courses.

Providers that do not access public funds but wish to do so to deliver online learning courses need to be registered with the ESFA. This requires the completion of a due

diligence procedure to ensure they have effective processes in place for financial management, quality assurance and providing learners with effective and safe learning environments. These requirements are no different to those for delivering classroom-based or work-based learning.

To deliver accredited courses, providers reported they did not have to undertake any additional activities with the AO if they already deliver the course through classroom-based learning. However, to deliver a new online course accredited by an AO the provider needs to submit an application to the AO. This sets out staff members' skills and capacity to deliver the qualification(s) and is generally completed in 3-6 months. This is the same process for delivering a new classroom-based course.

Providers that are not currently delivering AO accredited courses have to submit an application to an AO to become an approved qualification provider. Here they are typically required to set out their facilities and management arrangements and present their quality assurance system. Provider interviewees reported that AOs did not have specific processes for them to gain approval for delivering online courses. Providers did not consider the process overly burdensome.

Providers reported that there were no specific barriers for using AIEd for either their classroom-based or online learning. However, a few developers and academic researchers reported that providers may need to revise their data protection policies if they decided to use AIEd, as most would be likely to draw on some learner data (such as attendance, performance, demographic data) that could be regarded as sensitive. Providers would therefore need to ensure they have processes in place to ensure the data is not misused, particularly as AIEd products are hosted by third parties.

Online learning and AIEd developers

Developers and stakeholders reported few significant barriers to developing online learning tools and products. While all the new developers reported that developing their products required an upfront investment in research and development (R&D) to develop the product template, the on-going costs of developing new products for customers were low as the product template allowed new products to be produced relatively quickly.

The ability to produce templates was instrumental in ensuring the market was accessible. Most of the developers interviewed have a platform or system that underpins products. This could be a 'bare bones' version of an LMS system or core software that enables certain course content to be converted to games. For new projects, developers then tailor this platform to particular clients.

Few developers reported challenges in recruiting staff to develop products. Most felt there was a sufficient supply of IT software experts capable of developing products. A few developers did however report challenges in identifying new entrants with a mix of

software development and education knowledge, but none reported that this inhibited them from developing online learning products,

Development of AIEd

Most of the developers reported that there was a financial barrier to incorporate AIEd in their courses to create more personalised learning. It was generally felt that AIEd algorithms need to be tailored to course content, as they need to reflect linkages between course topics, list common errors and mistakes learners make and specify potential corrective action. Developers said that these would require significant upfront and on-going R&D investment, because of the input needed from AI experts, online pedagogy experts and tutors.

AIEd also requires access to large amounts of learner data to allow it to 'learn'. As a consequence, developers will commonly have to host these AIEd courses on their servers, while also employing data encryption and other security measures to protect sensitive data. This will be an on-going cost for the developer. The quality of the AI will also improve as more people use the tool, which means that to begin with the quality may be more variable.

There were fewer barriers to employing AIEd in other aspects of the 'learner journey', such as for the management and monitoring of learner performance or in providing learner support. Here the AI algorithms are less complex as they require less detailed data on the courses. However, they still have higher development costs, which means that products, such as LMS that use AIEd would be dearer than LMS that did not.

Developers also reported a significant time-lag before they could introduce new AIEd products. Most said that they would need to employ AI specialists to develop the products, and then it would be likely to take up to two years before they could develop, test and launch one. During this process it was felt that there would be a significant opportunity cost for developers, as they would have fewer resources to invest in making improvements and further developments to their core products.

Some developers reported that the lack of an AIEd authoring tool was inhibiting entry in the market. These developers suggested that if software was available that allowed organisations to develop AIEd applications for an online course then it would significantly reduce the costs for entry.

3.5.2 Expansion of the market

Online learning and AIEd providers

Most online learning providers did not report significant barriers to producing wholly online courses at new subjects or levels. To do so they largely needed to have subject

experts, either directly or through contracting, to produce new materials. Some MOOC platforms reported that they could also expand their offer by partnering with new providers.

For blended learning, or courses requiring significant tutor input, the availability of tutors was a barrier to expansion. However, providers reported that if there was demand for a particular new online course they did have some capacity to extend the contracts of some part-time tutors to change their hours of contact time to accommodate new courses without having to recruit new staff.

There was also a perception that courses mostly delivered through workshops or studios (such as woodwork, metalwork, hairdressing and electronics) are more difficult to deliver online as they require supervised manual instruction. For these subjects, many providers did not have the physical space to deliver workshop-based learning as part of a blended learning courses.

For some FE and HE providers, there is an also incentive to encourage use of their facilities. Most have large estates and consequently have to maximise their use ('sweating assets'). This could discourage providers from expanding their online learning offer where it may result in displacement from their classroom-based courses.

Most FE providers also reported that a lack of tutor skills in developing online courses was a barrier to expanding their online offer in some subject areas. However, to mitigate this some providers have book in place an online learning team to provide technical support to tutors for developing online content and hosting courses on the provider portal.

Some FE provider also reported that a lack of time from tutors also significantly hampers their ability to expand their online learning offer. They reported that most tutors were utilised during the week teaching or administration and consequently have limited time to develop online content. This has meant that providers have been unable to develop new courses or had to develop them more slowly than originally expected.

Online learning and AIEd developers

Most online learning developers reported that it generally required investment in R&D to develop completely new products. However, for most the development or revision of products was already incorporated within their business cycle, and consequently would not be perceived as a barrier to expansion.

Some developments were however felt to require a more substantial upfront investment. This included developments in Virtual Reality and AIEd. Both were felt to require significant resources to develop software and then to embed it within their existing products. And the recruitment of new specialist staff. Developers interviewed were reluctant to invest unless there was evidence of strong demand among their customers.

Most developers felt that they did not have any significant challenges to recruit sufficient technical staff to expand their offer. However, some reported a lack of capacity at senior level to manage new products or services, and difficulty in identifying suitable individuals for these roles. There was a risk that expanding their offer without having sufficient management resource would hit performance and profits.

3.5.3 Exiting the market

None of the providers interviewed reported significant barriers to exiting the market. Most had short-term agreements (generally annual) in place with providers of online LMS or products, or a monthly subscription model which meant they could cease delivering online learning relatively quickly. However, some private providers reported that the on-going costs for delivering wholly online courses were negligible, and consequently there was little need to exit the market.

Developers generally reported more difficulties in exiting the market. Some developers that produce online learning software had a duty of care in some contracts to maintain the software and provide technical support over the contract period, and some developers that host online learning platforms had contracts in place with network providers and clients that were using the platform. However, most of these contracts were less than three years and so most could leave the market relatively quickly.

3.6 Scope for differentiation

This section examines the scope for online learning and AIEd providers and developers to differentiate their products from their competitors. An effective market requires scope for suppliers to distinguish their products, as it allows improvements to be rewarded by increased take-up. For online learning and AIEd, it would be expected that providers and developers would have sufficient ways to improve the quality of their products and be able to communicate these differences to their customers.

3.6.1 Online learning and AIEd courses

For online learning courses, providers interviewed reported a range of methods where they felt they could differentiate their products. These included:

- The content of the course. This is both the subject content and the interactive or audio-visual material used in it;
- The additional support they provide to learners, which could include learning mentors, peer groups, access to resources and further learning materials;

- The graphic user interface of the learning platform, including the use of gamification and intuitive navigation systems;
- The recognition of the qualification completed, either through the formal accreditation of courses by independent awarding organisations/HEIs, or by its recognition by industry bodies and large sector employers.

The differentiation is largely visible to learners, and consequently providers commonly regard these factors as key ‘selling points’ to help them promote their online courses.

3.6.2 Online learning and AIEd products

Developers reported that the main way they distinguish their online course products (LMS and authoring software) from their competitors is in their graphic user interface and interactivity. This was felt to be particularly important for employers, as many recognise that a poor front-end could discourage their staff from using online learning, and may not reflect the employer ‘brand’. Some developers reported commonly using site demonstrations and screen shots when promoting their products.

Some developers also reported that they distinguished their products by the support and information they provide tutors and learners. Some promoted their ability to produce regular reports on attendance/usage, learner progress against plan, and analytics on learner strengths and weaknesses. Both providers and employers felt this was valuable to monitor learner progress.

Most AIEd developers reported differentiating their product through how they used to interpret learner data and how they used this to create flexible learning pathways. However, the developers reported that it was challenging to communicate this to potential customers, as the algorithms that underpin their products were not visible and the technical content was difficult to explain simply. Some reported that it provided challenges for promoting their products. As one stated *“there is no way to tell between good AI and bad AI, and unfortunately lots of providers have had experiences of bad AI”*.

3.7 Scope to switch

This section explores whether there is scope for providers to switch online learning product suppliers, and for learners to switch providers. In an effective market, there should be few barriers or penalties for switching supplier, which means that developers are encouraged to innovate and improve quality.

3.7.1 Switching developers

Most LMS developers interviewed did not report holding their customers to long-term contracts of over a year. Indeed, some only have monthly contracts as they operate a

subscription model, where customers would pay a monthly fee to access the platform, which can be cancelled through less than three months' notice. This meant that most purchasers can switch developers relatively quickly.

Authoring tools similarly did not commit purchasers to long-term contracts. Some tools are a pay month service, whereas other products such as Storyboard 360 employ a subscription model with a one-year mandatory contract period. As a consequence, switching is relatively straightforward.

Stakeholders reported that there was significant resource implication for providers changing LMS or software suppliers. This involved staff time for transferring materials and content from one platform to another, as well as costs for supporting learners or employees to use the new system or software. Additionally, providers and employers were also concerned that in the first year of using a new system they may experience difficulties using the new platform, which could cause reputational damage if it results in learners or employees having a negative learning experience.

While the costs were not substantial, stakeholders believed that they were enough to result in providers and employers being reluctant to change developer. Developers typically reported that around a third to a half of their new work comes from repeat business. However, this reluctance to change also meant that some developers felt it was difficult to gain new contracts with FE providers, which mostly use the Moodle or Blackboard LMS.

3.7.2 Switching online learning and AIEd providers

For low-medium skilled training courses, providers did not generally require learners to sign up for contracts to access their courses or include any penalties should the learner wish to drop out of their course. As a consequence, learners had ample opportunity to change online learning providers, or use multiple online learning providers at the same time.

The accessibility of online learning provision similarly meant that learners are not prevented from switching providers due to geography. Providers reported that learners generally have little difficulty in accessing courses in other areas where there is little or no classroom-based component.

4 Conduct of the market

Key findings

Providers

- Most FE and HE providers do not regard online learning as a priority and few planned to expand their online learning offer to reach a wider geographical area. In most cases provision was developed organically to meet a local need.
- Providers generally compete in terms of the flexibility and the reputation of their qualifications. Online learning providers predominantly compete with classroom-based learning providers by price. The proliferation of free online learning courses is also keeping the costs of online courses low.
- Few FE providers reported that they competed on the quality of their online courses. Most felt that this was less important to learners than accessibility. Some also felt that learners wanting more personal support would undertake a classroom-based course. FE providers did report that they promote the recognition of the qualifications by industry to recruit learners.
- There was little awareness among providers of AIEd. Most believed it would lead to less personal interactions between tutors and learners, which does not align to most practice. Few could identify tangible examples of AIEd working in practice.

