

Digital Learning Ecosystems: Discussing the outcomes of a principle led investigation into an alternative VLE

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Abstract

The proposal for a next generation digital learning environment (Brown, et al., 2015) promises a radical new way of delivering teaching and learning in higher education. In 2018, The University of Lincoln explored the aims and benefits of this vision and how, if at all, it or an alternative could be implemented at the University. This paper discusses this the activity of the cross-institutional working group, the challenges and vision that emerged and proposes next steps for where we (as a University) could go to deliver this ambitious vision.

Keywords

Virtual Learning Environments, Next Generation, Learning Platforms, Digital Education, NGDLE, VLE, Digital Transformation, Digital Technology, Digital Learning Ecosystems

Introduction

In Jan 2018, The University of Lincoln began to look at **an alternative 21st-century approach to digital education and provide a report on how it could be realised**. This investigation echoed a shift within the HE Sector towards a digital experience that more accurately reflects the kind of digital experiences freely available to our students outside of the University through what has become commonly referred to as the next generation digital learning environment (NGDLE). According to EDUCAUSE¹ in 2015, the future requirements for the NGDLE are:

'interoperability; personalization; analytics, advising, and learning assessment; collaboration; and accessibility and universal design. Since no single application can deliver in all those domains, we recommend a "Lego" approach to realizing the NGDLE, where NGDLE-conforming components are built that allow individuals and institutions the opportunity to construct learning environments tailored to their requirements and goals.' (Brown, et al., 2015, p. 1)

This paper discusses the outcomes of investigations into the promise and reality of delivering this vision.

Review of literature

Virtual Learning Environments (VLEs) or Learning Management Systems (LMS) have become critical learning platforms within higher education since their emergence in the late 90s; yet there is a

¹ a non-profit organisation based in the United States that helps higher education evaluate the impact of IT: <https://www.educause.edu/about>

perception amongst some users that VLEs, whilst important, are increasingly feeling old-fashioned and 'clunky-yet-functional' (Clay, 2010) & (Thomas, 2016) in comparison to more popular modern tools like Facebook or Twitter. With VLE vendors continuing to evolve their solutions through new features built upon their original platform, they can inevitably begin to suffer from 'scope creep' and the feeling of being increasingly complicated or convoluted (Phipps, et al., 2018, p. 6). Whilst more broadly, modern alternative platforms such as:

'...Facebook, Google, Microsoft, Amazon and Apple could... become huge players in the future of learning environments, and there have already been moves made in this direction such as Google Classroom, Microsoft Teams and Amazon's purchase of TenMarks...While these components may not currently be packaged as learning environments, individuals and institutions have, in some cases, taken them and created their own systems.' (Phipps, et al., 2018, p. 9)

This raises the possibility (or desire) to reframe VLE provision through more modern alternatives, but whilst the hope is we will gain an enhanced learning experience, what do we risk?

Though embedded in the delivery of learning in higher education, there is a mismatch between the promise and actual use in higher education, with VLEs becoming '*...highly successful in enabling the administration of learning but less so in enabling learning itself*' (Brown, et al., 2015, p. 2). Student satisfaction with VLEs [or LMS], can be high, however, albeit with some frustration expressed over the apparent lack of more advanced feature use (Pomerantz, et al., 2018). A view, in part, echoed by our own investigations at Lincoln, where an anonymous Lincoln staff Blackboard satisfaction survey in Jan 2017 (Beggan & Butler, 2017) revealed that 90% of staff respondents believed Blackboard to be useful or very useful, but further investigation into what tools were actually used revealed a predominance of module administration tools over the more sophisticated features that can help to deliver learning outcomes (see Fig.1 below).

Further investigation within the survey, however, revealed that respondents were aware of these enhanced VLE teaching and learning features but chose not to use them in favour of other tools or approaches external to the system. VLEs in their current form, therefore, do fulfil an important administrative function underpinning learning but tend to have a lesser impact on the learning that occurs there.

Consequently, perhaps, the ambition underpinning the sector-wide discussions surrounding NGDLEs are, in-part, a reaction to the complexity and perceived inflexibility associated with the current VLEs to support learning activities; coupled with a desire to exploit more modern technologies and digital experiences:

'Most of the conversations around NGDLE amount to a backlash against VLEs becoming increasingly feature rich and 'monolithic'. There is an alternative vision that replaces the VLE with a thin interoperability layer allowing institutions to pick and choose effectively 'best of breed' tools for communication, collaboration, assessment and feedback etc.' (UCISA, 2018)

