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CHAPTER 7

Contemporary Changes in Teaching Formats
An Overview

Narasimha Murthy Kalanatha Bhatta and Ashwathanarayana Shastry

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Teaching format is the mode through which knowledge is transmitted to the students and learning is facilitated. During the initial days, where textbooks and writing materials were not in vogue, teaching and learning were conducted orally, teachers used to have a complete repository of the subject within themselves. As they pronounced what they knew, students used to repeat several times to understand, assimilate and internalise the knowledge. Later, the chalk and talk method of teaching became prominent, where teachers took the help of writing on a board and students took notes and memorised and reproduced it during examinations. In both these traditional methods, it was mostly one-way transmission – students essentially only received information and their participation was limited to asking a few questions when things were not clear to them. These formats were traditionally known as authoritative formats, where no individual attention was given to each learner. These formats promoted rote learning and were not known to be very effective in internalising the knowledge.

As the generations changed, teaching formats changed to more of a delegator approach. Here teacher acted as a collaborator. Learning was through peer-to-peer interactions and the teacher acted as an active observer. In this format, the teacher's role was minimised and emphasis was placed more on the self-motivation of the students. While this format was effective in self-learning by students, it did not get much prominence, as the learning of the students was limited to the combined knowledge of the group and was severely restricted.

Further research in higher education led to facilitator teaching formats. In these formats, while students still resorted to peer-to-peer learning, teachers also played an active role as a facilitator, provoking and questioning the students. This accelerated and improved the quality of discussions, promoted problem-solving skills and increased internalisation of learning. However, this format was found to be difficult to practice in a large classroom setting and also called for a special setting of the classroom. In spite of these limitations,

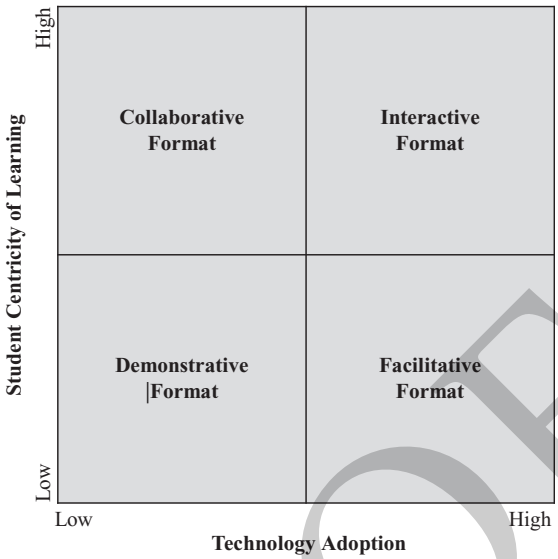


Figure 7.1 Teaching learning quadrant

facilitator teaching formats are still quite popular and widely practiced in the delivery of higher education (see Figure 7.1).

Other than the formats described above, a few other formats are also popularly adopted in higher education. The demonstrator format was popular in special areas like dance, art, music, physical education, medicine, science, etc., where instructors demonstrated a procedure by doing it himself and students learnt it through observation and internalised it through rigorous practice. Integrated or hybrid teaching formats found their place where students with different learning levels and needs are brought together in the same classroom. In this case, teaching format is tailored to the needs of each student (Middlebeck 2019).

Contemporary Changes in Teaching Formats

While several teaching formats are practiced in higher education, the key to choosing a format always depended upon the level of engagement expected, type of students and courses taught (skill-based or knowledge-based) and the learning level of the students. In general, in higher education, contemporary teaching formats encouraged more student-centric learning than adopting a teacher-centric approach. In student-centric

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learning, while the teacher maintained authority, equal participation and interaction were encouraged among the learners and between the learner and the teacher. This approach promoted more group work, communication and collaboration and the teacher generally assumed a supporting role acting as a guide or mentor.

As technology advanced, high-tech approaches found their way into the delivery of higher education (Bui 2020). The first among these were flipped classrooms, where the teaching content is pre-recorded either in a lecture form, for theoretical subjects, or demonstration form, for skill-based subjects. Learners were expected to watch videos as many times as necessary to get a hang of the subject and even attempt a few assignments before actual classroom interactions. In the classroom, students are encouraged to discuss the contents of the video and clarify any points which needed more elaboration; and application of the content is practiced through relevant case studies and practical or lab experiments.

Emerging Classrooms of the Current Decade

In this decade, 2020–2030, many new types of engaging classrooms are emerging:

- Flipped Classroom. In this format, students watch fifteen to twenty minutes of pre-recorded video on the subject which acts as a launching platform for the physical class.
- Hybrid Classroom. This is a combination of some learners participating physically and other learners simultaneously participating through electronic mode. This also called as Synchronous Classroom.
- Asynchronous Classroom. In this format, the instructor delivery will be pre-recorded and made available to learners to watch them at their own convenient time. This format comes in handy when learners are distributed across time zones. A separate interaction hour is provided for the learners to seek any clarifications.
- Virtual Classroom. These classrooms are facilitated by an augmented reality/virtual reality system. They will not have any physical teachers and are fully facilitated by technology.
- Intelligent Tutoring Systems. These are customised e-tutoring and learning platforms suited to individual learning preferences and styles of the students.

As mentioned by Andreas Kaplan in Chapter 1, personalised learning methods are quite popular in higher education particularly when learners

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were involved on a part-time basis. These methods were also popular for slow learners and those who had unstructured time for their learning. Here each student decided on his/her own pace of learning and progression depended upon competency attained at each stage. When a student masters a skill or an item of knowledge and clears an evaluation, he is allowed to progress to the next level of learning. Students' interaction with teachers in this case is need-based and customised. Teachers work more as guides or mentors. These days several universities run online programs which follow this teaching format.

Digital Transformation in Education

Digital Transformation is considered as a strategy to leverage technology to deliver knowledge to the students. The technology being talked about in this transformational sense includes cloud computing, the Internet of Things, data analytics, virtual and augmented reality and artificial intelligence. In the field of education, digital transformation is all about leveraging the technology to enhance the student learning process. The next-generation classroom is undergoing transformation in adopting technology to promote new teaching formats to engage students more effectively.

Cloud computing technology provides a platform for content developers to create a variety of education applications which can be accessed anytime, anywhere and using any device. The leading cloud computing service providers such as Amazon Web Services (AWS), Google Cloud Platform and Microsoft Azure have created platforms to host content at very affordable prices. Other software-as-a-service (SAAS) providers are creating learning applications where teachers can create their own content and blend it with video, audio, images and other digital content. Learning management systems such as Moodle provide hosting content on the cloud and allow students to access the same using any device. The assessment feature built into the system allows teachers to conduct quizzes and assignments online and auto-evaluate them. A live streaming software connected with a learning management system such as Moodle will allow teachers to run the classes in complete virtual mode or in blended mode.

Artificial Intelligence (AI)–powered examination software now allows teachers to conduct examinations online by remote proctoring of students. Attendance tracking is built into the live streaming software. Auto-grading of students based on their performance in various assessments is now enabled in the learning management systems.

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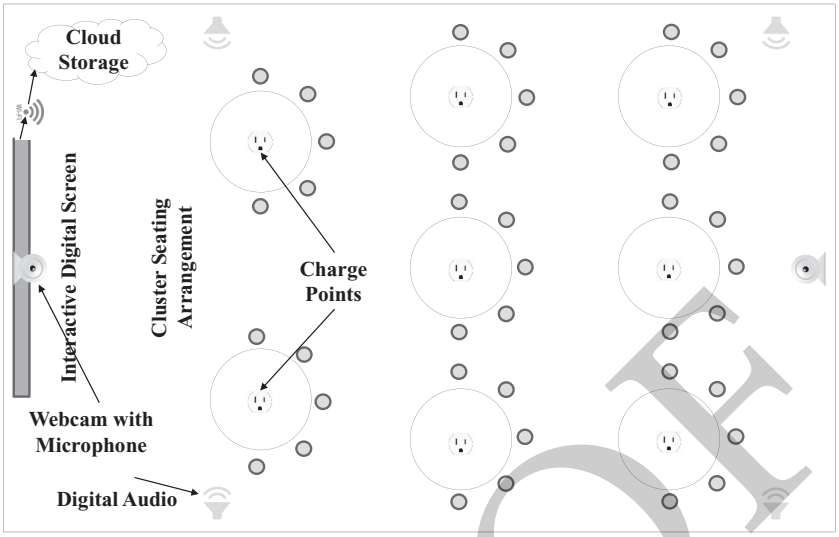


Figure 7.2 Next generation digital classroom

The Internet of Things (IoT) technology innovates the classroom teaching format in several ways. Smart boards (or interactive white boards) in the classroom allow teachers to access the same learning management system to conduct classes in a blended mode. These smart boards are next-generation computing devices equipped with a rich set of sensing devices including webcams, Wi-Fi, GPS, microphone, speakers, touch screen, graphic cards and a rich set of software applications which can overlap live content on a white board. Teachers can load live content on the white-board while teaching. Any update to content during class hours gets auto saved and becomes visible to students anytime on their smart devices such as laptops or smartphones. Other interactive learning tools such as gamification tools or simulation tools would also be available on the same smart board. In addition, IoT technology can condition the classroom in terms of air purity, temperature monitoring, light control, attendance tracking by sensing digital student ID cards and so on. Thus, IoT technology completely transforms a traditional classroom into a digital classroom (see Figure 7.2).

Creating a culture of 'big data' is nothing unusual in a classroom environment. Starting from the student admission information, emergency contacts, assignments, evaluations and grading – all these put together will create the sense of big data. Data analytics technology can act on this big

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data and hence bring transformation in classroom education. Data analytics helps teachers to keep track of student's historical data, comparing current performance with historical data and predicting student's future performance. This prediction of future performance will help teachers to adopt customised changes in teaching methods to enable students at all performance levels to perform better and hence can positively influence the improvement in overall performance of the students. This 'data driven decision-making' inside the classroom can significantly help in adaptive teaching styles to keep the higher levels of student performance.

Technologies Enabling Digital Classrooms

- Cloud Computing. Providing computing services, anytime, anywhere, on any device including a pay per use model to bring teacher and students together.
- Internet of Things. Sensors, devices and communication technology connecting teachers and students together on a common interaction platform.
- Data Analytics. Collection, cleansing, analysing, interpreting and predicting what can be achieved in learning.
- Artificial Intelligence (AI). Representing and leveraging knowledge models to predict future performance based on past and present data and adapt incremental learning methods to improve performance.
- Augmented Reality/Virtual Reality. Two promising technologies that would help in creating interactive content to aid student-centric learning.

The growth of AI as the general-purpose technology is transforming the way education is imparted on digital platforms (Agarwal 2020). Machine learning is the core of AI which can learn itself as it encounters every new data set it processes. AI tools can play a pivotal role in several ways to improve the teaching process.

With the globalisation of education using an online mode of learning, the need for personalised education is increasing. AI tools can provide support for personalised education by tailoring the study schedule according to student's specific capability and pace of learning. These AI tools are built using the knowledge space theory to define and represent knowledge gap.