Developers

- Nearly all developers regarded online learning as a key part of their business and had plans to expand their offer. Most specialised in working with employers, as it was considered more profitable and had greater growth potential.
- When selling to employers, developers generally compete on fixed value contracts. For lower value contracts price and reputation were important. For higher value contracts developers competed in terms of the usability of the product, the use of interactive content and the quality of the interface.
- When selling to providers, reputation was felt to be an important consideration which informed choice. Developers also felt that there was some resistance among FE and HE providers to change LMS suppliers as there was a resource cost for transferring information to a new system.
- Most online learning developers did not consider AIEd a priority. There was generally some scepticism towards the technology, with some feeling it is 'a fad'. This may be because they were not aware of the various ways AIEd can be used
- AIEd products are costly to develop, due to high R&D costs for developing an algorithm and tailoring it to a specific course. Most developers also incur costs for hosting AIEd courses as they need to collate the data to refine the algorithm.

4.1 Introduction

This chapter examines the behaviour of online learning and AIEd developers and providers. It specifically explores:

- The extent to which online learning and AIEd is a priority for developers and providers;
- The costs and time for developing and delivering online learning and AIEd courses;
- How developers and providers compete for customers;
- Any perceived information asymmetries in the market, where providers do not have sufficient information to choose between online and AIEd products.

The chapter draws on the findings from the qualitative interviews with providers and developers.

4.2 Strategic fit of online learning

4.2.1 FE and HE providers

A few FE and HE providers reported that expanding their online learning offer was a key priority for their organisation. In some cases, this was because it helped support a wider organisational strategy to recruit more learners that are in employment. In a few it was also believed that blended learning approaches could improve success rates. In one it was also considered that it could generate efficiencies which could help to maintain their large employer offer. Most of these providers however already had a large online offer, and some had previously had distance learning.

Very few providers interviewed planned to expand their online learning offer to reach a wider geographical area. In most cases providers primarily wanted to develop online courses that met the needs of their local area. Most felt that delivering provision in other regions or areas did not reflect their core mission, which is to support their local community. The exceptions were some providers that specialised in subjects, such as teacher training, where they felt they were meeting a need beyond their immediate catchment area in other regions.

More of the HE and FE providers interviewed did not believe online learning was a significant priority. Some said this was because the income generated from online courses was generally small compared to other classroom-based courses. A few providers also felt online learning was unsuitable for their learners, because from experience they believed that as many were from disadvantaged areas they required more one-to-one support when undertaking learning.

4.2.2 Private training providers and MOOC platforms

Most MOOC platforms and private training providers stated that online learning was the main component of their business and consequently a key priority. Most had concrete plans for expanding their range of courses to new geographical areas or delivering courses in new subjects. Some also stated they had plans to update their learning platforms and online learning software.

A few MOOC platforms reported that their priorities have shifted in the last two years. Previously they had focused on expanding their active users. However, more recently they have prioritised trying to generate income so the platform can become self-sustaining. As a consequence, some MOOC platforms have recently introduced new cost models (described in section 4.6) to generate income, while maintaining a mostly free offer. One MOOC platform also reported plans for engaging a more diverse range of learners to their platform and improving learner achievement.

A few private providers did not have plans to expand their provision. These providers generally operated in a specific sector where they felt there was little scope for growth. They were reluctant to expand in other sectors as they felt the market was already overcrowded with specialists. Additionally, most were content to have a small offer that met what they felt was a gap in the market, as they did not believe online learning was as profitable as some of their other work.

4.2.3 Developers

Most developers generally regarded online learning as a key part of their business, and consequently had plans to grow their products and customers. Most reported that they planned to expand their offer in more social learning content and interactive systems, as these were areas that were most in demand. In particular, developers commonly reported that they planned to explore opportunities in Augmented Reality (AR), Virtual Reality (VR), gamification and developing collaborative learning environments.

Most developers reported that they planned to grow the work they do with employers rather than educational institutions. This was because they felt the employer market was more profitable and they expected greater growth in the employer market in the next five years. Employers are thought to have more capacity and willingness to invest in high quality online tools and programmes. It is expected that the increasing availability of interactive and games-based content is changing their perceptions of online training. Moreover, some reported that employer demand has risen because more are investing in online training for mandatory training, partly as a result of legislative changes such as GDPR and Prevent, and the widespread availability of tools which all staff can access and use.

In contrast, most felt there was little market growth likely with FE, HE and private providers that deliver courses directly to learners. This was because there were perceived limits to what learners are willing to invest in online learning, given the wide range of accessible free or low-cost online courses available in some subjects. They believed that learners were unwilling to spend as much on an online course as on a class-based course, and many expected online courses to be substantially cheaper than classroom-based courses because they are perceived to have lower overheads.

4.3 Strategic fit of AIEd

4.3.1 Providers

The interviews found that providers' senior staff, particularly in HE and FE providers, generally had little awareness of AIEd. Although most interviewees recognised the term, few could envisage examples of AIEd that could be used in either an online or classroom-based courses. Agencies that work with FE providers also reported that most providers were at an early stage of understanding the implications and potential benefits of AIEd.

Developers similarly felt that most providers had a low awareness of AIEd, but also said that some had negative preconceptions of the technology which was inhibiting demand. Some of this related to views about the quality of teaching and the effectiveness of using online learning for assessment is from long-answer questions. Few providers considered AIEd a teaching aid.

Most providers did however recognise that AIEd is likely to be used more extensively in teaching in the next five years. As one stated *"it is something that we have known for a while to be on the horizon"*. However, there was a sense that most providers were currently adopting a *'wait and see'* approach, rather than proactively aiming to take advantage of the technology.

4.3.2 Developers

Among developers there were generally a few advocates of AIEd that were currently using AI in their products or planned to do so in the coming year. These developers felt AIEd provided an opportunity to conduct more in-depth analytics on learner progress and provide more tailored provision. Some also believed that the use of AI in other areas, such as self-driving cars and electronic assistants, meant *"it is only a matter of time before everyone is using it in education"*

However, among most developers there was some reluctance to using AIEd. Some developers felt it may lead to less human interaction with learners, as it would automate the contact that would typically be provided by the tutor. They felt too that AIEd ran counter to learners' and employers' demand for more social learning. This indicates that developers are not aware of the different ways that AIEd has been employed, including where it has been used as a teaching aid rather than to replace tutor contact with learners.

A few developers felt that AIEd was an unproven technology as there was little evidence of the benefits AI would bring to teaching. A couple of developers also felt that AIEd was a '*fad*' which would soon be superseded by other technologies. While they recognised that AI was being increasingly used in other areas of work, it was felt that it would be less effective in teaching where decisions are commonly based on qualitative judgements from tutors on learner progress and personalised engagement.

Developers also reported that there was little explicit demand among providers and learners for AIEd. Consequently, most were focusing on other developments where they felt there was more immediate demand. Only a couple of the developers that were not currently using AIEd reported that they had plans to do so.

4.4 Development of online learning and AIEd courses

This section examines the development of online learning and AIEd courses. This is important for understanding the efficiency of the market and whether the fees charged are proportionate to the costs.

4.4.1 Online learning developers

Nearly all developers reported that in developing their products they initially devised a template which they then customised for clients. For LMS and learning product developers, the template development generally took between six months and two years and required a mix of:

- Design team involvement to develop the initial structure and 'storyboard' for the course and its functionality;
- R&D (if necessary) to design new algorithms that are required to build in the functionality required;
- Software development of the core system;
- Graphic design input to produce the front-end.

The main costs incurred developing LMS are related to staff time. These vary depending on the services that clients wanted to include in the product and the type of product.

Some developers reported they could provide off-the-shelf products with minimal tailoring for 20-30 staff days' work. However, larger-scale products could take typically six months to produce. Some developers also reported that they also incurred small costs for using images and other copyright material, but these were generally considered negligible.

The development costs for developing new online courses varied considerably. Some of the developers we interviewed reported developing high cost (£50,000-£100,000) products, whereas others reported targeting low to mid-range contracts, typically ranging from £20,000 to £30,000 in value. The costs generally varied depending on the level of tailoring that clients required or the level of interactivity or use of filmed/animated material in the content. Developers felt they could produce the products relatively efficiently through using their templates, although they still needed some staff time and incurred costs in using actors and producing videos for some courses.

Developers that produced online learning content generally offered a mix of off-the-shelf products, tailored products, and a service for producing bespoke courses, which reflect the employers' work environment, management structure and the products/services they provide. The costs for providing the off-the-shelf and tailored products were generally low. Off-the-shelf products required no additional staff time after the initial R&D costs and developers reported that tailored courses could generally be completed in 3-4 staff days. Bespoke courses were costlier to develop as they required in depth consultation with the employer and a review of information on their organisation. Most developers outsourced this work to sub-contractors.

4.4.2 AIEd developers

The study identified few providers that specialised in developing AIEd products. However, some academic researchers reported that where AIEd was used it was generally likely to be embedded within other online courses of LMS systems.

Developers that used AIEd were reported to incur additional costs in terms of developing an AI algorithm. Although this is commonly based on existing AI models, most developers reported that they need to be adapted so they can be used for educational purposes. Consequently, the upfront development costs are generally felt to be significantly more than developing products without AI.

Some developers also reported using complex models for AIEd, which included not just AI but the use of neuroscience theory on learner retention of knowledge, and tutor expertise on the link between certain topics. These products had a high upfront R&D cost.

The on-going costs for developing new products is also higher for AIEd products than for online learning. The need for high levels of learner data for the AI algorithm to learn

means that many developers host their online courses online. Additionally, the calculations are conducted on developer servers which means they require high specification processing machines and extensive data security arrangements to protect sensitive information.

Expanding AIEd products to a new course is also resource intensive. It requires a mapping of what individuals are expected to learn from the course, the link between topics and what common mistakes learners can make. This requires significant staff time to produce. The data will mostly need to be collected again as well because patterns between learning modules and topics for one course may not be relevant for another course in a different topic.

4.4.3 Online learning providers

Most FE and HE providers and some private providers said that they delivered online versions of courses that they delivered in a classroom. In these instances, they reported that the main costs were in tutors translating their classroom course materials to an engaging online format and using pedagogical approaches that are more effective for online learning. This included producing online 'workbooks' which contained a mix of subject content, assignments and links to further reading. Some courses also required the development of online tests and coursework.

Developing new online courses on topics that the provider does not already deliver required more resources to develop. Providers interviewed reported that developing a new short course would take a minimum of 5-10 days. However, providers reported that longer courses could take over 3-9 months to develop. Producing new online courses was reported to be costlier than developing classroom-based teaching materials as they require more specificity and more variation in pedagogical approaches to be engaging.

Developing new courses has a significant opportunity cost for providers, as it takes tutors away from the classroom, meaning the provider can deliver fewer courses. To minimise this, most of the FE providers that were interviewed reported purchasing off-the-shelf online courses for particular qualifications, and most private providers would use external contractors to develop the course content. However, a few FE colleges have also developed a consortium where they jointly develop new online courses that can be used by their members.