Arts	Use	Non-use
Announcements	94.67%	5.33%
Learning materials	94.67%	5.33%
Send email	84.00%	16.00%
Turnitin	80.00%	20.00%
Grade centre	78.67%	21.33%
Staff details	76.00%	24.00%
Reading lists	69.33%	30.67%
Discussion boards	30.67%	69.33%
Tasks	18.67%	81.33%
Blogs	17.33%	82.67%
Tests	14.67%	85.33%
Portfolios	13.33%	86.67%
Site calendar	13.33%	86.67%
Surveys	12.00%	88.00%
Glossary	8.00%	92.00%
Journals	8.00%	92.00%
Wikis	8.00%	92.00%
Collaborate	1.33%	98.67%

Science	Use	Non-use
Announcements	96.30%	3.70%
Learning materials	94.44%	5.56%
Turnitin	87.04%	12.96%
Send email	85.19%	14.81%
Grade centre	83.33%	16.67%
Staff details	83.33%	16.67%
Reading lists	81.48%	18.52%
Discussion boards	50.00%	50.00%
Site calendar	46.30%	53.70%
Tests	46.30%	53.70%
Surveys	25.93%	74.07%
Wikis	22.22%	77.78%
Portfolios	12.96%	87.04%
Tasks	12.96%	87.04%
Journals	11.11%	88.89%
Blogs	9.26%	90.74%
Collaborate	5.56%	94.44%
Glossary	5.56%	94.44%

Social Science	Use	Non-use
Learning materials	96.00%	4.00%
Announcements	93.33%	6.67%
Turnitin	93.33%	6.67%
Staff details	92.00%	8.00%
Grade centre	86.67%	13.33%
Reading lists	85.33%	14.67%
Send email	80.00%	20.00%
Discussion boards	64.00%	36.00%
Tests	44.00%	56.00%
Surveys	36.00%	64.00%
Wikis	24.00%	76.00%
Tasks	22.67%	77.33%
Site calendar	22.67%	77.33%
Portfolios	18.67%	81.33%
Blogs	17.33%	82.67%
Collaborate	16.00%	84.00%
Glossary	14.67%	85.33%
Journals	13.33%	86.67%

LIBS	Use	Non-use
Learning materials	96.97%	3.03%
Turnitin	96.97%	3.03%
Grade centre	90.91%	9.09%
Announcements	90.91%	9.09%
Staff details	87.88%	12.12%
Reading lists	84.85%	15.15%
Send email	81.82%	18.18%
Discussion boards	51.52%	48.48%
Surveys	33.33%	66.67%
Site calendar	30.30%	69.70%
Tasks	30.30%	69.70%
Tests	30.30%	69.70%
Blogs	27.27%	72.73%
Portfolios	27.27%	72.73%
Wikis	27.27%	72.73%
Collaborate	24.24%	75.76%
Journals	24.24%	75.76%
Glossary	15.15%	84.85%

Fig 1. Breakdown of VLE feature usage from anonymous staff survey (Jan 2017)

The resultant 'Lego' architectural approach, advocated by EDUCAUSE in 2015 (Brown, et al., 2015, p. 1) and (EDUCAUSE Review, 2017) is on the face of it an attractive proposition and one that promises flexibility and interoperability for multiple purpose-built applications based around a central administrative hub. A move away from monolithic single-point-of-failure systems towards a distributed network of interconnected services. Some go even further and advocate possibly removing the 'square peg' VLE completely in favour of connected services based on a students' own personal digital services, (Thomson, 2016), whilst others pragmatically accept that *'the LMS [or VLE] will continue to be a hub for most institutional learning environments for the foreseeable future.'* (Brown, 2017). However, not everyone is convinced, with some citing concerns over a lack of student input into the discussions for what may amount to be a technology driven vision (Scott, 2017).

Discussions around the future of learning environments aren't limited to just the NGDLE of course and alternatives and new innovations are always appearing, with many attempting to create a buzz as the next 'big idea', for example: IBM's Watson (AI) powered teacher advisor (Crozier, 2017); AI enabled student support (AdmitHub, n.d.); Blockchain powered higher education (Woolf, 2019); new open source NGDLE inspired models of VLE delivery (ELMSLN, 2018); conversational learning platforms (Aula, 2018); rapid course creation tools from large publishers (McGraw Hill, 2017); as well as well-known and comparatively *older yet evolving* entrants like OneNote Classroom (Microsoft, 2019), Google Classroom (Google, n.d.) and MOOC providers such as the Open University led Future Learn platform (Future Learn, n.d.). What is clear, is that there is a desire for something different, that moves beyond the traditional VLE and embraces innovation, flexibility and interoperability:

'we're not talking about a single system, we're not talking about one type of experience, we're talking about organic experiences, and a way of capturing those organic things, those messy things that happen in classrooms... capturing innovations and doing so in a sustainable way'. (Ollendyke, 2017)

This ambition also aligns with The University of Lincoln's goal to:

'utilise digital technology to create new learning platforms and environments so that we bring together people from across the world enabling the sharing and dissemination of knowledge... creating leading-edge teaching environments... whether real or virtual'. (The University of Lincoln, 2016, pp. 7-8)

The University vision, therefore, reflects a desire for a transformational change in the delivery of digital education and this ambition directly informed our investigations

Methodology

To support our investigations a cross-institution working group (WG) was established in Jan 2018 with representative membership from College Directors of Teaching and Learning, ICT senior leadership, the University Librarian, SU President and Vice-President for Academic Affairs, Dean of Digital Education (chair), Digital Education Developers, Dean of the Lincoln Academy for Learning and Teaching, Director of Digital Student Life and the DVC for People, Services and Operations in order to help steer activities and outcomes. Specific responsibilities for the WG included: confirming overall process and informing activities; agreeing decisions and outcomes; participating and delivering associated tasks in support of the aims of the working group; representing area of responsibility within the WG; ensuring appropriate consultation and participation within their area of responsibility as defined by the requirements of project; and quality assurance.

The WG objective was to identify an enhanced digital learning experience in order to help Lincoln make a significant step-change in our digital learning provision. As noted, some UK and US universities were already exploring opportunities for new innovative digital technologies and approaches—some example case studies are captured within the JISC NGDLE report (Phipps, et al., 2018)—and Lincoln's ambition was to be amongst them. Therefore, to help the WG to look beyond just reviewing the current marketplace and thereby avoid undertaking a 'best-of-breed' vendor review, we chose to begin by defining a set of learning and teaching principles to help inform our decision-making. This allowed us to challenge any existing internal perceptions of what we thought we needed (such as a better version of what we already had) and explore something more aspirational that had the potential to deliver the kind of learning experience we really wanted for our students.

It was anticipated that a review of vendors would, in all likelihood, be required as part of the overall process but only following the identification of our teaching and learning vision and associated requirements placed within a principle-led framework; in so doing, we believed this would avoid making decisions based on a 'beauty pageant' review of which of the common alternatives had the

best/most features. Indeed, initial presentations and meetings with the leading vendors were undertaken throughout this project, which confirmed such reviews can offer enhanced services based on existing use cases and requirements, but we wanted to test whether we could rewrite our requirements to deliver something that more accurately reflected our vision.

Informed directly by the University strategy (The University of Lincoln, 2016) the learning and teaching principles were subsequently derived by extracting all the teaching and learning related statements from within the University strategy and grouping them into 12 separate-but-connected thematic areas. Through a facilitated half-day workshop with members of the WG, these were merged into six areas and summarised through a collective writing process into the following six principles:

1. **Collaborative Learning:** We believe in collaborating across disciplines to support the co-creation of new knowledge and the exploration of new ideas between staff and students. *We will deliver a digital environment that encourages collaboration, fosters respectful debate, nurtures creativity and enables active learning within and beyond the University.*
2. **Learning Journey:** We believe all students should have equal opportunities to succeed at every point of their academic career. *We will create an environment that supports each student's entire learning journey and enables them to fulfil their potential.*
3. **Flexible Learning:** We believe learning is most effective when it is flexible and responds to the individual needs of the student. *We will offer targeted and personalised learning opportunities to encourage our students to develop and grow.*
4. **Globally Connected:** We believe learning should not be limited and *we will guide our students to navigate all relevant knowledge gateways whether local, national or international.*
5. **Anytime and Anywhere Access:** We believe learning is the most effective without boundaries and borders. *We will use the latest technological advances to deliver accessible learning for all.*
6. **Professional-Practice Informed Education:** We believe in professional practice informing education and *we will collaborate closely with employers to understand the employment needs of today and critically the future to ensure our students have the (digital) skills needed to pursue their careers successfully.*

The six principles, in essence, describe a **flexible, interdisciplinary, inquiry-led learning experience that embraces collaboration, personalization and professional-practice** as key drivers for student attainment; in contrast to our experience of virtual learning environments (or learning management system (LMS)) which tend to provide a self-contained, often siloed and time-bound experience for our students. As anticipated the teaching and learning principles articulated a more ambitious vision with some challenges for current technologies, but one that also had to potential to extend the digital environment to enhance the support for the often cited 21st-century career-ready skills of critical thinking, communication, collaboration and creativity (Pace, 2015).