AI tools can produce smart content dynamically based on each student's interest and learning pace (Dharmadhikari 2020). Smart content is a blend

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of an innovative learning interface with customisation options, contextual information, quickly accessible references and tailored assessment. Visualisation tools provide a variety of learning interfaces to make the content highly perceivable. The content is updated in real time and remains up to date.

Teacher's administrative activities such as paper setting, evaluation and grading can be completely automated with AI technology. Text analytics and natural language processing technology can even generate interactive insights in student's native language thereby providing real-time feedback on student's performance and scope for improvements.

AI-powered virtual agents or chatbots can interact with students in their native language and handle all their personal queries, which students otherwise might find embarrassing to ask. These virtual agents also keep a record of history of all previous responses for the query raised and can provide responses quickly.

Knowledge Space Theory

Suggested by Doignon and Falmagne in 1999, knowledge space theory[1] proposes a set and ordered framework to mathematically represent knowledge in terms or problem, cognition and action domain. This theory assumes that the problem is represented by several states of knowledge and are dependent on one another to recognise the patterns and hence represent solutions to the given problem. AI applications leverage this theory to process ambiguous data sets given to them and can identify patterns and provide automated solutions to solve the problems.

AI tools built with sensor technology also aid students with special needs. Students with vision challenges can leverage voice activated interactive tools to meet all their learning needs. Similarly, students with listening challenges can use leverage visualisation tools to meet all their learning needs. Students with Autism Spectrum Disorder (ASD) can now use special apps designed to run on iPhones and Android phones that will help the students to learn to overcome their neurological conditions. AI tools have also made it possible to convert sign language into text and vice versa to help students/teachers with speech/hearing challenges.

[1] For detailed information on Knowledge Space Theory, see https://cran.r-project.org/web/packages/kst/vignettes/kst.pdf.

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Benefits of AI Intervention to Students

- Students will have 24–7 access to personalised content.
- Smart content will keep them better engaged with the learning.
- Students can adjust their pace of learning and hence there is no pressure.
- AI can facilitate equal opportunity of learning for students with special needs.

All four digital technologies mentioned above – cloud computing, Internet of Things, data analytics and Artificial intelligence – are interconnected to one another and can drive significant innovation in teaching formats adopted by the instructors. There are three teaching formats that are worth considering – simulation, gamification and augmented/virtual reality. The role of simulation as a means of learning critical thinking and decision-making has emerged as a new learning paradigm especially in higher education. The simulation allows students to assume different roles and play the given business situations there by ensuring hands-on learning. Simulation and gaming are considered as the primary formats for experiential learning.

Next Generation Teaching Formats

Globalisation of business is forcing corporations to look for fresh talent with a skill composition to include sound theoretical knowledge blended with exposure to real-world challenges in terms of critical thinking and decision-making (Payton 2015). Teaching business case studies is a stepping-stone in this direction and became immensely popular among the business schools to change the face of learning. But any given business case study is static in nature and can only bring out a fixed perspective of a real-world challenge. While the live cases concept has helped in overcoming this challenge to some extent, the need for the students to learn about the multi-disciplinary challenges a business will face and be able to critically think and make optimal decisions about them is largely unfulfilled. This limitation of the business case study approach can be easily overcome using a simulation format. What simulation does to a student is to connect the conceptual learning to a real-time situation by allowing the student to take decisions and learn the impact of such decisions.

With recent innovations in technology, interactive learning has gained significant momentum in teaching formats. The instructors now like to

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engage students more actively to learn basic concepts using technology interventions rather than listening to traditional lectures. Interactive learning involves many strategies – instructors can use collaborative tools to engage students more effectively by introducing flipped classes where students learn pre-recorded content before coming to the class for a discussion, peer learning where students in smaller groups learn a given topic using rich content and present their view to rest of the class and team learning where students are engaged to take each topic for discussion and create a constructive viewpoint. Interactive learning enhances engagement, promotes collaboration and drives critical thinking among students.

Simulation as a Teaching Format

Simulation as a teaching format is not new to the teaching world. It has been in existence for the last forty years or so. The business schools in the United States and United Kingdom are well known for using simulation games in their management courses. However, developing countries were slow in adopting the same but are catching up now as the access to digital technology such as high bandwidth internet and online simulation tools becomes more widely available. The digital platform provides a better collaboration environment where students have the option to join online or offline, assume different business roles, make decisions and see the instant impact on business and study what-if scenarios. The historical data maintained in the computer and an analytics engine processing this data can direct students to progressively improve on their problem-solving and decision-making skills to produce positive business results.

Online digital simulation games enable groups of students to work together to make right decisions to promote and run a business enterprise. This approach fosters strategic thinking among them and walks them through a formal planning process, simulating marketing conditions, analysing alternate pricing approaches and achieving the best possible results (Panoutsopoulous 2011; Sampson 2011). There are many digital simulation games available in the market today. SimVenture, a UK-based firm, provides learning simulation solutions to foster entrepreneurial ideas. Many universities around the world use SimVenture to promote simulation-based learning in their course curriculum. Cesim is another business simulation tool that promotes experiential learning in an online format.

One need to be careful while selecting simulation as a teaching format in the learning process. The technology platform on which simulation

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games run is diverse in nature – computers, laptops, operating systems, mobile devices, internet speed, language preferences, availability, data accuracy, validity of results and 'realness' of simulated business scenarios. It is important that simulation-based learning provides realistic learning to students so that they are more industry ready.

Gamification as a Teaching Format

Introduced in 2002 by Nick Pelling, a British IT expert, the word 'gamification' refers to the process of leveraging a game approach and game elements to achieve better engagement than can be found in non-gaming activities. Gamification is expected to trigger four aspects of learning among students – activity, interaction, motivation and engagement. A game by nature has randomness and competitiveness built into it. To play a game requires a student to perform certain activities to convert randomness into a measurable result within a stipulated timeframe. Performing activities require interaction with other players, game tools, game rules and a game environment. The students are hence motivated and engage themselves throughout the duration of the game. The primary idea behind using gamification in education is to create a learning environment that condenses the time required to learn key ideas and allows students to explore either variations of a given idea or more ideas in their learning period in a more relaxed and fun-filled environment (Makri 2017; Vlachopoulos 2017).

Gamification involves two steps – game elements and game process. The game elements are the aspects that will drive motivation among the students to keep engaged in the process. There are seven distinct game elements (see Table 7.1):

Table 7.1. *Seven distinct game elements*

Game element	Role in enhancing learning effectiveness
Points	Instant feedback on individual performance
Leaderboards	Instant feedback on relative performance
Badges	Representation of instant progress
Performance graphs	Representation of continuous progress
Avatars	Representation of individual role
Teammates	Representation of multiple roles coming together
Meaningful stories	Representation of task achieved in the game

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The game process involves introducing randomness in the learning process and challenging students to perform an activity to remove the randomness. This activity can be done by one individual or in a group. Each time randomness is removed, the participant will be rewarded with one or more of the game elements. This process will start conditioning the students in a learning environment and keep motivating them by awarding various game elements. The assessment is internally built into the gaming process and hence the student's performance automatically gets reported as soon as the activity is completed.

Gamification of learning became prominent where it was important to impart problem-solving skills to learners. Several games are specially designed with specific learning outcomes and objectives in mind. The advent of hi-tech animations and cloud computing helped learners to master complex skills on a trial-and-error basis using gamified teaching formats. Every failure in gamified learning acted as a reinforcement of learning. Internalisation of knowledge and skill was found to be maximum in a gamified learning format. These formats are quite popular in aviation training, medical education and several other skill-based learning systems.

Gamification Tools

There are many commercial and open license gamification tools available in the market today. For example, Gimkit is one tool that helps a teacher to blend a quiz question in between his content to check how well the students are following his teaching. Students can use their mobile devices to respond to the quiz question and will get rewarded every time they respond with a correct answer. Class Dojo is another tool which assigns an avatar to each student and allows that avatar to collect points as he/she engages in performing activities assigned by the teacher. Classcraft is another avatar-based gamification tool. Kahoot is a gamification tool that allows a teacher to blend a variety of content such as images, videos, audio and text in the form of questions and let students respond to the questions using their mobile devices. Kahoot is highly adaptive and can adjust pace to match the student learning speed.

Augmented/Virtual Reality as a Teaching Format

Two promising technologies to help interactive learning are the augmented reality (AR) and virtual reality (VR). Augmented reality as a technology lets content creators blend digital objects within the real physical world.

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With AR in action, students can now use their own favourite characters to navigate and interact in the real world, thereby learning the essence of the real world and its usage. AR promotes problem-solving, collaboration and creativity among students.

VR is paving the natural way for the next step in education. Two classical problems associated with the traditional methods of learning are fact retention and comprehending information. All traditional teaching methods provide lot of information that students should learn and remember. This leads to information overload. It is essential for students to understand what is being said in the information provided and how it would help them in the future. This is essential to learning. Unless teaching formats provide for comprehensive methods for students to interact with and digest the information provided, the learning will become rote. This is where virtual reality is coming in to provide alternate forms of content representation. The way it works is that the VR technology creates a virtual version of the real world with all the information contained in it and allows the students to interact with the real world virtually. This will allow students to 'immerse' themselves in the learning process and hence enhances engagement.

VR as a teaching format offers certain unique characteristics. First, it provides a real sense of place to the students and how information is contained in it. For example, it may not be possible for all students to visit an aeroplane to view different components of the cockpit. But VR content can provide a realistic view of the cockpit in different aeroplane models. It can also allow students to select a component in the cockpit and gives details of the purpose of that component in flying. Second, VR can scale learning experience among students. A student can take his/her own time to explore the cockpit using a VR device. Third, VR technology can allow students to learn by doing. A student can fly the aircraft virtually by operating different components in the cockpit. A guided interactive character can help the student to virtually fly the aircraft. Fourth, as students learn by doing, their emotions will be high and stimulating. Students flying the aircraft virtually will be excited and will attempt to venture into taking risks in the flying process. Finally, VR technology makes students more creative in the learning process and hence develops an attitude towards learning.

Developing AR– and VR technology–enabled education tools can be expensive. But with globalisation, access to these tools with multi-language support has made it affordable on pay per use model. The challenge for educational institutions is to scale their technical infrastructure quickly so that the faculty can adopt these formats of learning.

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VR and AI have completely redefined higher education, particularly in business schools. These technologies are providing a useful platform for co-creation of knowledge and also promote extensive collaboration among teachers across the globe. With the global impact of COVID-19, e-learning has become the new normal, which completely erases geographic boundaries. While many conventional educationists still feel that digital education can never substitute real learning, the very fact that it was forced on both teachers and the learners without leaving a choice meant that it was accepted as a new normal and they found their own innovative methods which helped to derive higher quality of learning. E-learning facilitated learning from multiple platforms, creating knowledge repositories in the cloud, exploitation of mentor-mentee programs for upgradation or upscaling of knowledge. Both synchronous and asynchronous modes of e-learning are practiced depending on time zone differences across the globe and hybrid classrooms using what is popularly known as simulcasting is also becoming popular.

Several research studies were conducted on teaching formats and student styles and their interactive effects on learning. These studies generally concluded that peer-centred formats resulted in better learning than pure instructor-led formats where problem-solving and situational customisation was considered important. The demonstrator style helped increase learning in skill-based programs. Learning efficiency almost doubled where demonstrator-led teaching was reinforced with prior e-learning using VR and AI technologies.