Aside from staff time, the other significant costs that providers incurred was in marketing, and hosting the online courses. In FE and HE providers, this was done by a specialist online learning team of 1-2 individuals. The team was responsible for maintaining their organisations' online learning portal, uploading courses and marketing and promoting their online offer. In some cases, they also translated tutor course materials to online course content or liaised with tutors to support them to develop and use online content.

Private providers similarly had an in-house team of 2-3 staff that are responsible for managing their online learning portal and deal with admissions.

A few providers incurred costs for purchasing off-the-shelf and tailored online learning courses and some for purchasing a separate LMS for online learning. However, these costs were generally not felt to be substantial.

4.5 Delivery of online learning and AIEd

This section examines the delivery of online learning and AIEd. It specifically sets out the approaches that online learning providers adopt at different stages of the process: initial assessment, teaching and accreditation, and how this compares to classroom-based learning.

4.5.1 Initial assessments

There is considerable diversity in the methods that online learning providers employ to conduct initial assessments. Some providers interviewed, particularly FE colleges, said they employ similar processes for online learning as they do for classroom-based courses, particularly for longer courses (those lasting over six weeks). Learners are invited to attend an induction day when their existing skills and knowledge of the subject area are assessed, alongside their motivations for conducting the course. During this induction learners are also given more detail of the course content to ensure it is in line with expectation.

Most private providers and MOOC platforms said they do not undertake an assessment of learners' starting point. Some present information on the prerequisite knowledge that learners will require to undertake the course, but this does not typically include the level of previous learning and standards in literacy/numerical reasoning that learners should have to undertake the course.

4.5.2 Course delivery

Most of the private providers and some MOOC platforms reported that their courses were wholly delivered online. Tutors were reported to have relatively little input in the delivery of the courses, with learners mostly learning through viewing the lessons through a browser screen. This was particularly common for short or unaccredited courses. However, in a few providers tutors provided written or verbal feedback to learners on assignments and signposted learners to further learning.

Online provision delivered by FE and HE generally had more tutor involvement. In the qualitative interviews, most FE and HE providers reported that their tutors for online courses monitored the progress and attendance of learners and had regular sessions

where learners could ask them questions. These were either in a group or one-to-one. However, providers reported that this was generally no different from the support tutors are expected to provide in similar classroom-based courses.

Very few of the providers that were interviewed gave 'live' lessons, where tutors presented the course content via video stream. Few providers also used pre-recorded courses. As a consequence, the level of tutor involvement in the delivery of online learning was typically less than for classroom-based courses, and could deliver online courses to larger groups than would be possible with classroom-based learning. The academic researchers agreed that online learners were generally less costly to deliver than classroom-based learning.

4.5.3 Accreditation of qualifications

The type of accreditation used in online learning varies significantly. Some providers said they use portfolio-based assessments, where learners have to complete a set of assignments and demonstrate certain competences in order to gain a qualification. Others reported having online tests during and at the end of courses, of which some are marked automatically while others are submitted to the course tutor to assess. A few providers also have face-to-face assessments, which they feel ensures the learner undertook the assessment themselves. The cost for the assessment is largely tutor time in setting and marking assignments.

In some online courses, algorithms are used to mark learner assignments when the results are multiple choice, numeric or one word/phrase answers. This meant tutors spent less time marking assignments than they would for classroom-based courses. For courses where assignments are predominantly essays, tutor involvement in assessments is largely the same as for classroom-based courses.

AIEd products are commonly reported to reduce tutor involvement in assessments. A few academic researchers reported examples of AI being used to assess essays to identify grammatical issues and also to assess the content to ensure the points are presented coherently. While tutors are still required to do the bulk of the assessment, the AI was felt to reduce the time it would take them to assess an essay by highlighting some issues that needed to be fed back to learners.

Provision delivered by FE and HE providers is generally accredited. HE qualifications are primarily institution certificates of achievements and FE courses are mostly accredited by independent AOs. MOOC platforms and some private training provider courses and courses developed for employers are similarly certified by the HEI that provided the course content, or in some cases by vendors (such as Microsoft, Cisco) or large employers that sponsor the programmes (such as Google, IBM and Mercedes-Benz).

There were some courses identified in the mapping that was unaccredited. These are largely leisure learning courses, but they also include some practical skills courses in areas such as in ICT.

4.6 Cost models

4.6.1 Developers

Most developers reported that they generated their work by bidding for fixed-price contracts through limited and open competitive tendering. Few reported that they directly marketed their products to employers by cold-calling. This was not felt to lead to high returns because most employers tended to proactively commission work instead. The reliance on tendering reportedly is keeping prices down, as most developers reported taking steps to reduce overheads and operating costs to be price competitive.

Developers also reported that most contracts also required the developer to provide on-going maintenance and repair. In most cases developers also therefore include call-off days to provide ad hoc support. However, a few developers also reported providing services through a subscription model. Here the employer or provider pays a monthly fee to have their online learning content hosted and maintained on a portal maintained by the developer. This approach was felt to give customers more flexibility, and ensured their organisation received a more regular stream of income.

After winning work through open and competitive bidding, most developers reported that around 30-40% of their turnover was from repeat work with the same customers.

Developers reported that employers were generally reluctant to change their in-house learning programmes because of the inconvenience this causes, and consequently preferred to stay with the same developer. However, some developers and researchers thought that this meant employers were not always utilising the newest technology in their online programmes.

Most developers reported that their quotes for work were generally set in terms of staff days to implement the project. The day rates included a contribution to overhead costs, such as the cost of facilities, marketing and R&D for designing the product. This helps ensure the fees charged by developers are largely proportionate to the costs incurred.

Some software providers also provided fixed price products (and outright sale). This was consistent with most other software packages. Most but not all used distributors or resellers to market their products, rather than doing it in-house.

4.6.2 Providers

Providers employed a range of cost models for online learning and AEd. FE colleges commonly used Adult Education Budget (AEB) funding to offer subsidised courses, particularly for Level 2 and Level 3 courses, that were free to learners. Some reported delivering courses that were fully funded by learners or employers. These were mostly higher-level courses targeted at individuals in employment, such as leadership and management courses.

The mapping found that most HEIs and private providers only offered full-cost recovery courses, in which the learner or employer pays. These providers commonly only delivered courses in niche subject areas or for qualifications required for regulatory purposes. Consequently, they felt learners and employers would be willing to pay for them. A few private providers also reported providing one-to-one tutorials and more personal interactions with tutors which learners would be willing to pay for, particularly when they were conducting higher level courses at L5 and above.

Most MOOC platforms initially provided wholly free-to-access courses. However, they have lately adopted a range of cost models to become self-sustaining. These include:

- **Charging certification fees, ranging from £40-£700 for learners that wish to gain a certificate (several).** One MOOC platform stated that they adopted this model because it meant they did not have to restrict access to their courses. Most MOOCs were sponsored by universities and have a public-service objective to improve access to learning. It was also felt to be fair to have the costs of providing the courses borne by those that benefit most by gaining a certificate that helps them progress in employment.
- **Introducing a ‘freemium’ model (three).** Learners pay fees for additional services such as access to an online learning mentor and peer learning opportunities, or for additional courses. MOOC platforms reported that they introduced this model because they recognised that some learners wanted additional support to what was currently provided by their online courses, and would be willing to pay for it. Additionally, MOOCs felt that having a freemium version allowed them to maintain a free offer, while also enabling them to deliver more costly courses (where course developers charge a fee) which they would not otherwise be able to deliver.
- **Providing a subscription model (four).** A few developers reported employing a subscription model where learners or employers played a small monthly fee (ranging from £5 to £20 for learners and £100-£200 for employers) to access courses. One MOOC platform required learners to pay a subscription to access all their courses, whereas the others have subscriptions which allowed employers or learners to access add-on services. Two MOOC platforms, for example, charged a

subscription fee to enable learners to access specialist courses or receive additional content, while one allowed employers to take subscriptions which meant they could host their own courses on a restricted area of the MOOC platform. One MOOC platform reported that they used the subscription model because it meant that learners or employers did not have a substantial one-off cost which could discourage them from undertaking courses. Additionally, they wanted learners to perceive the platform as a core service *“like a Netflix subscription where people feel they cannot live without it”*.

- **Providing a pay service for employers (two).** A few MOOCs reported using a funding model where employers can pay for hosting their online courses on the MOOC platform in return for a fee. One MOOC platform felt employers would be willing to pay for this service as it meant they did not have to host or maintain the programmes themselves. It also enabled employees to access other courses which could support their personal or professional development.
- **Charging providers for hosting courses on their platform (two).** The literature review identified that a few MOOC platforms charged providers a monthly fee for hosting their learning courses. As with employers, it meant that providers that wanted to deliver online courses did not have to develop and maintain their own infrastructure for delivering online learning.
- **Directly charging for courses (two)** A few MOOC platforms have also begun to charge learners for accessing their online courses. However, most also introduced additional services for the fees, which included external certification from a university partner and also access to one-to-one or group tutorials. One MOOC reported that they introduced this approach because it meant they could fund course developers to produce specialist courses which would otherwise be too costly to deliver. Additionally, the MOOC believed that providing additional support to learners would help improve success rates
- **Free service with adverts (two).** One MOOC platform reported they were able to generate income from providers to advertise pay courses which learners could undertake after completing taster courses on the platform. They also reported that some recruitment agencies advertise on their websites, particularly when courses were targeted at career changers.
- **Free service (two).** A few MOOC platforms also provided free services funded through subsidies from the commercial activities of HE partners. Here the partners were willing to contribute to the running costs as they believed the platform offered a public service by improving access to learning. One MOOC platform also reported that HE contributed to their site as they believed some learners would progress from MOOCs to pay courses at their institution.

Most of the cost models aim to maintain a free offer to learners, while also allowing them to develop additional services that improve the quality of the learning experience. MOOC platforms that have introduced fees for learners and employers reported that they have been paid by a considerable number. A few MOOCs reported that it had resulted in them delivering more vocational and higher-level courses as employers and learners would be more willing to pay for them, so they were more sustainable to deliver. However, it also resulted in some MOOCs focusing on in-work learners and those conducting higher paid jobs (such as management or technical IT roles) as they would be more able to pay.

4.7 Competition among providers

This section and the next explores how developers and providers compete for customers. In an effective market it is expected that suppliers have a good range of competitors for their services or products, and competition takes place in a way that incentivises suppliers to improve quality and price.

4.7.1 Number and type of competitors

FE and HE providers

Most FE and HE providers reported that for wholly online courses they frequently competed with each other as well as private providers delivering online courses. They reported that most learners that wanted to undertake an online course would generally search the Internet, which meant they would be competing with other national providers. In some subjects, such as accountancy, business and management and health and safety, they also reported competing with at least 10 providers, which included professional bodies and AOs. However, some that delivered courses in niche areas, such as marine biology or tutor training, reported relatively few (two or three) national providers delivering similar courses online.

For blended learning courses FE providers reported that they mostly competed with local providers offering blended or predominately classroom-based learning. They reported that these courses were generally targeted at learners that lacked IT skills or confidence to conduct wholly online courses, or may require specialist equipment or services. For these courses providers reported only one or two local competitors.