Further institutional input was then secured through three facilitated workshops (two face-to-face and one online) involving both teaching staff and students, to encourage debate and discussion on the ideas that were emerging. Each workshop lasted three hours and focused discussions on the six learning and teaching principles facilitated by an external consultant. A consultant prompted discussion in small groups around paired principles with the outcomes recorded for review. The consultant then undertook a content analysis approach to analyse patterns, recurring themes, and contradictions. The outcomes provided a high-level report which emphasised the importance of the following components for any proposed new digital learning environment:

- The experience is highly personalised
- Technologies are reliable, robust, seamlessly connected, always up to date, always on, and accessible anywhere, anytime – using any device.
- Has easily navigable pathways, mapped to the individual's profile and preferences are generated dynamically
- The digital interactions are connected, meaningful and fit-for-purpose

- The traditional roles become more fluid and inter-changeable, enabling purposeful co-creation and multi-disciplinary collaboration
- The University embraces global connectivity in its online spaces

The report and its themes (above) provided further background evidence that fed into this process and underpinned the need for an ambitious digital transformation across the online learning environment.

SAMR MODEL: INTEGRATING ED TECH INTO THE CLASSROOM

To help frame our discussions further, we then exploited Dr Ruben Puentedura's SAMR model (Wikiversity, 2018) to inform our thinking and provide a structure for any recommendations. The SAMR model provides differing levels of digital integration within the classroom, which proved helpful for informing our own considerations. A description of the levels of the SAMR model is provided below, with a brief explanation of how this applied to our own considerations for this review:

Enhancement level

- **Substitution:** Technology acts as a direct substitute, with no functional change, i.e. upgrade the existing VLE with a newer version. *No change to current practice.*
- **Augmentation:** Technology acts as a direct substitute, with functional improvements, i.e. the integration of additional tools and features within the VLE. *Change on the fringes of practice.*

Transformation level

- **Modification:** Technology allows for significant task redesign, i.e. reconfigure the VLE to extend support for teaching and learning based on current need and user feedback. *Potential to enhance and extend current practice.*
- **Redefinition:** Technology allows for the creation of new tasks, previously inconceivable, i.e. completely rethink how we deliver teaching, support learners and assess academic achievement. *High risk, but transformational.*

In order to deliver recommendations for the *21st-century learning experience*, the WG explored options across all four levels, but—given the ambitions of the teaching and learning vision—inevitably focussed more on the transformation levels of modification and redefinition. We felt this was an extension of the more 'traditional' VLE review which can often explore best-fit options within current-use requirements that more naturally aligns, we believe, with the enhancement levels of substitution and augmentation:

'it appears innovation [in VLEs] is more through evolution rather than revolution, with new tools being added as they are developed. Some innovation is driven by tools that are becoming popular outside the learning platform. Examples include social media, blogging tools, lecture capture facilities and mobile apps. This "feature creep" has long been a characteristic of the market. Even relatively new vendors such as Canvas, which make a feature of being simple to use with a wide range of app based tools, is still recognisably a "VLE" with many features in common with better known products. (Phipps, et al., 2018, p. 6)

Discussion

DEFINING THE FUNCTION OF A VLE

Of course, any transformational change to the virtual learning environment would need to ensure the University could still continue to deliver teaching and learning with minimal disruption to the University. To enable this, members of the WG explored what the current VLE was delivering through a functional analysis across two key areas: administration and management of learning and the teaching and learning experience itself (see Fig. 2 below).

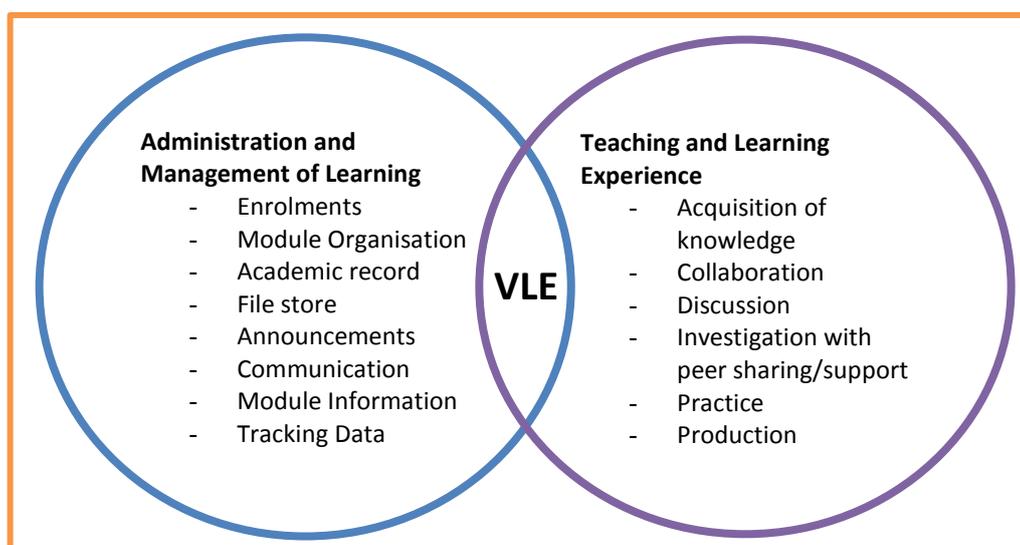


Fig 2. Breakdown of functional areas of the traditional VLE

As previously noted, the administrative and management features of the VLE have become essential for underpinning the delivery of learning within HE. For the process of teaching and learning, informed by Laurillard's Conversational Framework, (Laurillard, et al., 2012 & 2015), however, these experiences can often be less reliant on the VLE.