Conclusion

This chapter highlights changes happening in the teaching formats for higher education in the last few years due to the ongoing digital transformation. Various emerging teaching formats enabled by modern technologies like AI, cloud computing, the Internet of Things, data analytics and VR/AR have been included. The chapter also introduces the readers to newer types of classrooms like the flipped classroom, synchronous and asynchronous classroom, hybrid classroom, etc. The impact of the use of simulation and gamification tools in the delivery of higher education has also been discussed in detail.

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CHAPTER 8

Digital Transformation in Teaching and Learning
A Multiple Case Study Approach

Luiz Carlos Di Serio, Enido Fabiano de Ramos and Kenyth Alves de Freitas

> In digital education, everything you do leaves traces. It's not only footprints. It goes deeper than that. There are marks all over the place .... So, the professor needs to prepare himself better. It's the fundamental characteristic that immediately differentiates digital teaching from conventional teaching. In face-to-face interaction, lecturers can give any class they want ... in the digital environment there's no such thing.
>
> University Respondent

As mentioned in Chapter 1 of this book, the mindsets of staff and faculty members have changed as a result of the coronavirus pandemic and have become much more open to online teaching methods. Digital transformation in higher education, however, is not a recent phenomenon. It has been continuously evolving in recent years through the application of new technologies. Education has reached new markets by way of media such as radio, television and the Internet, and it has been constantly improving in quality over time. It has been possible to break the traditional paradigm of education supported by the unidirectional, individualistic and fragmented teaching of knowledge. Digital education has enabled an innovative educational model to emerge that is supported by the principles of multidirectional, collective, transdisciplinary and collaborative learning.

Higher education institutions have built different digital models based on their own distinct strategies. Besides the obvious geographical separation of students, digital courses can offer what Kaplan (2016) called 'separation by time perspective' through asynchronous or synchronous learning. In the former, which is very common in massive open online courses (MOOCs), students can learn at their own pace. Synchronous learning, on the other hand, depends on simultaneous study and is found mainly in small private online courses (SPOCs) that usually require some form of formal enrolment.

Despite all its advantages, there are criticisms of the use of digital education, which can be grouped into technical and teaching difficulties

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(Kaplan 2018; Blasco, Kjærgaard and Thomsen 2021). Technical difficulties are related to understanding multimedia resources and the structure of the virtual space of the course. Teaching difficulties, in contrast, refer to the lack of follow-up in the learning process by trained professionals and the massification of teaching. Kaplan and Heinlein (2016) showed that most of these criticisms could be addressed if students were better targeted and teachers were better trained. With regard to students, the development of digital initiatives must awaken their intrinsic motivation, while with teachers' educational institutions must identify and train their members to build courses and content that are aligned with current and future market needs.

This chapter sets out some of the important findings of qualitative research that was carried out with eight Brazilian educational institutions that employ digital transformation but that are at differing levels of maturity. The important factors needed for developing an effective and successful digital course will then be presented, based on this research.

The Critical Factors of Digital Transformation in Higher Education

Critical factors are essential items for achieving an organiSation's executive, strategic or tactical goals. They guarantee its competitive performance, even if other factors are neglected (Seo 2018). Graham, Woodfield and Harrison (2013) and Sheehan and Morgan (2020) highlighted five critical factors for achieving success in the learning process. First, contextual and educational assumptions refer to how individuals absorb and fix knowledge in each discipline and on each course, including knowledge-transfer beliefs, based on computer-supported collaborative learning and research theories. The second factor is the application of the learning theory that is in evidence throughout the teaching-learning process, the conceptual models that describe how students absorb and internalise the experience they have in each knowledge-transfer activity, the application process and exercises, the assessment formats and maximum knowledge retention. It also considers the cognitive, emotional and environmental influences, the previously acquired or changed experience and the retained knowledge and skills.

Third, student motivation explores the implications of new technology for student commitment and promotes creative ways for improving the attention and interest that students show in the teaching process. Fourth, the role of the teacher refers to the discussion about the approaches adopted by teachers and their limits in digital education. Some authors are radical concerning the non-permanence of this agent, others recommend a profound resignification of the role to that of mediator, while others mention

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that the role only becomes stronger with this approach, since new ways of evaluating and preparing 'classes' require better-prepared teachers. Lastly, collaborative learning refers to the way knowledge is presented and is a social construction. There are several possibilities for collaboration: in pairs or in small or large groups, with mediated challenges, major dilemmas or simple tasks. In the digital context, these dynamics are essential when considering the epistemological process and quality.

The Maturity of Digital Transformation in Higher Education

By evaluating strategies, structures and support, the framework shown in Table 8.1 enables the maturity level of higher education institutions involved in digital transformation to be assessed. Its objective is to support educational institutions that are looking to evolve, and it supplies coherent and effective information to enable this process.

The Multiple Case Approach

This study adopted a qualitative approach using the multiple case study technique. According to Myers (2013), qualitative approaches allow for analysis of the motivations behind the actions and decisions taken by managers and offer more extensive results of this analysis. We sought to understand the factors that are critical for implementing digital transformation in education in eight higher education institutions and to establish the maturity level of this service in the institutions we analysed.

A multiple case study should analyse between four and ten cases to be considered effective (Eisenhardt 1989). It was decided, therefore, to select higher education institutions that offer courses at the technological, undergraduate or postgraduate levels. We selected eight private higher education institutions for our research that offer courses in business (four institutions), engineering and social sciences (two each).

Data were collected by way of in-depth interviews based on a semi-structured questionnaire. In choosing the cases for this research, we undertook an extensive search for institutions that offer digital education at some level of higher education. This resulted in eight institutions being selected.

At least four managers from each institution were interviewed, for a total of thirty-six interviews; twenty-eight of these took place using conference software, while only eight were in person. We recorded and transcribed the interviews, the only modifications being to conceal the names of the person or institution.

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Table 8.1. *Digital transformation's maturity in higher education*

Category	STAGE 1 Consciousness/ exploration	STAGE 2 Adoption/ preliminary implementation	STAGE 3 Growth/ mature implementation	STAGE 4 Application of good practice	STAGE 5 Best practice market reference
Technological	Focus on technological support for the traditional classroom	Focus on technologies for partial face-to-face teaching	Technological support well-established and compatible with the needs of stakeholders	Digital recognition of the student's digital security	Teachers make the most of technological resources, using AI and blockchain
Pedagogic	No development process	Experimentation and construction of a formal development process	Established and robust process, systematically improved	Problem-based learning/effective assessment models	Active methodologies, world-class didactic design
Purpose	No goals defined	Objectives being explored through training and course development	Well-established goals and systematic course improvements	Guarantee of recorded technical and behavioural training capabilities	Student-centric planning, including UX and engaged teachers
Results	**Online Curiosity**	**Face-to-face moved to online**	**High level approaches**	**Quality deliveries**	**State-of-the-art digital education**

Source: adapted from Graham, Woodfield and Harrison (2013) and Sheehan and Morgan (2020)

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The interviews were then coded and analysed according to open coding using the content analysis technique. The inductive method was adopted for: (1) detailed transcription of the interviews, (2) coding the concepts, (3) tabulating and analysing the data and (4) interpreting the results.

Digital Teaching: What This Research Revealed

> There is a focus on the essential and results-oriented. There is no time for fake solutions. It is quality digitalisation or . . . we are dead!
>
> HU3 University Respondent

Our findings reveal that theses institutions applied several teaching techniques to develop their courses, including active education, a just-in-time vs. if-in-case approach, problem-based learning, project-based learning, flipped learning, neuroeducation, storytelling, the science of forgetting, game-based learning and experimental learning/escape room. No one technique is considered better than another, but combining them is a key factor in digital teaching.

One of the great challenges in digital courses is keeping students highly engaged. Courses that employed a humanised narrative were the most successful, with low dropout rates. The high impact of the educational elements and in-depth content of these courses, the teaching strategies of which are anchored in the neuroscience of education, were formatted to enable students to experience and handle sub-themes, concepts and practice. These courses were also intended to connect the subjects being taught/learned to the students' tacit knowledge to allow emotional associations to be established and to promote a better understanding of the subject matter. Ultimately, self-assessment with immediate feedback improves the overall learning experience. On this particular point, Kaplan and Heinlein (2016) provide us with insights, a framework for motivating students and tips on how institutions can identify and train those faculty members who are suited for digital education.

The Success Factors When Developing Digital Courses

> Look at the case of Harvard, which in its 377 years of existence reached one million students, and then in just one year had the same number of students enrolled on its MOOCs. Here in our institution, for every student who enrols for a classroom-based course, we have another 100 students online.
>
> HU5 University Respondent

A concern of researchers when conducting a case study is to ensure the veracity of the information collected. According to Yin (2014), this process

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begins before the researcher goes into the field, in the construction of the research protocol and in case selection. Thus, these factors help to ensure the reliability of the study results and allow the replicability of the findings.

Our research shows that the success of digital education is based on factors that must be considered when developing the course or discipline. Eisenhardt (1989) propose that a multiple case study must analyse between four and ten cases to be considered effective.

These *success factors* are guidelines and were collected and highlighted in the interviews with thirty-five administrative and faculty members who have direct responsibility for the digital initiatives in the eight institutions. They recommend the following.

Factor # 1: Planning Teaching

Digital education requires an in-depth assessment of the entire curricular matrix, a clear definition of the competences required and a detailed review of the content that exist in the face-to-face model.

> Nothing is done without planning. No investment is made without there being an objective, without having a destination for this teaching and digital learning: What's your plan?
>
> PM1 University Respondent

> The first thing you need to think about is what my educational project is. Who am I creating this project for?? Who's my audience?
>
> HU4 University Respondent

> When we reviewed the entire educational project, we reflected on the profile of the professional we wanted to deliver for society. As a result, we included management disciplines in medicine. In fact, 'we don't just want good specialists. We want leaders who know how to work in groups'.
>
> HU1 University Respondent

Factor # 2: Workload Optimisation

Most of the time, there is a lower workload in digital education than there is with the same face-to-face discipline. This does not mean a lack of the necessary content, or a lack of quality, but it is an important adaptation of the current learning process.

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> The current generation of young people is used to 'Twitter's standard 140 characters'. They're more digital and well-informed. They can't absorb a lot of content, or concentrate if the same logic of traditional classes is reproduced.
>
> HU3 University Respondent

> We've defined a new model for the course workload. We rethought the current way we measure course performance. Now it's by the results the students get, rather than by workload. The time spent on the virtual course is relative, and depends directly on the performance of each student
>
> EU1 University Respondent

Factor # 3: Right Content

Develop high-quality content that has the right depth and is aligned with the current and future challenges of the profession, embedded in practical coherence.

> Particularly in this complex and uncertain digital age that's full of vulnerabilities and ambiguities, students connect to narratives that are based on facts described using the storytelling method.
>
> EU2 University Respondent

> With regard to content, the focus is on teaching subjects that are useful for practising the profession. For example, in the beginning students generally learn some 60 ways for anatomically fixing the femur. But in the day-to-day profession, when it comes to treating patients, only 10% of them are going to be useful. 'Online undergraduate courses always focus on this most important part of the discipline.'
>
> HU1 University Respondent

Factor # 4: Lecturer Training

Empower all faculty members because the role of teachers has changed and been reframed.