Some FE and HE providers also reported competing with MOOC platforms for learners. These providers delivered a mix of technical and leisure learning courses at Level 4 and above which were felt to be similar to those available from MOOCs.

MOOC platforms

MOOC platforms reported that they mainly competed with other MOOC platforms or HE providers for learners, as well as private providers delivering intensive workshop-based courses or 'bootcamps' for subjects such as coding. Most generally reported competing with between five and eight organisations that provided similar courses.

Private providers

Private providers reported that for their wholly online courses they generally competed with other online learning providers and providers local to the learner which provide similar learning through classroom-based courses. They believed that while most of their learners were in employment and preferred the flexibility of being able to undertake online learning at times that suited them, some would also be attracted to taking leave to undertake intensive courses or could do evening or part-time courses. Most private providers therefore estimated they had over 10-15 competitors for their courses.

4.7.2 Approach to competition

Most FE and private providers reported that they mainly promoted the flexibility of online learning to recruit new learners. This included the fact that learners can study around work or childcare commitments and do not have to take time off work. Providers reported that this is particularly effective for learners that work in offices and computer-literate, and meant that when offering online or blended learning provision they tried to ensure that most of the provision could be undertaken online.

Some providers also reported that they compete with other learning providers on price. Most providers set the cost of online courses lower than the cost of equivalent classroom-based courses, as they felt learners expected to pay less as they were not receiving face-to-face tuition. One provider even offered learners a financial bonus if they chose to study the course online.

Some private and FE providers also reported that they kept the costs of their online courses low because of competition with MOOC platforms. It was felt that the proliferation of MOOC platforms meant learners were reluctant to pay significant fees for online courses. Some providers stated that as a consequence they mostly charge less than £100 for short (one term) online courses, although the costs for full year courses range from £250 to £1,000.

Few FE providers reported that they competed on the quality of the learning experience for their online courses. This was mainly because they felt the individuals wanting to study online were confident in undertaking self-directed learning and consequently more interested in the accessibility of the course. Some also felt that learners wanting more personal support would likely undertake a classroom-based course. FE providers did

however promote the recognition of the qualifications by industry in order to recruit learners, using employer testimonies and data on the destinations of their learners.

MOOC platforms, HEIs and professional bodies argued that they primarily compete on reputation. Most MOOC platforms used the status of their partners, which included Stanford, MIT, Kings College London and the University of Oxford to promote the quality of their learning courses. A few MOOC platforms and professional partners also use their industry status or the status of their partners to demonstrate that their products meet employer needs. Few consequently competed on price for the cost of courses or the cost of accreditation, with most tending to offer reasonably standard fees that were determined by the length of the course.

Providers also reported that they also needed to ensure their LMS was intuitive and they had an interactive, engaging learner environment to retain learners. However, few providers reported that they competed in terms of the quality of the learning environment (such as the quality of the online learning portal interface and site support). In most cases this was considered less important than being able to provide the training at a competitive price and being able to demonstrate that the course is recognised and valued by employers and sector bodies for providing career entry or progression.

4.8 Competition among developers

4.8.1 Number of competitors

Most LMS and content developers reported a range of competitors in their line of business. They commonly stated they were likely 10-20 developers that competed for similar employer or provider contracts. However, at the same time most felt they had 'unique selling points', such as the use of gamification, the user-friendliness of their interface, and the use of interactive content which differentiated themselves from their competitors.

Software developers generally reported having few direct competitors. Most stated that there are only three or four other software developers which offer similar packages. This generally included two or three market leaders and a range that offer more niche products.

4.8.2 Approach to competition

Developers operating in the employer market reported that they primarily competed on the quality of their product, in terms of:

- The quality of the user interface;

- The use of technologies and approaches that help make learning more engaging (e.g. gamification);
- The accessibility of the learning, which includes the delivery of mobile learning options and external hosting of content or the use of mirror sites;
- The reporting that could be provided to learning and development managers to show learner progress.

Most developers primarily competed for fixed price contracts. For large contracts, developers reported that price was not that important, as most developers reported that employers would be willing to invest in a better-quality product. However, some developers target lower value contracts, where they aim to develop efficiency savings to ensure they are able to quote to develop products within budget.

Developers in the learner market reported that they competed on price and the usability of their product. The quality of the product was regarded as important for competition, but it was recognised that most providers did not have the resources to invest in expensive products.

Reputation was also considered important in informing provider choice among FE and HE providers. Developers felt that these providers were mostly interested in products which they knew 'worked' in a similar large user setting. Some felt that this could be demonstrated by nearly all FE providers using the Moodle and Blackboard LMS, despite a range of new products entering the market in the last ten years. Consequently, most developers believed it is more difficult to win work with FE and HE providers.

Among employers, the reputation of the developer was considered less important as most were interested in the quality of the product. However, most developers reported winning repeat work with their clients, which was largely based on client satisfaction with their products and their working relationship.

For both the learner and employer market, very few developers reported that they competed in terms of the technology they use to support learning, such as AIEd. Developers felt that this was because the benefits of these technologies were difficult to articulate to employers and providers. Only a few developers reported using completion rates and data on knowledge attainment to promote their products.

4.9 Information asymmetries

Developers and providers reported that learners generally had a good understanding of the availability of online learning options, and those that wanted to undertake a specific course online would generally be comfortable in using a search engine to find an appropriate product, or go to the website of a local provider. However, it is not clear if

learners are able to access enough information to make an informed choice, and decide on whether to undertake online or classroom-based courses, and whether this information is provided by the National Careers Service.

Some of the academic researchers interviewed felt the awareness of MOOC platforms was variable among adult learners. They reported that it was generally high among recent learners and graduates but more mixed among others out of education. This may mean that some adults, particularly those that spend less time online, are less familiar with some of the learning options available to them, including the choices.

In terms of AIEd, the responses of interviewees in providers indicate considerable information asymmetries among staff in providers about the benefits of AIEd (described in section 4.3 above). Examples of good practice where AIEd improves learning (such as in supporting tutors to track the performance of learners, and in assisting tutors to mark assignments) do not appear to be shared widely, with most provider staff instead believing AIEd replaces tutor contact time. Academic researchers also generally agreed that knowledge of AIEd was primarily among people that worked in the education sector. They believed that there was generally low public awareness of AIEd and consequently little explicit employer or learner demand for AIEd learning experiences.

5 Performance of online learning and AIEd courses

Key findings

- There is no robust data on the volume of learners studying online courses at L2-5. However, a substantial number of learners' study MOOCs, with most platforms having over a million users, including the UK-based platform Future Learn. Large employers were also reported to commonly provide online learning to their staff.
- FE and HE providers however generally reported that online learning was a very small part of their overall offer. Most providers only offered provision in a few subject areas and FE provider courses were typically short and at Level 2 and Level 3.
- The completion rate of FE and HE provision delivered online was reported by providers to be around 70-80%, which is similar to their classroom-based courses. To maintain these success rates for online courses, most FE providers reported conducting targeted follow-ups of learners.
- Overall completion rates in MOOCs were low, at less than 13%, as many enrol to sample courses and then drop out if they feel it is unsuitable. The completion rates of MOOCs increased to around 40% for learners that completed their first module.
- Online learning and AIEd programmes, particularly when delivered by MOOC platforms or private training providers, were mostly undertaken by graduates and people in employment. FE and HE providers reported that their online learners generally reflected the demographics of their local area.
- Interviewees generally believe that online learning provide significant benefits in engaging adults in learning. It allows them to undertake learning at their own pace and at times convenient to them. The low cost of online learning courses, compared to classroom-based courses, encourages access and the proliferation of free courses also encourages learners to try new courses.
- The literature review and interviews identified examples of AIEd providing a significant enhancement of the quality of learning supporting learner retention and motivation. However, this is primarily when AIEd is used as a teaching aid, rather than as a substitute for tutor-learner or learner-learner contact. Its main benefit is in providing richer intelligence on learner progress and automates some marking tasks, which increases tutors contact time with learners.
- The market for online learning is expected to grow in the next five years. Most interviewees expect the greatest growth to be in the employer market as it was felt to have significant untapped potential.

5.1 Introduction

Chapter 5 examines the effectiveness of online learning and AIEd provision. It explores:

- How effective current provision is in improving access to learning and the learner experience;
- The characteristics of learners that have undertaken online learning and AIEd courses;
- Trends in demand and the expected future outlook for online learning.

The chapter draws on the findings from the literature review and qualitative research.

5.2 Volume of learners undertaking online learning

There is no robust data on the volume of learners in England that are undertaking online learning and AIEd courses. HESA data does not record whether programmes are delivered through online learning or AIEd and the Individualised Learner Record data is not robust. There is also no data available on the volume of learners in England undertaking MOOCs or provision delivered by private providers or employers.

Private providers and stakeholders generally believed the volume of learners undertaking online learning in England was substantial. MOOCs were felt to be significant in increasing the volume of learners studying online, with the UK-based Future Learn reporting that they have millions of learners while the US-based MOOC platforms interviewed also reported that a significant proportion of their learners are based in the UK. This is illustrated by Onah et al (2014)³¹ finding over 300,000 learners enrolled on six short courses in January 2013 that were developed by the University of Edinburgh and hosted on the Coursera platform. However, some provision will be above Level 2 to Level 5.

Most developers also believed that online learning was reasonably common among employers. They felt that most large employers deliver at least some of their in-house training online. The MOOC platforms that were interviewed also reported that they provided some online courses for employers.

The FE and HE providers that were interviewed did however report that online learning was a very small part of their overall offer. FE providers stated that provision was mostly in two or three subject areas and did not typically include qualification at Level 4 or Level 5. Only a few online courses were reported to be over six months in length with most

³¹ Onah, Sinclair, Boyatt (2014) *Drop Out of Massive Open Online Courses Behavioural Patterns*

generally shorter courses targeted at specific workplace competencies (such as leadership and management, health and safety and equality and diversity).

5.3 Effectiveness of online learning

5.3.1 Access to learning

To all interviewees a key strength of online learning is its accessibility. Most interviewees believed that it is providing learning opportunities to people in employment and people with care commitments, who may not otherwise have time to attend a classroom-based training course. A few of the researchers interviewed reported that computer-based learning was more accessible for learners with learning difficulties or disabilities. These learners can use specialist adaptive equipment and software for using computers, and do not need to travel for learning.

Some older research studies (e.g. Gorard and Selwyn³², 2004; Eynon and Helsper³³, 2010) reported that slow Internet speed and lack of access to computers can prevent some learners from accessing online learning courses. However, most academic researchers stated they do not believe this is a significant barrier today. This is reinforced by ONS data in 2018 which shows 90% of households in Great Britain have Internet access³⁴. A 2018 Basic Digital Skills UK report also found that 79% of adults have basic digital skills, although it is less common among people aged over 65 and individuals in skilled manual or semi-skilled and unskilled manual roles³⁵.