Perhaps in part to address the perceived lack of enthusiasm for the VLE's teaching and learning features, it has become the norm to extend VLEs through third-party tools. In this way, VLEs provide a platform for other tools and services. The features accessed may or may not be present within the VLE, but the external tools can often be preferred for a number of reasons, such as enhanced functionality, perceived usability, disciplinary relevance or desirability over those available natively within the VLE (e.g. Wordpress blogs are preferred to and recommended over Blackboard's own blogging tool at Lincoln). In reality, an administrative VLE hub extended by the inclusion of third-party tools is not too dissimilar from the NGDLE vision; albeit on a more limited scale.

It is worth noting at this point that the extension of the digital learning experience through third-party tools, especially those which reflect the digital environment that many of our students will face when they leave University, may provide additional benefits for our students. Namely, developing digital capabilities within career relevant tools. The sixth teaching and learning principle advocates *professional-practice informed education*. This not only refers to the curriculum but the digital environment as well. Unless our students remain in Higher Education, they are very unlikely to use VLEs again, a time-limited digital capability. Therefore, should we be exploring the use of common industry tools-- beyond the standard use of MS Office suite--to support collaboration, communication, practice, etc. instead? Certainly, collaboration tools such as MS Teams (Microsoft, 2019) offer opportunities to deliver digital learning experiences which more accurately reflects the digital world our students may enter when they leave University.

In reality, through the extension of third-party tools, the VLE provides a further critical function: as an integration layer for external tools, enabling single sign-on and sharing of data (e.g. student attainment). Migrating or maintaining the VLE as the central administrative hub enables the University to continue to provide these administrative functions with minimal disruption; whilst continuing to evolve the user experience with more relevant or desirable external learning tools (see Fig 3 below).

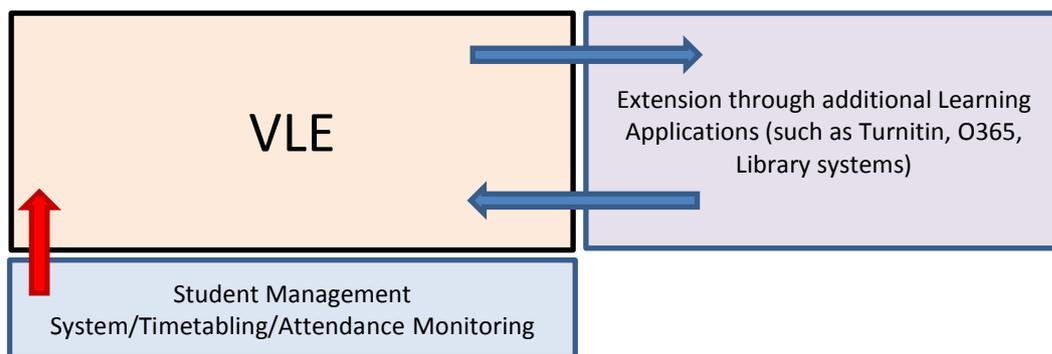


Fig 3. A simplified model of existing VLE architecture

The ability to extend the VLE feature set, however, has not prevented many VLE vendors from pursuing a strategy of extending its own features to mimic the functionality of emerging third-party tools, sometimes with additional licence fees. As a result, VLEs continue to enhance their core offering through promised value-add features over and above the administrative benefits previously identified. As aptly summed up Wood in his 2016 blog post *Taking Back Ownership from the VLE*:

'The VLE vendors have been stuffing more and more tools in there (each one of them just about "good enough"). Maybe to create a Swiss army knife, or perhaps as yet another "sweetener" to encourage institutions to pick their product. But we can't blame them; it works – the institutions buy it. (Wood, 2016)'

But, as an institution, do we get value for money from these additional features?