> With continuous updates, the lecturer is only the moderator of a discussion. There are some lectures, but they're a minority. . . we've moved to this model that's about empowering and raising awareness. It's a new way of doing things that's imposed by [today's] reality.
>
> HU5 University Respondent

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> We train lecturers and assistant lecturers to become learning community managers
>
> HU1 University Respondent

> Assistant lecturers with three years' service were trained in how to gather and arrange content for their own departments' lessons, and taught how to write better in order to make course content more dynamic.
>
> EU1 University Respondent

Factor # 5: Language and Teaching Format

Digital education requires self-study techniques, so all of the content must be vectorised and transcribed using heutagogy approaches: instructional design and online graphic design.

> In project-based learning, each student's creativity may be different from the others, and you can't let it die.
>
> HU2 University Respondent

> There are two production stages. We design all the content in a language that's appropriate to our target audience, and that's closer to the student, and in order to encourage reading. Then we produce videos and provide recorded lessons, animated films, games. . .
>
> EU2 University Respondent

> Learning at the right time, and access where and when it's needed. It's brief content that's straight to the point, and we quickly develop it and make it available.
>
> HU4 University Respondent

Factor # 6: Changes in the Assessment Process

Unlike traditional models, the assessment process is continuous and involves class attendance, the time spent in activities, the quality of the texts produced, interpretation of the academic challenges, interaction with peers, the level of questioning in tutorials, as well as the classic multiple-choice tests, case construction, problem-based learning, etc.

> The teacher accesses the student's screen (with their permission) and assesses the code and programming.
>
> HU2 University Respondent

> Students are assessed every week, by way of continuous tests. It is almost obsessive.
>
> HU1 University Respondent

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> We have a form of assessment that the class itself carries out. Each student has to judge the performance of their teammates – and they can't give everyone 'Excellent'. At least one colleague has to be 'Poor'. It's an assessment that has a quota of marks that have to be divided up between the group; it's the famous 'forced ranking'.
>
> HU4 University Respondent

Factor # 7: Student Centricity

There is a change in the paradigm of the role of the teacher being at the heart of the learning process: the focus of attention in digital education is on the student learning process.

> Online classes follow the 'team-based learning' method – the virtual room comprises all the students, or it's subdivided into teams of students. They receive texts and e-books and discuss the topics and agendas in groups.
>
> HU4 University Respondent

> Each student's interaction is built for them to be the protagonist in the process of autonomous learning. It's assumed that the student is the centre of the process. In fact, in our institution, we call it learning, not teaching as we used to do with face-to-face classes.
>
> HU5 University Respondent

Factor # 8: Technology

This is the means in the process, the tool that enables the teaching and learning process. It avoids the same mistakes made by many institutions that chose the platform and the technology first.

> The first mistake on this digital journey is to make technology the driver of the project.
>
> PM1 University Respondent

> When I came here (five years ago), I had to convince a lot of people that the platform is a mere messenger; if the message is bad, the excuse can never be the technology.
>
> HU3 University Respondent

Factor # 9: Teacher Compensation

Evaluate disruptive remuneration formats and seek the right incentives for migrating to digital models. Variable remuneration is linked to the success

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rates of the disciplines and online courses. There are formats for encouraging the production of content and clear criteria on copyright issues, the use of the image and the preparation of digital classes.

> In the beginning, some of the teachers didn't feel comfortable, especially because they were afraid of being replaced . . . it happened with about 85 per cent of them (HR climate survey). We set up groups of teachers to develop the online disciplines and complete courses, and they were paid a fee that was based on various indicators.
>
> HU5 University Respondent

> We hired a specialist company to create content, an EdTech, but our teachers receive royalties for the courses they've created. We have a lifetime contract with some of them.
>
> HU3 University Respondent

Factor # 10: Provide a Pleasant Experience

Ensure that the learning process will be positive and pleasant for the students. This does not mean being superficial and evasive or dull or overly-rigorous. The concept of 'edutainment' is becoming more powerful, and gamification and other techniques increase student motivation and make for a better overall experience.

> To be recognised as top quality, learning challenges don't have to be boring or serious, or too difficult.
>
> EU2 University Respondent

> Everybody agreed that student engagement and motivation indicators improved when we redesigned the course, involved scriptwriters, and had actors perfoming in course videos. We were inspired to upgrade our digital content format by some of the principles that are used by Disney.
>
> EU1 University Respondent

> Games are an evolution that enabled us to acquire skills and knowledge in a fun, but at the same time serious way. It's great, because in a game we can make mistakes in a risk-free environment, and we learn and actively practice the right way to do things by experimenting.
>
> PM1 University Respondent

Factor # 11: Social Learning

Share content in forums, chats and social networks. Use social networks because this facilitates the creation and the exchange of user-generated content.

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> In an activity in Module 1 of the course, we ask each student to establish their own timeline for all students to see, and to include what they expect to get from the course.
>
> HU2 University Respondent

> Collaboration is the basis of creativity and innovation.
>
> HU5 University Respondent

> Social learning (students are the protagonists of their life knowledge, which fosters digital collaboration).
>
> HU1 University Respondent

Factor # 12: Active Methodology

Make the students the protagonists in the learning process and highlight individual skills and competences that, in a traditional class-based model, remained dormant. Some of the techniques available were mentioned in the Section 'Digital Teaching: What This Research Revealed'.

> Problem situations that need to be solved with the final delivery of expert apps and software
>
> HU2 University Respondent

> One of the great changes we made was that we adopted active methodologies. They became a very important teaching resource for us.
>
> EU2 University Respondent

Although the COVID-19 pandemic was a catalyst in the digital transformation of the sector, the twelve factors based on these eight cases can be used like a compass to upgrade the maturity of digital transformation in any higher educational institution.

Conclusion

Digital transformation in higher education through the use of online courses and digital tools is a point of no return. Both students and faculty members need to embrace change and understand that the future of learning and teaching involves the use of digital methodologies. Educational institutions must recognise that the students of today must be understood in their essence as must their current and future needs. Faculty members must also be trained to enhance their digital teaching capabilities, over and above what they know and do in face-to-face interactions.

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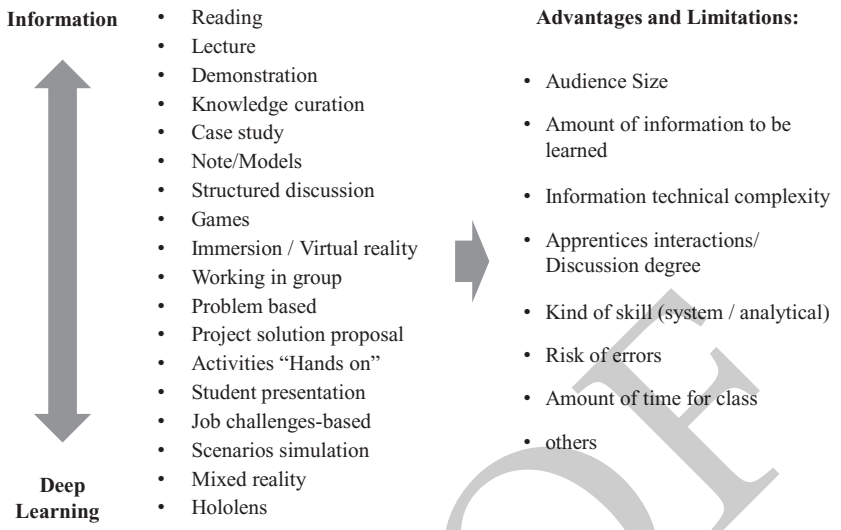


Figure 8.1 Higher education digital learning elements

When structuring the course, all available learning elements (Figure 8.1) must be considered and based on the objectives, profile and needs of the students.

In this sense, the *success factors* that are listed in this chapter provide a good pathway in how to think about and build digital learning activities and courses. The fact that these factors were taken from interactions with educational institutions, plus the experience of the authors, strengthens their use in real life.

In summary, we can design the development of digital learning strategies in three stages: before, during and after the course. Before the course, be clear and specific about the development of the courses and how they will be given. During the course, ensure that content is developed according to the target audience in order to stimulate interest and encourage reading. Humanise execution and use as many different tools as possible, such as videos, animated films and games, always bearing in mind that educational needs must be met. Lastly, after the course, use student assessments as a process for reflecting on the learning journey. We also suggest the use of infographics for presenting the most relevant points discussed during the discipline or study period.

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Digital initiatives in higher education are growing, but there is still much to be explored, discovered and developed in this journey of genuine transformation. Welcome to the new world of learning where digital innovation is key, keep going and always put the planning teaching first.

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CHAPTER 9

Blending Emerging Technologies for Student-Centred Teaching
A Critical Analysis

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Student-centred learning is different from traditional teacher-centred or institution-centred learning, where the power balance leans more towards teachers and institutions. They set the learning outcomes while students remain passive listeners. In institution-centred learning, schools, colleges and universities design learning in a way that advances their own financial, administrative or logistical benefits; student learning becomes a secondary aim (Wibowo et al. 2016; Kaplan 2021). However, in recent times, these traditional teaching approaches have been replaced by a movement that places students at the centre. The ideology of student-centred learning proposes a paradigm shift that makes student participation a crucial part of teaching. Some of the key principles of student-centred teaching are the following:

- The curriculum, content and pedagogy are designed to build on what the students have already learnt to relate to what they would like to learn further.
- Student-centred learning assists students to independently acquire knowledge via active participation in the teaching process.
- Student-centred classrooms are characterised by students provided with specific, skill-based learning outcomes to motivate them to fully engage with the teaching process.
- Students are provided with opportunities to actively interact with the class and share their views and knowledge openly.
- Student feedback is emphasised to ensure that the teaching is student-centred, and the teacher is aware of what the students would like to learn.

Implementing these student-centred learning principles involves radical changes in the way teaching and educational institutions worldwide rely on

e-learning platforms to implement student-centred teaching and learning. The present chapter will critically analyse the ways in which five leading e-learning platforms – learning management systems (LMS), virtual reality (VR), internet of things (IoT), Massive Open Online Courses (MOOCs) and social media – offer their support in implementing principles of student-centred learning.

Learning Management Systems

Learning management systems facilitate student-centred learning through synchronous or asynchronous communications between the students and teachers to simulate a face-to-face learning environment while the students are away from the classroom. The asynchronous aspects of LMSs present creative opportunities for students to learn at their own pace. LMSs are well known for facilitating student-centred learning (Mtebe 2015) and have the technological capability of integrating multiple media to actively engage with students. There are numerous LMS versions with many interesting learning features (Christino de Oliveira et al. 2016) that open up endless opportunities for educational institutions to invest in student-centred learning. Moreover, LMSs present learning resources in an organised and student-friendly manner, thereby promoting student-centred learning (Tella 2012).