The low cost of most online learning courses also meant that it was affordable for most learners, and the widespread availability of free provision also encouraged learners to 'try' online learning. Provision delivered by FE providers, particularly at Level 2 and 3, was commonly funded through AEB and therefore free to access to learners. Most provision available on MOOC platforms and from private providers was also generally free to access or at a low cost compared to classroom-based courses.

5.3.2 The quality of online learning

Interviewees largely agreed that the most effective use of online learning is when there is a degree of social learning and direct engagement with tutors. Most interviewees reported that the quality of current online learning was mixed, with some provision using

³² Gorard and Selwyn (2004). *How do adults learn at home?*

³³ Eynon and Helsper (2010). *Digital natives – where is the evidence?*

³⁴ Office for National Statistics (2018). *Internet access – households and individuals, Great Britain: 2018*

³⁵ Ipsos Mori (2018) *Basic Digital Skills UK Report 2018*.

more interactive, flexible content but most still largely presenting information sequentially on screen. However, most agreed that the quality of provision was generally increasing.

A key reported benefit of high-quality online learning, when compared to classroom-based learning, is that it can also provide:

- More interactive learning, particularly through the use of gamification, AR and VR;
- More customisation to reflect learning styles and speeds;
- Greater flexibility, by allowing learners to study at a time that suits them.

The use of some of these technologies, most notably AR and VR, is generally considered to be in its infancy. However, developers believed that the use of AR and VR are likely to grow in the next 3-5 years. Developers and researchers believed they could increase participation and improve the learner experience, provided it is used appropriately.

The quality of online learning varies depending on how courses are delivered. Dixon³⁶ (2015) examined effective engagement in online courses. He found that the most effective online learning courses generally included considerable learner-to-learner and tutor-to-learner communication. The study involved a survey of 186 learners from six US university campuses and 38 courses. Means' (2009)³⁷ meta evaluation of 50 estimated effect sizes comparing blended and classroom-based learning similarly found that online learning with high levels of interaction and/or tutor direction was more effective than where the learning was wholly self-directed. Where the learning was largely self-directed, Means' study found no attributable improvement in learning outcomes for online courses compared to classroom-based learning.

Bonk (2017)³⁸ found that online learning can streamline the learning process, as it allows learners to quickly obtain credit for what they already know by completing course unit assessments, rather than sitting through classes covering skills, competencies or knowledge they already possess. A mixed-methods study by Onah et al³⁹. (2014) found that the unitised approach of online learning courses allows most learners, even those that drop out, to participate in the course in their own preferred way, either at a slower pace or with selective engagement.

³⁶ Dixon (2015) Creating Effective Student Engagement in Online Courses: What Do Students Find Engaging? *Journal of the Scholarship of Teaching and Learning*, 10(2), 1-13.

³⁷ Means et al. (2009) Evaluation of Evidence-Based Practices in Online Learning: A Meta-Analysis and Review of Online Learning Studies, US Department of Education

³⁸ Bonk (2017) *Keynote: What is the State of E-Learning? Reflections on 30 Ways Learning is Changing*.

³⁹ Onah, Sinclair, Boyatt (2014). Dropout rates of Massive Open Online Courses: Behavioural Patterns.

5.3.3 Learner achievement and destinations

Some online learning courses, particularly MOOCs, have low success rates. Onah, et al (2014) found that MOOCs generally had a completion rate of less than 13%, although most MOOC platforms interviewed in the qualitative research reported this had improved and Onah et al acknowledged that retention rates were higher (around 40%) for learners that completed their first module. Academic researchers interviewed reported that low success rates were primarily due to learners starting a course so they can try the content, and then drop out. Consequently, they felt the low success rates were misleading, although most agreed that they were still lower than would be expected if learners were motivated and encouraged effectively to continue.

Private providers and FE/HE providers in contrast reported success rates of 70-80%. This is slightly lower than for their classroom-based courses. They largely attributed this to online programmes being more difficult for course teachers to motivate learners to complete their programmes as they communicate and see them less regularly. Success rates were reportedly higher for full-cost recovery programmes, because learners were felt to be more motivated as they have invested more in undertaking the course.

Some FE providers believed that the higher completion rates of online FE courses compared to MOOCs was due to colleges conducting more follow-up with learners that are not making the expected progress. A few also reported that the thorough initial assessment and induction they conduct with online learners means they can identify early learners that are not suitable for the course. However, it may reflect that FE courses are generally at a lower level of learning compared to MOOCs and therefore require less pre-requisite knowledge to complete.

5.4 Effectiveness of AIEd

5.4.1 Increasing participation in learning

Interviewees had mixed views about the impact of AIEd on increasing participation in learning. Some believed that the added support it can provide to learners on online learning may attract more to study through that medium. The ability of AIEd to create programmes that are tailored to individual needs may also attract new learners. However, others reported that the use of AI may deter some learners from studying online programme, as they may be concerned that AI would not be able to replace the support provided by a tutor and therefore would lead to a lower quality learning experience.

In the academic research there were some examples of AIEd initiatives that aim to encourage learner engagement in learning. For example, Luckin et al⁴⁰ (2016) concluded that a potential direction of AI is the creation of learning companions – life-long learning partners who can accompany and support individual learners throughout their studies. This was expected to increase learner motivation for undertaking training.

5.4.2 The quality of teaching

Among the academic researchers interviewed there was a consensus that AIEd is most valuable when it is used alongside tutor instruction, where it complements existing modes of study rather than replacing them. This was supported by du Boulay's (2018) review of six meta studies on AIEd projects, which showed that learners receiving direction only from an AIEd intelligent tutoring systems performed less well than those that received wholly classroom-based learning.

However, when AIEd is used as a *teaching aid*, it is reported to have significant impacts on the quality of teaching. These include:

- **Automating some assessment tasks.** The research identified examples of online learning products that use AIEd to interpret test results to understand learner strengths and weaknesses. This is mostly done for STEM subjects that have multiple-choice or numerical answers. However, there are also examples of AIEd software being used to assess spelling, punctuation and grammar or whether the text fits common rules for clear English. The assessment was generally intended to be supplemented with additional tutor observations and then communicated to learners;
- **Providing additional intelligence to tutors on learner performance.** This was felt to support tutors working with large groups to understand the strengths and weaknesses of learners, particularly when used alongside learner observations;
- **Supporting personalised self-directed learning.** AIEd allows content to be tailored to reflect learner strengths and areas of weakness, which was felt to be particularly valuable for providing bespoke homework assignments which give learners falling behind an opportunity to catch up;
- **Using chat-bots to moderate and interpret discussions.** This can be particularly valuable for facilitating learner discussions on assignments, as well as allowing providers to facilitate multiple small group activity at the same time.

⁴⁰ Luckin, Holmes, Griffiths, Forcier (2016). *Intelligence Unleashed: An argument for AI in Education*

AIEd's role in formative assessment and guidance is supported by a meta-review of 50 evaluations of AIEd products conducted by Kulik and Fletcher (2015)⁴¹, which found that AIEd can improve formative assessment by replacing a 'stop and test' approach with more continuous assessment which allows issues to be identified earlier. The study also found examples of intelligent tutoring systems providing learners with opportunities to change their answer or use different solution methods, which in turn improved overall learning and retention, particularly when the system incorporated hints and instant feedback.

Research on AIEd has generally focused on its application for knowledge-based learning courses. However, a small-scale study by Li et al⁴² (2017) also showed that AIEd in game-based learning can also result in a positive increase in learners acquiring practical skills. The study only however drew on evidence from one class of 20 learners.

As well as improving the quality of teaching, AIEd was also reported to reduce tutor workload. One AIEd developer reported that a survey of tutors using their product found that most reported it saved them over 6 hours a week in administration and marking. Most of these tutors then stated that they re-directed this towards increasing the contact time with learners, which further improves the quality of the learning experience.

5.4.3 Learner achievements and destinations

A range of meta-reviews⁴³ have found that AIEd, when used in the context of intelligent tutor systems, has been more effective in supporting learning outcomes than other teaching methods, with the exception of small group learning where the results were generally comparable. One meta review reported that it raised test scores by a medium level of effect size (0.63 standard deviations). Some small-scale studies also found emerging evidence that AIEd has helped narrow the attainment gap, as it allows less well-performing learners to gain personalised support on areas of weakness, which is less regularly available in large classes.

Kulik and Fletcher (2015) also identified some studies that found AIEd helped learner acquire of knowledge. The technology created a deeper understanding of the subject through providing hints and further learning that supported learner skills in inference,

⁴¹ Kulik, Fletcher (2015). *Effectiveness of Intelligent Tutoring Systems: A Meta-Analytic Review. Review of Educational Research*

⁴² Li, Hall, Bermell-Garcia et al (2014) *Measuring the Learning Effectiveness of Serious Gaming for Training of Complex Manufacturing Tasks*

⁴³ Steenbergen-Hu, Cooper. (2014) *A meta-analysis of the effectiveness of intelligent tutoring systems on college students' academic learning*; Schroeder, Adesope, Gilbert (2013) *How Effective are Pedagogical Agents for Learning? A Meta-Analytic Review*; Ma, Adesope. Nesbit, Liu. (2014) *Intelligent Tutoring Systems and Learning Outcomes: A Meta-Analysis*,

reasoning, problem solving, and application of concepts. Luckin et al (2016) concluded that AIEd can play a deeper role in the acquisition of these skills as it allows tutors to have a greater understanding of learner knowledge by examining how they arrive at the answer, rather than just examining the answer itself.

In the qualitative interviews, a key expected impact of AIEd was in improving learner retention and achievement. This was because it could help providers interpret information on learner attendance and progress to identify learners at risk of dropping out, which allows tutors to identify issues early. Holstein (2017) and Luckin et al (2016) also reported that this was a key potential benefit of AIEd. However, there were no empirical studies that measured any change in retention.

Other applications of AIEd, in areas such as learner monitoring, creating tailored learning pathways and in supporting assessment, were not examined in depth in any of the identified research studies. This may reflect where AIEd is embedded as a part of a wider programme it may be difficult to discern what benefits are attributable to AIEd and what are due to other factors related to the teaching of the course.

5.5 Learner characteristics

5.5.1 FE and HE providers

FE and HE providers generally reported that most of their online learners lived in the local area. They felt that this was largely because most of the course marketing was undertaken locally. It was also reported that learners planning to undertake an online course are more likely to review the website of their local providers.

A few providers said that they commissioned 'learner recruiters' to promote their online products. This has resulted in some providers attracting learners from further afield. One provider in the Midlands for example reported that they recruited around a third of their learners on one course from Yorkshire, as that was where the recruiter was based. Some HEIs and FE colleges that offer more unusual subjects also reported recruiting learners from a wider geographical area.

Most providers reported that the characteristics of learners that undertake online learning largely reflected the characteristics of the local area. However, some believed that learners on online courses were generally younger, and more likely to work in an office environment, compared to learners that choose to study classroom-based courses. This was felt to be due to these learners being more comfortable with the wider use of digital technology.

Providers generally reported that for some business administration and health and safety courses nearly all the learners were in employment. However, courses in subjects such

as engineering, ICT and accountancy attracted a high proportion of unemployed learners, as well as in-work career changers who wanted the social interaction of a classroom-based course.