As a result, and as part of the functional analysis of our current VLE, the WG completed a detailed assessment of the unique and distinctive features--those not replicated within other systems based on an analysis led by ICT and Digital Education for each of the individual requirements provided by school administrators, central learning technologists, ICT, Students Union and academics--within our own VLE (Blackboard). The aim was to attempt to identify what exclusive benefits our VLE offers, or more pointedly what we would miss if we didn't have one. This process revealed the unique benefits of our VLE (Blackboard) for Lincoln were:

1. Common interface and single point of entry (including support for sequencing learning activities)
2. Integration layer with third-party systems and access management (single sign-on)
3. Granular record of student attainment (breaking down individual assessments)
4. Management of ad hoc creation of groups and group activities
5. Variable levels of admin roles and access management: site, college, school, time released, etc.
6. Tracking user engagement

These are vital requirements, but are VLEs the only way to deliver them? Is it feasible to replace these largely administrative and managerial requirements with a lightweight Learning Management Platform (possibly as an extension of student management system or reduced VLE feature set) with single presentation layer of integrated third-party learning tools, as advocated by the EDUCAUSE 'Lego' approach (Brown, et al., 2015, p. 1)? The aim here is to realise the vision and enable a more flexible digital learning ecosystem that harnesses best of breed components to deliver teaching and

learning activities (collaboration, discussion, practice, etc.) through a suite of tools that are pulled together into a single presentation layer:

'... it seems legitimate to conclude that any LMS will always need to be supplemented by additional components and resources, resulting in a digital learning environment instead of an LMS platform. This is the crux of the NGDLE idea, and it is essential to evolving our learning environments to add learning enablement to course management. (Pomerantz, et al., 2018)'

Delivering the Digital Learning Ecosystem

This vision of a digital learning ecosystem has some attractive benefits, providing disciplinary flexibility as well as the potential utilisation of tools our students will more commonly have access to when they leave University. The simplified model (see Fig. 4 below) represents a high-level conceptual design presented in layers of functionality. Long & Mott have articulated an alternative vision, separating the IT components needed into software architecture and learning architecture, distinguishing the administration of learning and the organisation of learning (Long & Mott, 2017) which I have envisioned largely within a lightweight Learning Management Platform below or delivered within software tools accessed within the learning application layer. Any potential implementation of a digital learning ecosystem will need to review the feasibility and technical realities, but the model here is presented as an example of how it might look.

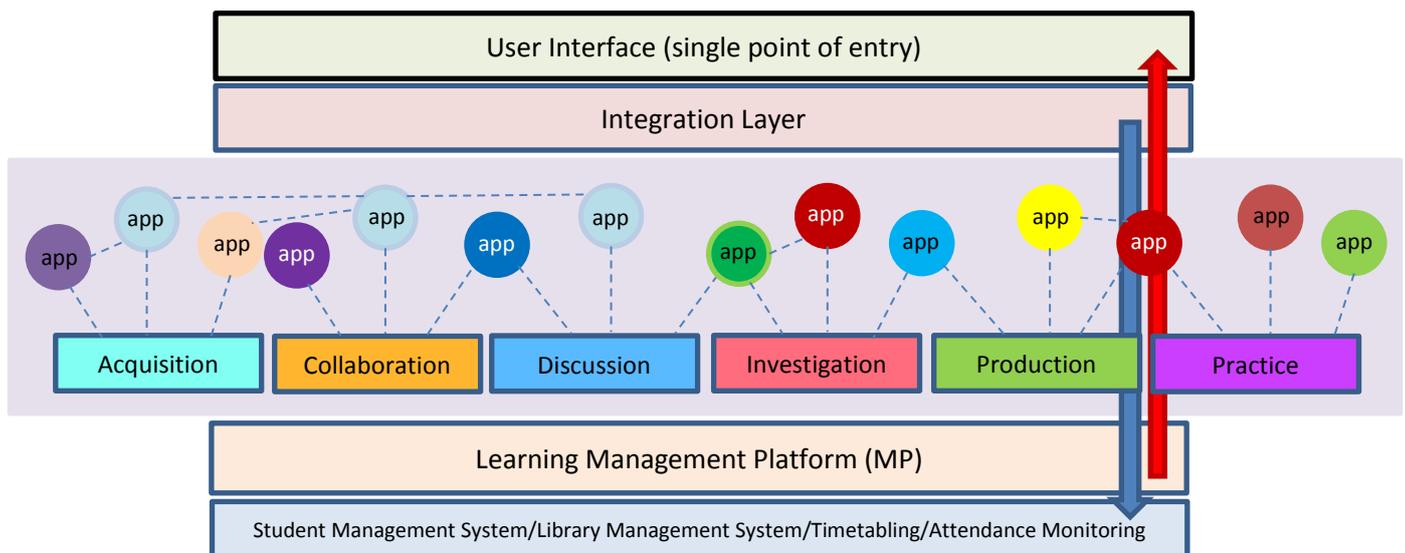


Fig 4. Simplified concept design for future digital learning architecture

Even so, there are a number of immediate challenges with delivering the vision above, that the traditional VLEs have, in part, helped to resolve.

1. There is no guarantee that the third-party tools will support surfacing data generated from within their systems within the presentation layer. Certainly, access to the learning applications can be enabled, either through a dedicated interface either by single sign-on or direct login; but investigations are needed with each solution to explore whether the integration can go deeper than this.