Designing Pedagogy Based on What Students Already Know and What They Would Like to Learn Further

Curriculum design is a dynamic process that evolves as the teacher interacts with the students to understand what they have already learnt and what they would like to learn further. The demand for continual professional development, combined with the availability of technologically supported flexible learning opportunities, have increased the opportunities for students with advanced pre-existing learning who are looking for further opportunities to enhance their professional skills. This means that the curriculum design has to be dynamic and flexible to suit the needs of students who come from a wide range of backgrounds. In fact, technological platforms such as LMS have the potential to design curricula based on the students' existing knowledge and further learning interests; for example, the teacher can organise virtual discussion groups using LMS. This prevents repetition and helps sustain student motivation. LMSs have other helpful options – online quizzes, polling and live feedback facilities can be

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used to understand existing student knowledge while the class is in progress and can instantly elevate the classroom discussion to build on what the students already know.

Assisting Students to Acquire Their Own Knowledge by Active Participation

Empowering students to acquire their own knowledge necessitates the curriculum to provide a foundational knowledge for students to commence their learning and motivate and challenge them to enhance their learning to a level that each student prefers. LMS offer students the flexibility to access foundational knowledge when and where they want it in order to reflect and acquire their own knowledge. For example, the teacher can nominate specific readings that students must read, reflect on and summarise to post online for the class to read. This process ensures that students acquire knowledge independently and share it with the class. To involve all the students in the acquisition of their own knowledge, the teacher can request them to read every student's comments and reflect on what they have learnt from the whole process.

Assistance in Creating Skill-Based Learning Outcomes to Sustain Student Motivation

Skill-based learning not only facilitates the transfer of skills but also increases student motivation and involvement in the learning process. LMSs have the capability of integrating multiple media such as YouTube to demonstrate professional skills. In addition, some of the recently developed LMSs have the technological capability of combining virtual reality and augmented reality files to improve the real-life demonstration of professional skills. Another possibility is to form discussion groups using the LMS to work on case studies and professional skills relevant to the scenario. Importantly, the skill-based curriculum creates an evidence base for teachers and students to evaluate its learning outcomes.

Creation of Opportunities for Students to Actively Interact and Share Views with the Class

LMSs have the technological capability of creating life-like virtual classrooms that facilitate open communication like face-to-face classrooms. For example, there are live chat facilities for students to ask questions or share their reflections while the class is in progress. This platform also offers live video relaying of lectures and students can live-stream to have a face-to-face interaction with the

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teacher. LMSs have numerous other facilities that can increase student interaction in the class. In addition, the teacher can create time-restricted discussions with the groups finishing at specific times so that students have to move from one group to another to interact with all the students in the class.

Learning via Student Feedback to Ensure the Teacher Is Aware of What the Students Would Like to Learn

Learning based on student feedback is a concept that is central to the philosophy of student-centred learning. LMSs offer numerous facilities for students to provide feedback (Almrashdeh et al. 2011) anonymously, thus facilitating free and frank communication. The teacher can also create numerous opportunities for the students to provide feedback on specific matters. This means that the teacher need not wait for the term to finish to receive student feedback; consequently, students can benefit from their own feedback. Moreover, LMSs have the technological capability of integrating with multiple media to engage with the students; they allow students to communicate through hand-held devices such as tablet computers and mobile phones while the class is in progress. This creates an excellent opportunity for the teacher to receive live student feedback and improve the teaching content to confirm that the students learn what they want to their satisfaction.

Critical Analysis

There is a presumption that LMSs can solve all the problems associated with the lack of face-to-face interaction in e-learning. However, it is important to note that this platform cannot totally replace the aspects of face-to-face teaching.

Virtual Reality

Virtual reality (VR) is the application of three-dimensional (3D) computer graphics in combination with interface devices to create an interactive, immersive environment (Mihelj et al., 2014). VR technology facilitates learning through engagement, immersion and interactivity.

Designing Pedagogy Based on What Students Already Know and What They Would Like to Learn Further

Radianti et al. (2020) point out that teachers can adopt VR technology to conduct various activities virtually, including field trips, laboratory and

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science sessions, safety training and medical training, as part of the classroom experience. VR technology is an effective tool for engaging students in a deeply immersive sense of place and time and has the capability to improve learning based on student feedback. This is because VR visors have eye-tracking mechanisms that provide ongoing improvements to the software.

Assisting Students to Form Their Own Knowledge by Active Participation

VR technology offers the possibility of imitating complex real-life processes and systems (Chang and Lai 2020), which are difficult to replicate with traditional educational material such as lectures or case studies. VR technology provides students with a deep learning experience via three basic features: (a) immersion, (b) imagination and (c) interaction (Banerjee 2021). Several studies have identified the positive impacts of VR technology through immersive learning experiences and further found that engagement, presence, experienced realism and elicitation of emotions can facilitate learning (Chang and Lai 2020) as better elicitation of emotions increase engagement in participants (Buttussi and Chittaro 2017). Being immersed in what you are learning motivates you to fully understand it. It will also require lesser cognitive load to process the information. Moreover, VR technology enables students to make learning experiences social by allowing them to communicate with each other. Using avatars and mapped facial expressions, people can come together to discuss, synthesise and learn from one another. For example, Liaw et al. (2000) discuss the use of VR technology in teaching healthcare students. The social interactions among the students in their study were supported further by application of an experiential learning approach that underpinned learning activities such as role-play and debriefing in VR simulations.

Assistance in Creating Skill-Based Learning Outcomes to Sustain Student Motivation

VR technology proposes a different way of learning: It assists teachers in creating real-life scenarios and skill-based learning outcomes for motivating students to engage closely with the teaching process. VR technology also enables practice-oriented learning content rather than content that needs memorising. It can provide learning experiences at a level of immersion that other technologies cannot offer.

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Creating Opportunities for Students to Actively Interact and Share Views with Others

VR technology creates several opportunities for students to actively interact with the class and openly share their views and knowledge. In order to achieve this, many universities around the world have built online versions of their campus within Second Life environments. Second Life is a virtual world where users interact in simulated 3D spaces (Virtual Reality Society 2020). In Second Life, students are able to exchange messages in real time and see their classmates' animated images. The University of Glasgow uses Second Life to create a space where students can interact with each other and their teachers in an environment that enhances student experience and promotes a feeling of 'being part of' the university (University of Glasgow 2020).

Learning via Student Feedback to Ensure the Teacher Is Aware of What the Students Would Like to Learn

VR technology enables teaching to be student-centred as students are inspired to discover new information and knowledge independently. This provides an opportunity for students to learn by doing rather than passively reading. In addition, VR technology provides a more customised learning experience wherein students can provide feedback directly to the teacher, and their learning progress can be assessed and monitored by the teachers through the capability and transparency.

Critical Analysis

The cost of using VR technology can be very high; therefore, it is recommended to start with a realistically small scope, tailoring the application case to what seems feasible and achievable over time. However, the development of VR applications is quite complex, so teachers and students might need more VR experience to apply them.

Internet of Things

According to the International Telecommunication Union, the internet of things (IoT) is a dynamic global network infrastructure with billions of physical devices connected to the Internet, all collecting and sharing data

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(Zuerner 2014). IoT replaces the 'information age' with the concept of 'the connected age'. The application and incorporation of IoT technology brings significant benefits to many sectors including education, enabling the uninterrupted learning of any content at any given time (Şad and Ebner 2017).

Designing Pedagogy Based on What Students Already Know and What They Would Like to Learn Further

Sensor technology is part of the IoT and has advanced features to collect information from varied people for different purposes. In fact, sensor technology has vast potential in generating a valuable evidence base for student learning. Based on what students have already learnt, IoT technology can be useful to develop curriculum content within adaptive learning environments. Further, the big data about learners collected through sensors have a huge benefit in improving adaptive learning systems during the stage of curriculum development.

Assisting Students to Acquire Their Own Knowledge through Active Participation

An experimental study by Stojanović et al. (2020) shows that the use of IoT and mobile technologies has increased the level of students' knowledge and active participation in learning compared to the control group that used the traditional learning method. The IoT also offers many opportunities for students to acquire their own knowledge through active participation since a smart classroom enables real-time learning experiences that are much more effective.

Assistance in Creating Skill-Based Learning Outcomes to Sustain Student Motivation

The usage of Twine products on university campuses allows users to link almost all physical object to a local area network, thereby facilitating easy setup and quick data transfer. The accurate demonstration of professional skills in a classroom has always been a challenge for teachers. Thanks to the IoT, digital devices can be used to demonstrate real-life scenarios in a classroom and generate debate and discussion regarding professional skills.

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Creating Opportunities for Students to Actively Interact and Openly Share Views with the Class

A huge benefit of the IoT is that it enables seamless uninterrupted learning at any given time by making every aspect of the learning environment digital, intelligent and connected (Şad and Edner 2017). Unsurprisingly, IoT applications have changed the education sector drastically. The usage of mobile devices maintains continuity in the learning environment by moving the classroom environment anywhere and to anytime, ensuring student engagement throughout. The Horizon Report 2015 acknowledges the use of the IoT in the higher education sector (Johnson et al. 2015). Embedded technologies such as sensors, RFID and cloud computing support seamless learning that can easily be accessed via mobile devices. With the help of mobile devices, students can actively exchange information, interact with the class and learn from each other at a flexible time and environment.

Learning via Student Feedback to Ensure That the Teacher Is Aware of What the Students Would Like to Learn

An important application of the IoT in learning is its capability of bringing a wide range of interacting devices to facilitate feedback from teachers to students and vice versa. Never before have the students had so many open channels for them to directly communicate their needs and provide feedback to teachers. Thus, IoT technologies have created a revolution in the implementation of student-centred learning.

Critical Analysis

The IoT is a group of technologies and not a single platform; hence, their usage in education requires a lot of preparation. Moreover, the huge investment on new technologies to adapt and maintain users' security and privacy poses challenges for educational institutions.

Massive Open Online Courses

As indicated by Kaplan in Chapter 1, Massive Open Online Courses have been the subject of technology-enhanced learning research for many years

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(Ebner et al. 2020) and are a 'big deal' in open education and distance learning (Kaplan and Haenlein 2016). MOOCs are online courses for a large number of participants that anyone can access from anywhere as long as they have an internet connection; they are open to anyone and offer a full online course experience for free (Mulder and Jansen 2015). In addition to typical course materials, MOOCs often offer interactive user forums that help build a community for students and teachers. Although MOOCs do not always offer academic credits, they provide training that can enable certification and qualification for employment or further study. There are mainly two types of MOOCs: xMOOCs and cMOOCs. The distinguishing feature of the two is the use of software platforms, video lectures, online assessment, support materials and opportunities to comment and discuss. xMOOCs are suitable for transmitting information to a wider audience. In contrast, cMOOCs are based on network learning where learning evolves through interactions and discussions between participants over social media. There are a few other forms of MOOCs that are more aligned to the concept of a flipped classroom (Ebner et al. 2020).

Designing Pedagogy Based on What Students Already Know and What They Would Like to Learn Further

Autonomy is one of the main features of MOOCs. When students enrol in the MOOCs, they choose online courses according to their interest, which is in contrast to the limits of a traditional curriculum schedule. In the learning process, students are not restricted by time and place, thus ensuring sufficient learning time, on the one hand, and improving learning efficiency, on the other. In fact, universities in some countries have even set up a credit transferring system (Li 2019).