5.5.2 MOOCs

In the interviews, MOOC platforms reported that most of their learners are educated at a degree level or above. This is consistent with Christensen's study in 2013⁴⁴, which found that internationally 79% of MOOC learners possessed a Bachelor's degree or higher, and 44% a postgraduate degree, which was far above the general educational attainment in their own countries. The academic researchers interviewed in part attributed this to these individuals being more comfortable in searching for information online, and also because they spent more time online. However, one of the researchers also posited that the model employed by MOOC platforms to deliver online learning, which is largely based around self-directed learning, is less appealing for lower skilled adults. Some of these learners were perceived to be less confident in their abilities and therefore reluctant to undertake learning where they do not get support.

Nearly all MOOC platforms also said that most learners that undertake their course are in employment. They felt this was unsurprising, as most of their provision is targeted at supporting people in work to upskill for new job roles or responsibilities or to change careers.

5.5.3 Private providers

Private providers that do not deliver FE provision similarly reported that learners undertaking their online courses tended to be younger and in employment. Most chose to undertake such a course because it was the most convenient option available to them, with providers reporting that some were willing to pay more for additional support. They included people aiming to progress in work, as well as career changers. These included both higher and lower skilled adults.

Private providers generally reported recruiting learners from across the country. This was reflected in their approach to marketing, with most wholly advertising online and registering themselves for e-learning training directories. A few also operated across the UK and Republic of Ireland.

⁴⁴ Christensen (2013). *The MOOC Phenomenon: Who Takes Massive Open Online Courses and Why?*

5.6 Perceptions of future growth

Nearly all interviewees reported that they expected demand for online learning to increase in the next five years. Most believed there would be particularly substantial growth in the employer market, continuing the trend identified in the 2017 Employer Skills Survey which showed that the proportion of employers offering online learning in the last 12 months increased to 51% from 45% in 2015. They felt that employers have only started to recognise the value of providing online learning to upskill their workforce, and consequently there was more scope for growth. Moreover, recent legislation on data protection, the Government Prevent strategy and equality and diversity were also expected to drive demand for regular mandatory employee training.

Interviewees has more mixed views on the extent to which the learner market would grow in the next five years. Some believed it would grow substantially, as a result of learners becoming savvier in using different digital technologies and therefore more willing to study online. However, others believed the market was stagnating as they felt that most of the learners that were willing to study online were already doing so.

A few providers reported however that they are seeing increasing demand for blended learning, and they expect this trend to continue in future. This included reported demand from employers for blended learning for apprenticeships. Providers reported that many employers felt this was more convenient for learners than having to travel to a provider to undertake their 20% off-the-job learning, and also allowed learning to be more easily slotted around their existing work commitments.

6 Conclusions and recommendations

This chapter draws together the findings from the review of the online learning and AIEd markets to draw out what works well, what aspects of the market could be improved and the key market failures. It then sets out recommendations for the supporting the delivery of online learning and AIEd to support learners to acquire low to medium skills.

6.1 Conclusions

This section presents a summary assessment of the structure, conduct and performance of the online learning and AIEd market, highlighting strengths and weaknesses. Each element is broadly assessed, and colour-coded, as follows:

- **Generally effective** [G]. This is where the supply-side of the market is operating in a way that reflects what would be expected from an effective market. In the areas where the market is generally effective there are no major issues that are likely affecting learner choice or the responsiveness of the market to learner and employer demand.
- **Partially effective** [P]. This is where the market exhibits some characteristics of an effective market, but there are some areas where it could be improved.
- **Not effective** [N]. This is where there are potential risks in the way the market operates which may be restricting the supply of provision or the quality of online and AIEd learning.

The study only engaged with market participants who were primarily involved in the supply side of the market (the developments of the products and provision of training). The demand for online learning and AIEd training was not covered in depth as the study did not include primary research with employers or learners. However, where possible it has presented developer and provider perceptions of the factors that influence demand.

6.1.1 Market structure

Assessment of the market structure

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
Ease of entry to the market	There should be few barriers in place for new entrants to operate in the sector, which encourages competition.	P	Strengths: For online learning the availability and low cost of authoring tools and provision of off-the-shelf online courses makes it relatively easy for new providers to deliver online courses. Online learning developers require more up-front costs to develop new products (coding for game mechanics, videos

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
			<p>and animation) but this is not prohibitive. AOs allow providers to deliver some of their courses online, and the process for registering to deliver a new qualification is not overly burdensome. Funding rules allow providers already in receipt of public funds to deliver online learning courses through AEB.</p> <p>For AIEd there are similarly no major barriers for providers to deliver qualifications and access funding.</p> <p>Weaknesses: For online learning there is a lack of tutor time or skills in some providers to develop new online learning content, and FE/HE providers have no funding incentive/steer to do so.</p> <p>For AIEd there is a significant upfront R&D cost for producing new products, which discourages new entrants.</p>
Ease of expansion	Well-performing providers and developers should have the opportunity to expand their offer if they wish to do so. This rewards quality		<p>Strengths: For online learning the developer model to initially develop a template which can then be tailored for different customers makes expansion relatively straightforward. Providers also have few barriers to delivering new online learning courses.</p> <p>Weaknesses: In FE the lack of staff time and skills in using online authoring tools and online pedagogies inhibits the development of new online programmes.</p> <p>There are some elements of courses are not yet possible to teach online as they require supervised manual practice using specialist equipment. This may be resolved with use of AR/VR.</p> <p>For AIEd there is a significant cost for developing AI algorithms for new courses, as they require significant tailoring to the course content and objectives.</p>
Ease of exit and switching	An effective market does not include significant barriers to		<p>Strengths: For online learning and AIEd, developers generally have short contracts and liabilities with their customers, which allows</p>

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
	exit. This encourages innovation and ensure poor provision is removed from the market		<p>them to exit relatively quickly; providers similarly can stop delivering courses without any financial penalties.</p> <p>Weaknesses Providers have to incur some in-kind (staff time) costs for switching materials to a new LMS platform. However, these costs are relatively low.</p>
Scope for differentiating products	There should be sufficient scope for providers and developers to differentiate their product, which encourages providers to innovate and allows high quality providers and developers to grow		<p>Strengths: For online learning developers are able to differentiate their online products through the interactivity of their product and the quality of the course content. Providers have scope to change content and the online pedagogy.</p> <p>For AIEd there is scope to alter the methodology and rules used in their AI model.</p> <p>Weaknesses: Customers are unable to distinguish between AIEd products, as the quality of the algorithms used are not easily visible. This means the benefits of AIEd not easily apparent to developers and providers</p>
Market concentration and coverage of online learning providers and developers.	There should be a broad range of organisations supplying products, so that one organisation or a group of organisations do not have a dominant position that leads to non-competitive behaviour.		<p>Strengths: For online learning there is a high volume of online learning developers, including some specialists in areas such as gamification. There are also a broad range of providers, including professional bodies, colleges, HEIs and overseas organisations that deliver English language courses in UK.</p> <p>Weaknesses: For online learning there is relatively little provision at L4-5 as FE provision is mostly at L2-3 and MOOCs and HE courses primarily delivery courses at higher levels (L6 and above). This does however reflect the general low take-up of L4-5 provision in FE and HE. Moreover, FE providers are not generally promoting their online courses outside their traditional geographical boundaries.</p>
Market concentration and coverage of AIEd	As above		<p>Strengths: A few well-established AIEd providers in UK that operating in other markets (schools and HE) and international developers</p>

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
providers and developers			<p>have scope to enter the market for delivering low-intermediate skills courses</p> <p>Weaknesses: Overall however there are few specialist providers and very few online learning developers that use AI in their products, primarily due to a lack of explicit employer and learner demand.</p>

Key strengths and weaknesses

Online learning

The review found that the structure of the online learning market is partially effective. There are a diverse range of providers and developers, which includes some that specialise in products (e.g. games-based learning) or in sectors. The developer base is large enough to provide online learning products at different price points and they have scope to differentiate their products so most invest in improving the interactivity and content of their products. The provider base is also diverse enough to include around a fifth of all FE colleges, small specialist private providers and large-scale MOOC platforms, which creates healthy competition for learners.

The market structure also generally supports competition. It is relatively straightforward for new developers to enter the market, as the upfront costs are not prohibitive. Providers that wish to deliver online courses also have a relatively straightforward process for gaining approval to deliver their qualifications, and the legislation and Ofsted inspection regime does not inhibit qualifications from being delivered online. The short contract period and limited liabilities means that developers have the flexibility to leave the market and providers have ample scope to switch to a developer that best meets their needs, although there will be a small resource implication on the provider for changing platform.

There are however some weaknesses in the market. There is relatively little FE provision geared at higher technical skills while a high proportion of MOOCs are for leisure learning. There are also limits to how effectively online learning can be used to teach some programmes that require practical instruction and practice under supervision, such as construction or hairdressing, but this could partly be resolved through new technologies such as AR and VR.

In FE providers, a lack of staff time and skills in developing online courses is also hindering providers from expanding their offer, while the staff time required to switch LMS is also discouraging FE providers from changing their systems, which can potentially lower innovation amongst developers. Moreover, most FE providers promote their online courses locally and therefore are not taking advantage of the opportunities to deliver courses across a wider geographical area.

AIEd

The structure of the AIEd market is not effective. There are few AIEd specialists and few online learning providers that use AIEd products. This is largely because there is no significant financial incentive for developers to produce AIEd products because there is poor information, little explicit learner, employer or provider demand and high development costs to develop an AI algorithm that is tailored to a particular course. There is also a widespread perception among developers that there are few authoring tools that can speed up the development of AIEd products so there are also significant resources required by providers and developers to expand their offer.

Alongside this, it is also difficult for potential customers to distinguish between 'good' AIEd and 'bad' AIEd, as the algorithms used are not easy for customers to assess. This limits high quality AIEd developers to distinguish themselves from their competitors in order to increase their market share. It also does not incentivise developers to innovate in order to improve the quality of the algorithms that underpin their products.

Even so, the regulatory environment for skills training does not inhibit the use of AIEd. There are no restrictions that limit the use of AIEd for delivering public funded courses and the Ofsted inspection regime does not penalise providers from using AIEd. As a consequence, there are few barriers for providers to expand their use of AIEd. Moreover, the short contract periods and limited liabilities of AIEd developers means they can easily leave the market if they so wish.