2. An interim or alternative approach could be to provide an app-based solution (akin to accessing separate dedicated apps on a mobile phone). Here a single point of entry provides access to a suite of 'learning apps'. The experience would mimic the mobile experience most students are already familiar with. Students would then be encouraged to access different applications for different functions as needs dictate. The significant downside to this approach though is the lack of a sequencing (or scaffolding) of the learning experience (especially in the critical early years where such support is vital). This might be addressed with a simple learning 'playlist' webpage to help guide students to which apps they need to access and what they need to do, but this would, in all likelihood, feel 'clunky' and may well fail to address one of the main criticisms of the traditional VLE.
3. Effective management of a 'Lego' inspired approach at the scale of a University (also described as enterprise level) may be less certain without an effective administrative middle layer (normally provided by the VLE). For example, OneNote Classroom is part of the Office 365 suite of tools and provides a collaborative space for staff and students to post text, documents, images and videos. It is a fantastic cross-platform collaborative space. However, management and administration appear to be conceived as one member of staff administering a medium sized cohort (30-40) manually. Scale this up to multiple modules, with varying sizes of cohorts across multiple years and the burden of managing this space becomes unfeasible for academic staff. Mechanisms for managing such tools at an enterprise level from within the NGDLE management platform need to be explored.
4. The promise of providing personalised and adaptive learning experiences for our students is a compelling factor for the integration of AI and is naturally included within any discussion involving next generation learning:

'with 90% of 16-21 year olds in the UK owning a smartphone, today's learners are constantly generating a 'digital exhaust' of data. It's not unreasonable to think that some of that data could potentially be used to improve teaching and learning outcomes. But when we start to make predictions based on linking data that the institution holds with learners' own data, a whole new class of ethical issues arise.' (Hamilton, 2018)

As indicated above, however, learning analytics is a difficult service to introduce requiring access to the right skills, technologies and data (with permission). Tracking data within VLEs provides a high-level indication of student engagement, but further investigation and investment is needed to scale this up and ethically implement learning analytics into a tutor and student dashboards/chatbots to extend the digital ecosystem to provide personalised, timely support.

5. VLEs tend to be structured into stand-alone modules for learning delivery. This has been attractive in the past, delivering a secure 'walled garden' for student learning, safe from external gaze. However, to deliver a truly interdisciplinary learning environment that encourages collaboration between disciplines either organically or by design, the concept of 'walled garden' modules will need to be altered with a move to open access (within a University domain) across all modules or resources. VLEs, of course, can offer guest access already, but adoption can vary between individual academics, complicated further by inadequate search features within the VLE; both would need to be addressed to be successful. However, if institutionally adopted, in future this could be extended to include exploring the use of library systems as the central repository for *all* teaching resources, facilitating site-wide search, personalised recommendations and serendipitous discovery across disciplines; acknowledging the challenges with cataloguing this may present. An interim first-step could be to extend connections between specific cohort groups where there is an obvious synergy and encourage collaboration. As this model develops over time it can be extended as appropriate.
6. The cost of licencing and supporting multiple solutions may become prohibitive if not offset by the savings elsewhere or extension of solutions already provided by the University (such as Office

365). Ultimately, however, it may not be feasible or affordable to support the full potential flexibility desired across the wide range of disciplines offered and staff and student expectations will need to be managed.

7. Finally, the exact technologies underpinning the integration of third-party tools is not clear if not using a fully functional VLE. This will need further investigation and possible vendor development. As a result, as noted by (Brown, 2017) it may be necessary to pilot new tools alongside the existing VLE platform and make use of the integration and admin features provided. This approach aligns to the vision, but is expensive, accepting the license fees associated with the VLE plus extension through additional tools. A lightweight (and presumably cheaper) learning management platform is preferred but not yet available. If this approach is explored, therefore, staff and student expectations would need to be managed as the outcome may not deliver the user experience desired within the vision in the first instance.

DELIVERING CULTURAL CHANGE

Whilst the technological challenges outlined should not be underestimated, possibly the most challenging aspect facing the adoption of transformational digital approaches, as described in the vision of **a flexible, interdisciplinary, inquiry-led learning experience that embraces collaboration, personalization and professional-practice**, is the capability of staff and students to make effective use of the supporting technologies that delivers it. Well established activities to deliver consistency and coherence across modules have been important elements for existing VLEs, often described as 'VLE minimum standards.' However, such standards (as utilised at The University of Lincoln (The University of Lincoln, n.d.) can often be limited to features that support the administration of learning such as: staff profile pages; availability of module handbooks; assignment information; reading lists; and so on. More advanced and challenging uses within the learning activity domains can often be described as *aspirational standards*. Ensuring administrative and organisational consistency in digital approaches across all modules within a programme is critical. Effectively re-enforcing the adoption of the VLE as an administrative hub.