Since the beginning, major MOOC providers required all learning materials to be presented in ways that are accessible to a diverse population of learners. As a result, MOOCs have the potential to meet the needs of diverse learners in various ways and aim for further learning based on what they already know (Barman et al. 2019).

There is considerable empirical evidence that suggests that MOOCs mostly benefit those who are already well-educated, whereas the disadvantaged and underprivileged do not benefit from MOOCs (Emanuel 2013). The prior educational standards of MOOC students across the world far exceeds that of the general population in their own countries. In some countries, almost 80 per cent of MOOC students come from the wealthiest and most well educated 6 per cent of the population (Barman et al. 2019).

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Assisting Students to Acquire Their Own Knowledge by Active Participation

Traditional MOOCs show a lack of interaction. In contrast, MOOCs that are aligned to the flipped classroom concept allow teachers and students to make the most of classroom time through blended classes. Students receive assignments to listen to or watch a recorded lecture in advance and return to the classroom for a more valuable discussion time or interactive learning. This process encourages students to develop independent learning skills to acquire their knowledge by active participation in the learning process.

Assistance in Creating Skill-Based Learning Outcomes to Sustain Student Motivation

The learning experience in MOOCs remains more knowledge-based than skill-based due to the less-pronounced opportunities to convert theoretical knowledge into practice. However, MOOCs offer the opportunity for students to reflect on the skill aspects through self-paced courses.

Creating Opportunities for Students to Actively Interact and Share Views with the Class

MOOCs allow extensive participation by learners, thus offering the opportunity of exchange between people from all over the world. MOOC forums can have different functions: learners can socialise with their peers and ask questions about the course content. Moreover, forums take on the traditional classroom role of offering assistance to a classmate to clarify a challenging subject (Diver and Martinez 2015). Concerning the completion rates of MOOCs, research suggests that online forums offered as part of MOOCs play a significant role in increasing successful completion of MOOCs (Bonafini 2017). Furthermore, active engagement of participants on online forums predicted their greater commitment to the course materials (Ferguson and Clow 2015). However, it is important to mention that discussions on online forums might be problematic in MOOCs due to the massive number of participants (Cagiltay et al. 2020).

Learning Facilitated via Student Feedback to Ensure That the Teacher Is Aware of What the Students Would Like to Learn

MOOC platforms offer limited student feedback due to the high student volume. The learners' behaviour, instructional design, assessment processes and interactions among learners and teachers in MOOCs are significantly

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different from traditional educational platforms. For instance, MOOC learners were rarely able to obtain direct and timely feedback from teachers. This was due to the shift to MOOCs based on flipped classrooms (Cagiltay et al. 2020).

Critical Analysis

The role of MOOCs is more as a supplement rather than a full-fledged replacement of classroom learning. The courses register a huge number of dropouts as students lack motivation to finish these courses since they do not provide official credit points; probably, the students themselves not being ready for a self-guided study process serves as evidence for this (Birzina and Cedere 2020). Moreover, there are concerns raised about the pedagogical quality of MOOCs. The quality assurance from institutions offering MOOCs is another area of debate (Barman et al. 2019).

Social Media

Social media are forms of electronic communication (such as websites) through which people create online communities to share information, ideas, personal messages, etc. (Merriam-Webster 2020). Students can use such platforms via their smartphones, tablets or computers. There are different types of social media used for creating and sharing information (see Table 9.1).

Designing Pedagogy Based on What Students Already Know and What They Would Like to Learn Further

Social media facilitate creativity in curriculum design as instructors can develop new forms of assessment activities by combining social media and learning. For example, students writing essays as blog posts can improve their writing and critical thinking skills. This also allows students to respond to weekly prompts by making them informal and loosely structured. Additionally, students may adopt social media, such as Instagram and YouTube, to present a series of videos and pictures to accomplish their learning tasks, such as observation assignments. This can also improve the students' critical thinking skills by actively evaluating and commenting on their peers' works (Davies et al. 2019).

Assisting Students to Acquire Their Own Knowledge by Active Participation

Skill-based learning has seen a significant improvement due to the capability of social media to transfer audio and video files, thereby

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Table 9.1. *Social media types for information creation and sharing*

Types	Purposes	Examples
Social networks	To connect with other people	Facebook, Twitter, LinkedIn
Media sharing networks	To find and share photos, video, live video and other media online.	Instagram, Snapchat, YouTube
Discussion forums	To find, discuss and share news, information and opinions.	Reddit, Quora, Digg
Bookmarking and content curation networks	To discover, save, share and discuss new and trending content and media.	Pinterest, Flipboard
Review networks	To find, review and share information about brands, products and services, as well as restaurants, travel destinations and more.	Yelp, Zomato, TripAdvisor
Blogging and publishing networks	To publish, discover and comment on content online.	WordPress, Tumblr
Shopping networks	To spot trends, follow brands, share great finds and make purchases.	Polyvore, Etsy, Fancy
Interest-based networks	To connect with others around a shared interest or hobby.	Goodreads, Houzz, Last.fm
Sharing-Economy networks	To advertise, find, share, buy, sell and trade products and services between peers.	Airbnb, Uber, Taskrabbit
Education networks	To enhance collaboration between the teacher and the student or student to student	Google Classroom

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demonstrating key professional and social skills. Educators are able to use online messages, comments, news and articles from blogging and publishing sites (e.g., WordPress), online discussion forums (e.g., Quora) and bookmarking and content curation networks (Pinterest) to transfer key professional skills and keep the students actively involved in the learning process. These platforms often contain content based on students' individual interests, presented with eye-catching photos and other media. This also promotes critical thinking while engaging in social media and online communities to evaluate, use and share information (Al-Aufi et al. 2017).

Assistance in the Creation of Skill-Based Learning Outcomes to Sustain Student Motivation

Social media optimise institutions' career assistance for their students as they use social media to connect students with career services and

employers. For example, students and employers can have informational question-and-answer sessions and make connections through professional networking sites such as LinkedIn. Educational institutions can also host live events and webinars via social media platforms, including Zoom and Facebook, in which employers communicate with students about their organisations and career opportunities. Social media allow institutions' career services to achieve a more dynamic presence and develop creative content, which supports career assistance teachers and workers to become opinion leaders in campus communities and professional networks. This can facilitate an engaging culture where students regularly share positive experiences and promote career services' perceived values by referring peers (Dey and Cruzvergara 2014; Conroy et al. 2020).

Creating Opportunities for Students to Actively Interact and Openly Share Views with the Class

Social media have revolutionised the way in which students actively interact with their peers. They are especially useful for disadvantaged students who are unlikely to communicate with other students for a range of social, emotional and equity-related reasons. In fact, social media–supported educational programs are also acknowledged as more flexible and engaging learning methods for both on-campus and blended-learning students. For example, educators are able to create online groups for each of their classes through social media networks. Students are also able to connect with their peers and teachers via instant messaging applications to exchange questions and make phone calls or video calls. Some educational networks, such as Google Classroom and wikis, allow students platforms to undertake group work. These platforms also scaffold learning through the real-time posting of assignments, tracking work-in-progress, discussing and debating (Chu et al. 2017).

Learning via Student Feedback to Ensure That the Teacher Is Aware of What the Students Would Like to Learn

Social media platforms allow educators to engage with their students by responding to enquiries, posting discussion activities, assigning homework and announcing updates either during or outside school hours (Dutta 2020). Social media also enhance parental involvement in children's education. For example, educators can update parents on school-related news via Twitter or Facebook. Some cloud-based platforms (Microsoft

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Table 9.2. *Social media usefulness for student feedback facilitation*

Social media platforms	Focuses	Benefits	Examples	References
Skype, Zoom, Facebook, Microsoft Teams	Distance learning	It provides students with more flexible learning methods, especially for the disadvantaged students who are not able to acquire formal education by attending regular classes on campus	University students in India during COVID-19	Dutta (2020)
Wikis, Google Classroom	Collaboration and cooperation	Students see it as a novel and effective method of quantifying levels of collaborative group learning, which facilitates better group learning outputs	Collaborative writing group of secondary school students in Hong Kong	Chu et al. (2017)
WordPress, Tumblr	Literacy and reading skills	Students are motivated to devote their time and put some extra efforts into their learning. It also promotes their critical thinking skills	Undergraduate students in Sultan	Al-Auf et al. (2017)
Instagram, Pinterest	Curriculum design	Students are able to participate in new forms of assessments, such as photo assignments and blog post essays. It promotes students' learning engagement.	Geography field courses in Germany	Davies et al. (2019)

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Table 9.2. (*cont.*)

Social media platforms	Focuses	Benefits	Examples	References
Facebook, Whatsapp, Wechat	Parental involvement	It enhances students' performance with the better informed academic support offered by their parents at home	Wechat groups of secondary school students' parents in China	Huang and Lin (2019)
LinkedIn, Facebook, Twitter	Career Assistance	Students are able to identify more job opportunities via direct communications with employers. Social media platforms also promote students' engagement with career services provided by schools and universities.	Undergraduate psychology programs In the United States	Conroy et al. 2020

Teams, Zoom, Skype) share students' real-time progress between school-teachers and parents. This enhances parents' communication with the school. It also improves students' performance as their parents can offer better-informed academic support at home (Huang and Lin 2019). Table 9.2 provides a literature review on the usefulness of social media in facilitating student feedback to ensure the teaching is student-centred.

Critical Analysis

While social media can enhance the quality of the student-centred approach of educational institutions, their usage has risks of psychological or behavioural issues such as internet and smartphone addiction among young users. Therefore, educational institutions should educate their students about the moderate use of social media.

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Conclusion

Emerging technologies have transformed the ways in which students learn, and educational institutions have gone through major reforms in their approaches to teaching and learning processes. Students, as consumers, have gained a lot through this process. Never before has learning gone through such major reform. Educational institutions could not have made such a major transformation without the support of emerging technological tools. These technological tools for learning are still evolving and will continue to play a crucial role in making student-centred learning a permanent reality. However, it is important that these technological tools are used cautiously based on a critical analysis of their strengths and weaknesses. Practicing caution will ensure that the optimal use of these digital and technological tools remains viable to communities around the world.

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CHAPTER 10

Artificial Intelligence
An Adaptive Learning Methodology

Francesca Pucciarelli and José Cobo-Benita

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As every teacher knows, no one student is equivalent to another. Each of them has their own characteristics, peculiarities, abilities and weaknesses, and broad-based learning approaches may be ineffective in embracing this complexity over the long term. This is where adaptive learning (AL) comes in. This method delivers customised solutions to meet the specific learning needs of individuals. AL is an educational system based on technology and data analysis, allowing teachers to track students' performance and adjust methods and programs to each student's needs.

Nowadays, students have a diverse learning and knowledge background when they attend class. It is therefore natural to argue that a drive towards progression in Higher Education (HE) institutions should not only consider scholars' age and time spent in class; it should also be more focused on proficiency. This student-centric approach supports students in their efforts to master concepts, rather than accepting failure based on other students' performances and on time limits. In addition to giving students the right amount of time to maximise their efficiency and engagement, there are other significant implications of putting AL into practice. Think about how useful it would be for teachers to get real-time analytics about their class' performance, emerging difficulties and successful activities (Xie et al. 2019). Thanks to automated data analysis, they could intervene promptly on critical issues and adjust their methods to solve them. As a consequence, those in charge of producing content for HE institutions will also benefit from the increasingly wide use of AL, as they will receive more objective and detailed feedback about the efficiency of their work and emerging areas to be covered by educational programs.