6.1.2 Market conduct

Assessment of market conduct

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
Policies and funding support the market	Policies and funding should support take up while not adversely affecting organisational behaviour and capacity to respond to customer demand		Strengths: To support online learning and AIEd, the Government funds JISC to help HE and FE providers exploit the benefits of technology on teaching, and recent interventions of FELTAG have ensured providers are able to use public funding to deliver online learning and means online learning courses can attract loans. Weaknesses: FE/HE providers have not had a particular policy steer for expanding their online learning offer, as it has not been an explicit focus in recent government skills policies. There has also been little funding provided specifically for online learning or a

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
			<p>financial incentive for providers to expand their online offer.</p> <p>AIEd has similarly not been explicitly promoted in recent government skills policies and there has been little explicit promotion of the benefits of AIEd or guidance of the ethical considerations that should inform the use of AIEd.</p>
Providers and developers taking effective steps to grow their online and AIEd learning offer	Organisations priorities support the growth of online learning and AIEd		<p>Strengths: For online learning, most MOOCs platforms and some specialist private providers have plans to expand their offer. Most developers similarly had plans to grow their offer, particularly in the employer market where demand is expected to grow in the next five years, in areas such as AR and VR. A few FE and HE providers developing online content to meet local employer needs and to make their specialist courses available to a wider national audience. A consortium of FE providers is also collaborating to develop online qualifications they can all use.</p> <p>Weaknesses: Most FE and HE providers do not regard online learning as a priority and have little knowledge of AIEd;</p> <p>Similarly, few developers reported concrete plans for using AIEd, as many were sceptical about its benefits.</p>
Effectiveness of product development and delivery	Organisations should have efficient systems in place to develop and deliver online learning and AIEd		<p>Strengths: Online learning developers use product templates which means new products can be developed efficiently. For most providers there is a higher cost for developing online courses, but the delivery costs are lower as tutors spend less time delivering online courses, and the courses can be delivered to larger groups</p> <p>Most examples of AIEd use effective mechanisms for generating data to allow the system to 'learn'.</p> <p>Weaknesses: AIEd is currently costly to develop, as it needs to be extensively tailored for a new course. It also has ongoing costs associated with hosting</p>

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
			content, which is necessary to ensure the system collects sufficient data for AI.
Effective competition between providers	Organisations compete in a way that raises quality, encourages innovation and keeps down fees		<p>Strengths: For online learning, providers compete in terms of the flexibility of their offer and the reputation of their qualifications. There is also some price competition with many providers positioning their online courses as more cost-effective than studying in a classroom. The widespread availability of free courses also keeps course prices low.</p> <p>Weaknesses: No explicit focus on the quality of the learning experience in competition</p>
Effective competition between developers	As above		<p>Strengths: Developers generally compete on the quality of the user interface and the interactivity and use of media in the courses they develop and on price. Open tendering means providers are incentivised to keep costs low.</p> <p>Weaknesses: Little competition by use of educational technologies (such as AIEd).</p>
Information asymmetries	Providers and learners should have sufficient information to make informed decisions on selecting developers and courses respectively.		<p>Strengths: Learners and employers have a good understanding of online learning, which is relatively well established. Many learners have experience of more modern online courses through their employer or via MOOC platforms</p> <p>Weaknesses: Tutors and senior managers in FE/HE providers have little awareness of AIEd and the benefits it can bring, which means examples of good practice do not spread widely; also little understanding or demand for AIEd among employers and learners</p>

Key strengths and weaknesses

Online learning

The review found the conduct of providers and developers in the online learning market contained was generally effective. Developers compete on the quality of their user interface, interactivity and use of media which encourages them to improve the quality of the products available, as well as to introduce new features, such as AR and VR.

Developers also compete on price as much work is tendered and delivered on fixed quotes.

Providers compete on the flexibility of their provision and their reputation. Providers are also promoting online courses as more cost-effective than classroom-based courses, which in turn should encourage more learners to undertake learning. The costs of online learning courses are also being kept low by the plethora of free courses that are available through MOOC platforms.

The development and delivery of online programmes is also largely efficient. Developers' use of templates allows them to develop new products relatively quickly, and the initial research and development costs for developing new products is not prohibitive. There are also developers that operate within different project sizes, with some focusing on smaller contracts which are more sensitive to price and others focusing on larger contracts where quality and interactivity are more important for winning work. For providers, online courses do require a higher upfront cost for designing the courses but in most cases the ongoing costs are lower as they require less tutor support than equivalent classroom-based courses and can be used to support a larger group of learners.

There are however some aspects of the conduct of the market that work less well. Few FE and HE providers regard delivering online learning as important. This is perhaps unsurprising given that for many their key assets are their facilities and products which are mostly available for classroom-based learners. Many FE providers also believe their key target groups of learners have greater barriers to learning which require more one-to-one support and tuition.

FE providers also do not generally compete on quality, as most believe that accessibility is the key '*selling point*' of online learning. This means there is little incentive to innovate in improving the learning experience, particularly when coupled with the needs to keep costs low to compete with free or low cost online provision delivered by MOOC platforms and some private providers.

There has also been little policy intervention that incentivises providers to deliver online learning. While the Government has long championed the use of educational technologies, recent skills policies have not explicitly aimed to increase the availability of online learning. There is also little financial incentive for providers to deliver online learning, as there are no specific funding programmes that specifically target online learning, aside from the pilot Flexible Learning Fund which was rolled out in 2018.

For developers, the higher perceived profitability and growth potential in the employer market has resulted in many developers focusing on this area. Relatively few developers reported producing products for learning providers. A few providers reported being

disinclined to change developer as it would require staff time to transfer information across to a new system and to train tutors and learners to use it.

AIEd

For AIEd, the conduct of the market is not effective. Few developers reported it as a priority or were making plans to develop new AIEd products or embed AIEd in their existing products. This was largely because of a lack of explicit demand among providers and employers for AIEd products, and a perceived high development cost for producing AIEd products and hosting content online.

Alongside this, there is a lack of awareness of how AIED can be used to enhance the learning experience, which is also inhibiting its use. Developers for example have the misconception that it replaces tutor involvement in programmes, where in most cases it has been used as a teaching aid. Senior managers and tutors in providers also have little awareness of AIEd, which affects demand for these products.

At present there has been also little consideration given to ethical issues on how AIED should be used. AIEd machine-learning means that decisions can be made on learning that are not clear to learners or tutors. There is a risk that this lack of transparency may limit trust in technology.

6.1.3 Performance

Assessment of market performance

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
Volume of learners undertaking online learning provision	There should be sufficient learners undertaking online learning and AIEd courses to meet demand		<p>Strengths: MOOCs and private providers support a range of learners, with some MOOC platforms reporting over a million users (although it is not possible to discern how many are based in England or that are at L2-5).</p> <p>Weaknesses: There is a lack of robust data on the learners undertaking online learning courses. From the mapping not all FE and HE providers deliver online provision and for those that did it was only a small part of their offer. Provision was also mostly at L2-3 with little at L4-5.</p>
Demographics of learners	The learners accessing online learning provision should reflect the characteristics of society		<p>Strengths: FE and HE providers report that their online learners generally reflect the demographics of their local area.</p>

Performance metric	Characteristics of an effective market	Rating	Strengths and weaknesses
			Weaknesses: MOOC platforms engage relatively few low to medium skilled learners, appearing to reach learners who are already highly skilled. Research suggests online learning is less effective in engaging older learners.
Accessibility of online learning and AIEd provision and impact on the learner experience	Provision is accessible to a broad range of learners and provides learners with a positive learning experience		<p>Strengths: Perceived strength of online learning is that it provides learning opportunities to employed learners or learners with disabilities or family commitments.</p> <p>AIEd also provides benefits for accessibility in terms of addressing learner and employer demand for more 'made-to-measure' learning.</p> <p>Weaknesses: Benefits of AIEd on accessibility not realised as yet.</p>
Achievement and outcomes of online learning provision	Provision should support learners to progress into and within employment		<p>Strengths: Evidence of online learning, when supplemented by learner-learner and learner-tutor communication, provides better outcomes than classroom-based learning for similar-sized classes. AIEd also found to improve achievements when used as a teaching aid and to reduce tutor workload.</p> <p>Weaknesses: Very low completion rates of MOOCs which reduce their impact. Literature review found wholly online or wholly AIEd courses do not provide better, statistically significant outcomes than classroom-based learning.</p>

Key strengths and weaknesses

Online learning

There are elements of the performance of online learning that are generally effective. Existing research demonstrates that there are benefits that online learning can provide to support learners to access and achieve learning. These benefits are increased when it is delivered alongside tutor support rather than as self-directed learning. This is particularly likely to be important for low-medium skilled adults.

However, there are considerable limitations in the performance of the online learning market. There is relatively little provision at intermediate skills levels (Level 4 and Level 5) because FE providers deliver most of their provision at Level 2 and Level 3 while MOOC platforms and private providers target most of their provision at Level 5 or above.

Additionally, completion rates of MOOCs are relatively low. Although some of this can be attributed to learners trying courses before deciding to commit, it is also evident that without personal contact and follow-up learners feel less committed to complete online learning than they would attending a classroom-based course. The flexibility of the learning also means learners are less likely to commit to spending a certain amount of time per week studying the course.

AIEd

The research identified a range of ways that AIEd can be used to improve the quality of learning. Intelligent tutoring systems were found to be effective in raising attainment. Examples of AIEd in the school sector have shown that it can provide benefits in terms of creating more personalised learning and automating some learner monitoring and assessment tasks to free up tutor time. It is notable however that the main benefits of AIEd appear to be when it is used as a teaching aid rather than to replace tutors.

However, the limitation in the performance of AIEd is that it is rarely used and consequently, its benefits are not currently being realised in the current landscape. A key challenge here may be that there are limited economies of scale in FE. Unlike in schools, where learners predominantly undertake a small range of subjects, in FE, learners can undertake over 1,000 vocational courses at L2-5 subjects. These courses attract smaller volumes of learners per course and therefore the cost of developing any bespoke AIEd product for these courses would be high in comparison to the number of learners it would support.

6.1.4 Market failure

The review of the market leads to identifying the following market failures for online learning and AIEd:

- There is limited awareness among public sector providers of the benefits of online learning and particularly AIEd. As a consequence, despite examples of its positive impact, few providers are taking steps to develop their online learning and AIEd offer. The lack of explicit demand for AIEd is also discouraging developers from investing in AIEd products.
- Online learning and AIEd appears to represent a small proportion of adult learning provision, and little incentive for FE and HE providers to invest in expanding their offer or improving the quality of current online provision. There is also no stated

Government policies in AIEd and online learning which could encourage providers to invest in the area. This is important given private sector incentives to invest may be limited.

- Few developers are creating AIEd products or have plans to do so in the near future. There are very few specialist AIEd developers in England and considerable resistance among most online learning developers to produce AIEd products. The high cost of developing AIEd products and lack of provider, learner and employer demand also inhibits growth.
- It is difficult for providers and employers to make informed choices about the AIEd products they purchase. This is because it is not straightforward to distinguish the quality of an AIEd product as it is based on the algorithm and the data used.
- Lack of teacher capacity to develop online learning course content and to make effectively use of 'online pedagogy'. This is likely to affect both the number of courses available online and their quality

6.2 Recommendations

The study identified the following recommendations to improve the quality of online learning and AIEd and address some of the market weaknesses described above:

- **The DfE and its partners should issue guidance and training on how HE and FE providers should use online learning and AIEd to provide high quality learning.** This would raise senior managers' awareness of the potential benefits of the technologies and support practitioners to understand effective online learning pedagogies. It would also demonstrate Government's commitment to growing this provision, which in turn will encourage provider developments of online learning.
- **The ESFA and OfS, through their existing relationship management arrangements with HE and FE providers, should encourage providers to develop an online learning offer for subjects or courses at Level 3 to Level 5, particular where they have specialist provision.** This would encourage providers to make their courses available to learners across a wider geographical area or to expand their offer of Level 3 to Level 5 courses. It is an area where FE and HE providers can add significant value to the current online learning landscape.
- **The DfE should fund the development of 'test bed' AIEd products to be used by the FE sector.** These products will help raise provider awareness of the value and potential benefits of AIEd, while also addressing negative perceptions of the technology. We suggest that this could initially be self-study programmes that can be used as teaching aids in the delivery of some key T level subjects. The high volume of learners that are expected to study T levels would mean that the

product could benefit a large number of learners. Moreover, it would provide the added benefit of supporting the implementation of a key Government policy which aims to increase the quality of technical education. The commissioning of the products should be done through Jisc as they can bring to bear efficiencies through collective bargaining on behalf of the sector, while also having the technological knowledge to effectively appraise bids.