Therefore, for the digital learning ecosystem experience to deliver the aspirational benefits described within the six learning and teaching principles, the concept of what constitutes *minimum standards* across the entire domain will need to be expanded through comprehensive staff and student support to enable all users to develop new digital capabilities and migrate successfully to the new ways of working. As noted in the 2018 NMC Horizon Report HE edition preview:

'Digital literacy transcends gaining isolated technological skills to generating a deeper understanding of the digital environment, enabling intuitive adaptation to new contexts and co-creation of content. Institutions are charged with developing students' digital citizenship, ensuring mastery of responsible and appropriate technology use, including online communication etiquette and digital rights and responsibilities in blended and online learning settings and beyond. This new category of competence is affecting curriculum design, professional development, and student-facing services and resources.' (EDUCAUSE, 2018, p. 5)

Developing the digital capabilities of both staff and students—as described within Jisc's Digital Capabilities Framework (Jisc, n.d.)—is helpful in informing the delivery of support within any digital pilots undertaken. Changing digital practice within a complex University setting cannot happen overnight, however, and transformation needs to happen pragmatically and in waves through pilots of new technologies, cases studies and evidence-based interventions. As noted within the Jisc report Deepening Digital Knowledge:

'Digital expertise exists in 'pockets' or 'silos' with relatively little opportunity for it to become shared or known about... If they are to assimilate a system fully to their practice, they need

opportunities to explore it in the context of that practice, preferably with peers in similar roles.'
(Beetham, 2015, p. 11)

The use of targeted interventions through pilot and evaluation, that builds evidence to support wider adoption is critical and should be explored within the wider Jisc Digital Capabilities Framework to support the delivery of the aspirational digital experience. Alignment of pilots against the teaching and learning principles should be used to assist prioritisation and measurement of success before wider rollout (if proven successful).

Conclusion

The aim of creating an inclusive digital learning ecosystem that supports a **flexible, interdisciplinary, inquiry-led learning experience that embraces collaboration, personalization and professional-practice** is both technically challenging and yet a familiar goal within HE; and one which aligns closely to the University of Lincoln vision:

'By 2021 be a global 'thought leader' for 21st Century higher education. We will be known for addressing the opportunities and challenges presented by the changing world by developing a new approach to education and knowledge development.' (The University of Lincoln, 2016, p. 4)

To manage institutional change and reduce risk to current teaching, it is proposed that development is phased, exploring pilots, with migration to and adoption of, new applications or services. The first iteration should (pragmatically) include and build upon the existing VLE platform, serving as the core learning management platform. With focus given to the digital learning experience and sequencing through a unified web front-end. To begin this process, it is proposed the University adopts a combination of activities to support digital capabilities, service developments (or applications), with evaluation and review to inform next steps. To support Lincoln's vision, as outlined within the teaching and learning principles, activities could include but are not limited to:

- Maximising staff and student digital capabilities through embedded support and exploration of services such as the Jisc Digital Capabilities tracker.
- Prioritising tools and systems that our students will use beyond their studies; rather than ones that are only relevant whilst they study at Lincoln.
- Exploring library search tools that adapt to the needs of our students and provide targeted results and support their inquiry-led investigations through automated suggestions and peer recommendations (Amazon-like experience).
- Facilitating interdisciplinary learning by sharing resources across modules. Consideration should also be given to whether this could be extended to recorded lectures where desired.
- Enabling inter-disciplinary staff and student collaboration via flexible tools that allow sharing of resources, feedback and discussion within designated and/or user-created groups.
- Assessment activities that embrace digital tasks that reflect the world of work with technologies to enable effective delivery and feedback.
- Exploring opportunities to make use of artificial intelligence (AI) and personal assistants. In particular, how can AI enhance the student experience and provide staff with personalised and adaptive support?
- Utilising data and dashboards to support lecturers and students to make informed decisions (learning analytics), such as: targeted student support; early warning indicators for staff; performance prompts for students; curriculum overview; and career options.
- Enabling externals (business or university partners) and our staff and students to meet via tools and environments in order to participate in shared learning experiences.

- Exploring (where required) additional personal reflection tools as mechanisms for demonstrating compliance and mastery of learning outcomes whilst on campus or on placements/at work.
- Facilitating a community of learners before they arrive at Lincoln and after they leave.
- Ensuring the resilience and reliability of our services by exploiting tools and solutions (aligning to the ICT guidance for a preference of SaaS where possible).

Resource and feasibility depending, this approach will enable an organic and priority driven exploration of new tools and services to move the University towards the digital ecosystem described.

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