AL is not new (see, for example, Paramythis and Loidl-Reisinger 2003), and some of the benefits of adopting this pedagogical mechanism are well proven. Think, for example, of the possibility for professors to update their teaching style as the curriculum moves forward based on technology-assisted insights and analytics (Kaplan and Haenlein 2016;

Midgley et al. 2000,) or even of the positive impact on learner performances and engagement of the one-to-one personalised experience.[1] What is unprecedented in our times is that artificial intelligence (AI) is enabling AL to reach a completely new level. In fact, AL powered by AI has made it possible to use this educational approach on a large scale and in combination with other educational innovations to provide real-time mass-customised learning experiences, which improve with use and time (Kaplan and Haenlein 2019). As a result, it is not surprising that AL is once again attracting the interest of HE decision-makers, scholars and many practitioners from publishing houses to EdTech start-ups.

How Artificial Intelligence Is Transforming the Learning Experience: Opportunities and Challenges

Many of the products and services we use every day are already leveraging AI to improve the user experience. Learning styles influence the development of learning solutions. A person's learning style can be influenced by age, ethnicity, cultural background and other factors that must be considered in the development process. Current HE students rate training and personal development as the number one job benefit (Afini Normandi et al. 2019). HE institutions and organisations must be prepared to begin implementing AI to empower students and employees by optimising content to suit users' preferred learning style. This will not only make the learning experience more enjoyable for them, but it will also help with knowledge retention and on-the-job performance.

An AI-powered training program allows that program to be adaptable, whereby modules are modified to suit the needs of each student (Hung and Wu 2016). The learning management system can offer video tutorials for certain students, but it will automatically transcribe the videos into text-based articles for other classmates. You can create images based on written content and suggest that an employee takes a day of in-person training on the sections of the course that they are struggling with. Learning insights also help develop a broader understanding of student behaviour, generating predictive capabilities (Kautzman and Jaques 2019). Using these insights, HE institutions can create smarter content that is adaptive, intuitive and responsive to a learner's personal journey.

[1] This is well-illustrated by Bloom in 1984 with the concept of the '2 Sigma Problem'. See Bloom, B. S. (1984) The 2-Sigma Problem: The Search for Methods of Group Instruction as Effective as One-to-One Tutoring. *Educational Researcher*, 13(6), 4–16.

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AI through adaptive learning can drastically shorten the learning process by suggesting only specific modules that the student needs to improve their skills for the future job they are applying for (Capuano and Caballé 2019). Having learned the strengths, weaknesses and learning preferences of the user, the system can suggest suitable training courses and modules for the student. AI can enhance the training experience for students and provide personalised feedback on areas for improvement (Kaplan and Haenlein 2016). For example, using tools such as speech-to-text that rely heavily on AI and machine learning, users can receive feedback on the performance of your presentation in areas such as voice rhythm, number of hesitation words used and whether certain keywords were mentioned, among others (Truong 2016).

In corporate training, performance data can be collected when employees perform their jobs in the workplace and also during training courses. Once this data is collected, AI can analyse it and apply it to obtain certain insights (Mavroudi et al. 2017). When workplace data is analysed, learning and development professionals gain insights into which training programs should be assigned to specific employees to improve their effectiveness at work (Manyika et al. 2017). The data analysis should highlight the areas in which employees need to improve, and the AI system can recommend suitable courses to fill these knowledge or practice gaps. An analysis of training data reveals what types of training material should be assigned to employees based on their learning styles (Truong 2016). It can also help to compare employees to each other with assessments and provide an appropriate level of difficulty in training materials to challenge the learner (Xie et al. 2019). Any gaps discovered in training can be assessed and training programs can be redesigned. The collection and analysis of employee data needs to be continuous, so that systems stay up to date with current trends and AI models are trained using the latest data.

Whether we realise it or not, we can be prejudiced against certain parts of the learning process. This can range from creating a new course with just a few evaluations because we do not particularly like them, to rating students differently based on their backgrounds, to accepting new hires based on how we feel about them (Nabizadeh et al. 2019). AI enables the learning process to be unbiased and objective, with processes, learning paths and new courses based on data and results. However, it is important to note that bias can still appear when training AI and machine learning models, as humans still choose the predefined variables and data sets. To remain accurate and relevant, the adaptive learning system must be

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continuously trained to account for changes in the market and to eliminate any biases that occur through new data sets.

On the side of HE institutions, using AI through adaptive learning presents a number of opportunities. First, the use of AI identifies proficiency gaps: across disciplines, identifying proficiency gaps is crucial. However, in many cases, students are not aware of the gaps in their understanding (Chen et al. 2020). AL uses a question-based approach (or situational questions, depending on the competency to be assessed) to understand what students know and where the gaps are. Second, it offers tailor-made training by providing focused attention to every individual student. It also offers personalised feedback to students, which enables them to understand concepts better (Cobo-Benita 2020). AL leverages the algorithms and data it receives from the student in the form of assignments and responses and adapts the content accordingly. Third, an AL system accommodates different learning styles: unlike one-size-fits-all courses that might intimidate some groups of students, AL is suitable for all types of students, regardless of whether they are at the beginning, intermediate or advanced level of knowledge of concepts. A well-designed AL system learns how students learn and focuses on delivering learning materials that are tailored to their learning styles. Lastly, an AL system is updated when information changes – one of the crucial challenges in designing learning content is providing the most up-to-date material. The AL system keeps track of what a student has learned. When a teacher introduces changes to the course, the system can differentiate between material that a student has already covered and new areas to master (Mirata et al. 2020). This helps students get up to speed without having to quickly recheck all content.

But of course, AL brings its own set of challenges. First, convincing teachers of the enormous time investment required to rethink their learning content and teaching style to adapt it to AL. Second, a trained team is required to implement AL systems: developing this pedagogical solution is not only a matter of cost but also one of skills (Mavroudi et al. 2017; Mirata et al. 2020). HE institutions need to find the right team of managers, teachers and developers who can handle these projects efficiently. And third, it is important to clearly design the data analysis process, graphs, patterns and information available to teachers (Afini Normandi et al. 2019; Nabizadeh et al. 2020) so that they can design the right content depending on current trends and on each student's performance.

In our rapidly changing world, HE institutions and organisation development teams have to be proactive and strive for real pedagogical

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innovation, as analysed in Chapter 1. They have to ensure that the most relevant training tools and knowledge resources are available to their employees when they are available to learn. The learning technology landscape is changing extremely fast. HE institutions and organisations must keep abreast of the latest trends, whether in AI, virtual reality or blockchain, to remain relevant. A key part of upskilling and re-skilling is through the use of AI and machine learning to provide students and employees with the most relevant content when they need it. AI will transform how learning content is delivered, leading to greater alignment with business values.

Adaptive Learning and Higher Education

Technological advances are fundamentally changing the nature of the university system: challenging fundamental aspects of education, changing the way we learn, teach, assess (Bergamin and Hirt 2018; Kaplan 2021) and research (Gorska et al. 2020) and overcoming many of the common barriers of higher education. Think, for example, about the issue of access inequalities, both geographically and financially, and how online learning and massive open online courses (MOOCs) have extended reach potentially across the whole globe and made tuition fees much more affordable, at the single-module, certificate and full programme level (Bailey et al. 2018). Another example could be the enormous amount of information educational institutions hold on their students – from attendance, to progress, from favourite subjects, to test scores and grades – all of which are data-points that can assist both the institutions and the students themselves in understanding their strengths and weaknesses (Kaplan and Haenlein 2016). Moreover, many universities are increasingly using online education and technology in classrooms – and will continue to do so – to augment students' learning experience, creating even more data-points (Pucciarelli and Kaplan 2016).

Thus, it is not surprising that AI is now expected to make education smarter than ever before in a number of dimensions. In teaching, learning and assessment, for example, AI and digital technologies can offer innovative, purposeful and effective ways of engaging both teachers and students. Adaptive learning acts like a GPS (Dziuban et al. 2018). AL helps students to focus on what they need to learn and teachers to better allocate their time to value-added activities; the adaptive learning software dynamically adjusts the lesson (e.g., the next learning activity) based on student performance to create a personalised learning experience, personalised

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feedback, content recommendations and real-time progress dashboards that both students and instructors may review.

Adaptive learning is seen by many as the future of HE. Yet a limited number of documented cases of successful adaptive learning implementations are presented by the extant literature (Imhof, Bergamin and McGarrity 2020), even though adaptive learning has been around for quite a while.

Back in 2013, The Bill and Melinda Gates Foundation initiated the Adaptive Learning Market Acceleration Program (ALMAP) in support of an evidence-based understanding of how adaptive learning technologies could improve college completion (for disadvantaged adults). The project involved fourteen higher education institutions, both public and private online universities (for the full list of educational institutions involved, see Yarnall, Means and Wetzel 2016, pp. 30–31), which incorporated nice adaptive learning products into twenty-three courses, run multiple times over three years (from summer 2013 to winter 2015) to measure, in comparison with the comparison group, the effects of AL on students' outcomes, cost and savings impacts and students' and teachers' satisfaction. The effects on student learning and course completion were somewhat limited, probably because of the limited maturity of adaptive learning itself. Stronger outcomes were produced with adaptivity at a micro level (individual lesson or learning object), which also explains the initial rise in the cost of implementation of adaptive learning, as the format change requires instructor labour. Costs were lowered in the following implementations of adaptive courseware and were lower than traditional learning formats. Moreover, most instructors were satisfied with adaptive learning, pinpointing the real-time progress dashboard as useful for informing their teaching; and students reported higher rates of engagement and learning gains (60 per cent and 95 per cent, respectively, versus 25 per cent and 35 per cent of the comparison group).

Among the early adopters of adaptive learning, previous scholarly works cite Colorado Technical University (CTU) and its commitment to provide industry-relevant higher education to a highly diverse student population (i.e., online open enrolment student population), making teaching and adaptive learning a crucial part of its strategy, at both pedagogical and institutional level (Kaplan 2017; Bailey et al. 2018; Dziuban et al. 2018). Another interesting example is the University of Central Florida (UCF), a public research institution strategically using digital learning. UCF offered its first online course in 1996, offering a variety of course modalities with online and blended learning counting for the majority of enrolment

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growth and piloting adaptive learning in 2014 as an instructional technology for faculty use (choosing Realizeit as a provider, as was the case of Colorado Technical University). Dziuban et al. (2018) investigate the impact of adaptive learning in the two above-mentioned universities (CTU and UCF) and prove that adaptive modality stabilises learning organisation in multiple disciplines (e.g., math and nursing), whilst positively impacting students' engagement and growth.