- **Future research on AIEd should focus on creating products that can be easily re-used for different courses and contexts.** This could include research on AIEd authoring tools or templates. These products would significantly reduce developer costs for designing new AIEd products, which ought to encourage more developers to use AIEd and reduce the fees charged to providers.
- **The DfE should conduct research with learners to examine demand-side factors that affect the online learning and AIEd market.** This research could focus on identifying the potential market for online learning (how many learners are willing to study online, what types of course they would like to do on-line, what would they be willing to pay) to examine how far this matches supply. The research would also allow the DfE to identify any demand side barriers or information asymmetries which may be reducing the take-up of online learning.

The research also found that online learning and AIEd can play an important role in supporting adult retraining. There is strong employer demand for online learning products and most developers believe that demand for online learning will increase in the next few years. To inform any future online training initiatives for adult re-training, the study recommends that:

- **Future DfE online training policy interventions should support online learning at a mix of levels.** There is a need for higher level qualifications (Level 4 and Level 5) that provide entry to particular occupations as there is relatively little of this provision delivered in FE. However, there is also a need for lower level provision, including functional skills provision, which can enhance the quality of the learner experience.
- **To ensure sustainability, future interventions should also consider models where employers can pay to access services.** This includes providing access to online portals that host training and allow employers to monitor their take-up, as well as giving employers the opportunity to co-design a suite of accredited qualifications relevant to their organisation. The experience of MOOC platforms is that employers are willing to pay for these services which means provision could be self-sustaining. It would be particularly attractive to medium-sized employers that may not be able to purchase an LMS but need an effective means to ensure all their staff undertake relevant training.

- **Online learning courses funded through DfE initiatives should include collaborative learning environments and tutor communication.** This was found to increase the quality of online courses and completion rates considerably, and also reflects current employer and learner demand. It is particularly valuable for low to medium skilled adults, who MOOCs have found difficult to engage in online learning, as well as individuals who may lack confidence or the ICT skills to undertake wholly self-directed learning.

ANNEXES

Annex 1 Market assessment framework

Table 2 Market assessment framework

Measures	Sources
Structure	
Is there a diverse range of organisations providing online learning and AIEd and providers delivering them?	<p>Desk research to identify the volume of organisations developing and delivering online learning and AIEd.</p> <p>Desk research to identify the characteristics of organisations developing and delivering online learning and AIEd.</p> <p>Qualitative interviews with providers, developers and stakeholders to further explore characteristics (including the extent to which there is overlap in organisations providing both services, the extent to which training providers develop their own in-house services, any typologies or segmentation in the market).</p>
Does the developer market's level of concentration allow innovation, price-competition and encourage new entrants?	Information on the number of products, price, quality etc. collected from qualitative interviews and desk research.
Are there any barriers to delivering online learning and AIEd?	Qualitative interviews with providers to identify any enablers/barriers to the delivery of online learning and AIEd.
Are there effective models in place to generate income from online learning and AIEd?	<p>Desk research to identify current funding models and revenue they provide for developers and providers. This includes examining income generated from public and private sources</p> <p>Qualitative interviews with providers and developers to further explore their access to public and private funding.</p>
Is entry, expansion (including mergers) and exit from the market for developers and providers feasible?	<p>Desk research to identify trends in the number of developers and providers active in the market, rates of entry/exit, and expansion.</p> <p>Qualitative interviews with providers, developers and stakeholders to explore perceptions of easy/difficulty of entry, expansion and exit, and what factors determine this.</p>
Is there any legislation, policies or funding that inhibits or promotes the development and provision of online learning and AIEd?	<p>Desk review to identify policy developments related to online learning and AIEd.</p> <p>Qualitative interviews with developers, providers and stakeholders to explore their perceptions of</p>

Measures	Sources
	current policy and funding landscape and how it influences decision-making.
Is there scope for differentiation between online and AIEd products and provision.	Qualitative interviews with developers, providers and stakeholders to explore how they currently market their products/provision and seek to compete with others.
To what extent can online learning and AIEd products be re-used in different providers and courses?	Qualitative interviews with developers, providers and stakeholders to explore the substitutability of different products.
Conduct	
Are developers and providers effectively assessing demand for online learning and AIEd?	Qualitative interviews with developers, providers and stakeholders to explore methods they use to assess demand (e.g. research with learners? use of labour market intelligence?)
Are developers effectively promoting online learning and AIEd to providers? And are providers effectively promoting online learning and AIEd to learners? And	Qualitative interviews with developers, providers and stakeholders to explore how they current seek to 'sell' online learning and AIEd to their respective target audiences.
On what basis do developers and providers currently compete (e.g. on price/funding model, reputation, etc.)?	Qualitative interviews with developers, providers and stakeholders to collect views on nature and extent of competitive behaviour between developers and between providers.
Are providers making informed decisions about the online learning and AIEd products they purchase/access from developers?	Qualitative interviews with providers and stakeholders to explore current levels of provider knowledge and factors informing provider decision-making.
Are learners making informed decisions about the online learning and AIEd they access from providers, and the value of online learning compared to classroom-based provision?	Qualitative interviews with providers and stakeholders to gain views on current levels of learner awareness/knowledge and factors informing learner decision-making.
Do providers have reasonable opportunities to change the online and AIEd products they purchase/use?	Desk research to establish average contract length, contract status and lifespan of tools, including any financial or other penalties for changing supplier. Qualitative interviews with providers, developers and stakeholders to collect views on easy/difficulty of changing products.
Are there any constraints on providers' choice of online and AIEd products, either quality or price?	Qualitative interviews with providers and stakeholders to collect views on choice in the market; including any limitations in the quality and coverage of existing online learning and AIEd tools.

Measures	Sources
Are the current fees and funding models charged for online learning and AIED effective in encouraging take up from learners while allowing developers and providers to cover their costs?	Qualitative interviews with developers, providers and stakeholders to understand business models and pricing decisions. Developer and provider views on how their fees and funding models influence learner take-up.
Are developer and/or provider decisions influenced by the availability and level of public funding?	Qualitative interviews with developers, providers and stakeholders to collect views on the importance of different funding sources in decision making.
Are developers and providers effectively assessing demand for online learning and AIED?	Qualitative interviews with developers, providers and stakeholders to explore methods they use to assess demand (e.g. research with learners? use of labour market intelligence?)
Are developers effectively promoting online learning and AIED to providers? And are providers effectively promoting online learning and AIED to learners? And	Qualitative interviews with developers, providers and stakeholders to explore how they current seek to 'sell' online learning and AIED to their respective target audiences.
On what basis do developers and providers currently compete (e.g. on price/funding model, reputation, etc.)?	Qualitative interviews with developers, providers and stakeholders to collect views on nature and extent of competitive behaviour between developers and between providers.
Are providers making informed decisions about the online learning and AIED products they purchase/access from developers?	Qualitative interviews with providers and stakeholders to explore current levels of provider knowledge and factors informing provider decision-making.
Performance	
Is the financial performance of developers and providers in line with expectations? Can they achieve a reasonable financial return for developing and delivering online learning and AIED?	Desk research to identify indicators of the financial health of developers and providers (e.g. from annual reports/accounts). Qualitative interviews with developers, providers and stakeholders to further explore developer and provider finances.
Are there a wider range of developers developing online learning and AIED products?	Desk research to establish volume and characteristics of developers. Qualitative interviews with developers, providers and stakeholders to explore views on breadth of developer market.
Are there a wide range of online learning and AIED products?	Desk research to establish volume and characteristics of products. Qualitative interviews with developers, providers and stakeholders to explore views on breadth of product market.

Measures	Sources
Are there a wide range of providers delivering online learning and AIEd provision?	Desk research to establish volume, geographical coverage and characteristics of providers who deliver online learning and AIEd. Qualitative interviews with providers and stakeholders to explore views on breadth and coverage of provision.
Is online learning and AIEd provision accessible to a wide range of learners?	Desk research to establish volume, distribution and characteristics of learners who currently access online learning and AIEd. Qualitative interviews with providers and stakeholders to explore views on extent of uptake. Qualitative interviews with providers and stakeholders to understand the types of groups that benefit most from online and AIEd, including its particular role in supporting the medium skilled in employment.
Does the supply of online learning and AIEd products meet provider demand?	Qualitative interviews with developers, providers and stakeholders to collect views as to whether the needs of providers are currently being met by developers.
Does the supply of online learning and AIEd provision meet learner demand (and contribute to employers' needs for upskilling and retraining)?	Desk research to establish the supply of online learning and AIEd provision. Qualitative interviews with providers and stakeholders to explore views on extent supply is meeting demand.
Is online learning and AIEd effective in engaging learners and providing them with employment-relevant skills?	Desk research to examine take-up, retention, completion, achievement and progression rates for different types of online learning and AIEd. Qualitative interviews with developers, providers and stakeholders to collect wider views on the relative effectiveness of online learning and AIEd.
Is the financial performance of developers and providers in line with expectations? Can they achieve a reasonable financial return for developing and delivering online learning and AIEd?	Desk research to identify indicators of the financial health of developers and providers (e.g. from annual reports/accounts). Qualitative interviews with developers, providers and stakeholders to further explore developer and provider finances.
Are there a wider range of developers developing online learning and AIEd products?	Desk research to establish volume and characteristics of developers. Qualitative interviews with developers, providers and stakeholders to explore views on breadth of developer market.

Annex 2 MOOC platform business size

Table 3 MOOC platform business size

MOOC platform	Size
Coursera	Large – More than 250 employees or turnover over £50 million
Lynda.com	Large – More than 250 employees or turnover over £50 million
Udacity	Large – More than 250 employees or turnover over £50 million
Canvas	Medium – Between 50 to 250 employees or turnover between £10 to £50 million
edX	Medium – Between 50 to 250 employees or turnover between £10 to £50 million
Shaw Academy	Medium – Between 50 to 250 employees or turnover between £10 to £50 million
FutureLearn	Micro – Less than 10 employees or turnover under £2 million
iversity	Small – Between 10 to 50 employees or turnover between £2 to £10 million
OpenClassrooms	Small – Between 10 to 50 employees or turnover between £2 to £10 million
Alisson	Small – Between 10 to 50 employees or turnover between £2 to £10 million
Kadenze	Small – Between 10 to 50 employees or turnover between £2 to £10 million



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