Moving to Europe, a few and more recent cases of adaptive learning technology can be found, mostly in management education institutions piloting this new learning model primarily in MBA and Executive MBA programs. The Politecnico di Milano Graduate School of Business (MIP) launched FLEXA in 2018, an innovative, personalised continuous-learning platform and a digital mentor for students, powered by Microsoft AI. The platform is currently available to MIP Politecnico di Milano alumni and students, as well as to all interested professionals in the business world, with a strong focus on mentorship, career service and networking, furthering continuous and customised learning (see www.som.polimi.it/en/flexa/). Similarly, the ESSEC Business School Talent Center Project is providing personalised recommendations based on predictive analysis, among other functionalities. As part of a bigger digital transformation plan, the ESCP Business School has launched a project of adaptive learning in Executive Education for the Global Digital EMBA, in partnership with several EdTech start-ups, to design customised learning experiences and confirm the impact of adaptive learning.

Furthermore, using adaptive learning in corporate training is a powerful approach for achieving highly effective, personalised training and better performance outcomes. A number of corporate academies are in fact using adaptive learning to upskill and reskill their employees. Renault Group 'Primo Manager' is an AL-blended module aiming at producing a diagnostic of the management skills of its current and aspirant managers across eleven main target skills and designing individualised training paths. The AG2R La Mondiale (French Insurance company) sales academy is tailoring learning plans adapted to the challenges of the specific Business Unit, as well as employees' profiles and needs, skills proficiency and learning history. SNCF Réseau (French National Railway Company) provides newly recruited employees with AL training during their first months in the field, to reinforce technical skills and eventually hire them (if they fail the final exam, they will not be entitled to join the company).

In sum, even though the promise of a more personalised and engaging experience through adaptive learning is generating a lot of enthusiasm and

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attention, the adoption of this important and influential development is still at an early stage. At first glance, AL may sound complicated to implement; but actually, switching a class to AL can be a gradual process rather than one involving abrupt, unmanageable changes. Additionally, HE institutions can create and deliver new learning experiences adapted to each student's learning needs, thus putting them on track towards excellent academic outcomes, oriented to match their professional expectations. Many HE institutions (Universities and Business Schools) are increasingly adopting AL to ensure that everyone learns the same skills at their own pace and according to their level of understanding, whilst adding a further marketing weapon in their bid to establish themselves as cutting-edge and innovative players (Pucciarelli and Kaplan 2016, 2019).

Conclusion

When a HE institution or a corporate university is strategically and organisationally prepared to adopt artificial intelligence, adaptive systems have the potential to improve the way teachers instruct and enhance student learning and can help higher education institutions and policymakers to better understand how to improve the learning experience. At minimum, these systems allow for proper calibration of the curriculum, initial assessment, customisation of the learning process, ongoing monitoring and finally, validation of acquired knowledge and skills. However, these systems require a rethink of the roles and dynamics between students and trainers.

The latest technological trends and current learning dynamics confirm that we can no longer just rely on traditional ways of teaching and learning. It is increasingly likely that in the future of learning, technology can diversify the means to support students. As shown, adaptive systems could be an opportunity to support self-directed learning, as well as other forms of learning, making it more accessible, impactful and engaging. However, given the complexity of adopting and deploying adaptive learning systems, HE institutions and corporate universities have to address significant technological and organisational change management challenges.

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CHAPTER 11

Quality Assurance and Enhancement
An Application of Digitalised Data

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The last decade has witnessed a heightened need for quality assurance (QA) in higher education. This need derives from 'a growing demand for accountability and transparency' (Smidt 2015, p. 626) from stakeholders such as students, faculty and government funding bodies (Leiber et al. 2015). The rise of online teaching and blended learning has also expanded the range of QA measures (Martin et al. 2017). Together with the rising demand for QA are challenges in the implementation of QA measures, two of which are most evident in the literature. One is staff resistance: their unwillingness to participate in QA exercises (Jingura and Kamusoko 2019). The main reason or resistance is that most QA measures are imposed by different levels of administration. Such measures place students, faculty and even institutions in a position of compliance with external standards, and their voices are rarely heard in the process (Leiber et al. 2015). These 'reward-or-sanction-led' measures have resulted in some institutions adopting a 'reactive quality culture' (Harvey 2008, p. 85). As a result, some faculty consider QA exercises a 'beast that need[s] to be fed' (Newton 2000, p. 31).

The other main challenge, according to Mishra (2019), is that the data generated in the QA process is not fully used for academic activities. In other words, the continuous improvement in teaching, research and public services, which are regarded as the three missions of higher education Kaplan (2021), has not yet been fully achieved via these exercises. To address this issue, Harvey (2008) introduced a regenerative quality culture, a QA culture that aims to achieve continued internal development. It places an emphasis on internal developments although with some awareness of external requirements. Despite a growing literature on the importance of a regenerative quality culture and how it should be developed (e.g., Harvey 2008; Kohoutek 2016; Tavares et al. 2016), little is known about how to implement measures needed to engender the culture. This chapter aims to bridge this gap by reporting on a case study of an internal

quality review with the integration of learning analytics (LA) into the review process. LA is 'the measurement, collection, analysis and reporting of data about learners and their contexts, for the purposes of understanding and optimising learning and the environments in which it occurs'(Long and Siemens 2011, p. 34). These big data analytics affordances have greatly extended the suite of approaches in the review. This review proved itself to be a successful application of digitalisation in higher education 'beyond simply transferring offline courses into the online world', as described in Chapter 1.

The study, which was conducted in a university in Hong Kong, describes an internal curriculum review of an academic English programme led by the faculty in the English Language Centre. The review was in addition to the routine QA procedures implemented for academic English courses in the centre. The courses under review were designed to form a pathway of academic English learning for students who had newly entered the university. Three levels of academic English courses were offered according to students' English scores from the Hong Kong public university entrance exam. Each student in the university was required to take two language e-courses. Those with low scores are required to take Course A and Course B; those with average scores, take Course B and Course C; and those with high scores take Course C and an elective English course. Course A focuses on skills to prepare students for studying academic English, Course B focuses on basic academic English and Course C focuses on advanced academic English. These three courses were designed to enable students to experience a progression of their acquisition of academic English skills.

Curriculum Review in 2016

Four years after the commencement of the three-level course programme, the language centre undertook a comprehensive review of the programme (Chen 2018). The design of the review was based on O'Leary (2010), who asserts that effective quality assurance should explore views from all members of the stakeholder group, namely, the providers, the recipients and the wider community. Following this framework, the review collected views from subject leaders (the providers), faculty and students (the recipients) and local as well as overseas external examiners (the wider community). Multiple measures were adopted to examine objective artifacts in the programme, such as course and assessment materials, existing QA-loop documents (student and teacher feedback), as well as data from the

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university's learning management system (LMS) on student assessment and student and teacher engagement.

What We Did in 2016

Three review teams were formed for each of the reviewed courses. To explore various aspects of the subject materials and the course management, a wide range of methods were deployed. These included but were not limited to:

- Reviewing authentic data from the university's LMS including student assessment engagement data, students' interactions with course materials, student engagement/results in online summative assessments and teachers' engagement.
- A comprehensive review of the existing course documents: in-house teaching materials (students' and teachers' notes, assessments, QA-loop documents).
- Interviews: focus-group interviews with students who had taken the courses and semi-structured interviews with teachers who had taught the courses. Three types of teachers in the team were interviewed: experienced teachers who had taught the reviewed course for three to four years, new teachers who had taught the reviewed course for less than a year and teachers who had formally informed the timetable officer that they wished to stop teaching the course under review. Each interview was conducted by two teachers on the review team. No subject leaders participated in the interviews with teachers so that the latter could freely express their views without having to worry about any consequences their comments might incur.

All the information gathered from the review was triangulated to identify and merge common patterns that appeared in the documents.

What We Found in 2016

According to the review reports, Course A was 'hard to sell' to both students and teachers due to its perceived lack of challenge, so major revisions were required for both the course materials and the assessments. For example, teachers and students reported a lack of connection between Course A and Course B. To confirm this with the digital data, a multiple linear regression equation was established to explore the relationship between the overall grade for Course B Assessment One (BA1-Grade; an

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Table 11.1. *Independent variables for course A progression in 2016*

Course A in 2016	Unstandardised coefficients	*t
Assessment – Assessment components	Beta	
(Constant)	1.10	7.58
Grammar test	0.17	5.43
Prose writing – organisation	0.10	2.09
Prose writing – grammar	0.13	2.38
Digital story – content	0.08	2.06
Digital story – conventions	0.12	2.14

*Only independent variables that were statistically significant were reported.

in-class problem-solution essay writing assessment) and all the component grades of Course A. While the overall model was statistically significant (R^2 = 0.10, $p < 0.01$), it could only explain 10 per cent of the variance. The variance explained (R2) just met the threshold for 'small' based on a review by Plonsky and Ghanbar (2018) on L2 studies. Only five out of ten predictors were statistically significant (Table 11.1). It is important to note that the strongest predictor in the model was the grade for a Grammar Test (i.e., the first assessment for Course A in 2016; b=0.17, $p < 0.001$). This seemed to confirm that there was a lack of connection between Course A and CBA1 (assessment one of Course B).

The review reports on Course B concluded that it had 'all the right ingredients' that made it a success and thus only fine-tuning of the course materials was required. LA was conducted to further explore the strength of the e-learning component of the course. LA provides further empirical evidence to support whether there was an acceptable alignment between the course learning outcomes and the e-learning components (Foung and Chen 2019a). Student log data also revealed that students continued working on the e-learning activities even after meeting the course completion requirements of 60 per cent; and many continued with activities with the aim of obtaining as high a grade as possible. Visualisations of student log events showed that students engaged in goal-oriented behaviours (Chen and Foung 2020). This means that students set a goal for completing activities and made plans for meeting these goals. Digital data provided avenues for the curriculum team to understand the strengths of the course and this shed light on how materials could be tweaked.

The review reports also found that Course C was well-received by students, but some teachers held very different views, and revisions were

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needed for some parts of the course and assessment materials. First, students believed that some tasks for the e-learning component were too demanding (e.g., three 170-word reflections) while some other tasks were not helping them to learn. Learning analytics was conducted on the digital data to explore the correlation between the completion of the e-learning component and the assessment component grades. Using Pearson's correlation, the average of all correlation coefficients was 0.08 with the highest being 0.14. This suggests that there was no correlation between the e-learning components and assessment results. In other words, there was almost no relationship between e-learning components and assessed tasks. With both self-reported and digital data suggesting problems with the e-learning components, it was recommended that the e-component of the course be re-designed.

The 2016 curriculum review recommended that the e-learning components for Course C be redesigned to better align with the course outcomes, and the assessments of Course A be revised so as to better align with the first assessment of Course B. However, further analytics needed to be conducted to understand the impact of these enhancements.

What We Decided to Do Next

Three years after the programme review described above, a new team was formed to evaluate the effectiveness of the changes made as a result of the first review. This study included (1) revisiting the revised course and assessment materials, (2) interviewing teachers and (3) employing e-analytic data analysis to compare student performance before and after the review of the three courses.

Methodology

Research Design

The main study described in this chapter was primarily an impact study. It was designed to address practical needs and to understand how the curriculum was enhanced. A mix-methods approach was used to allow the curriculum team to understand the general impact through data analytics, whilst qualitative interviews captured how individual teachers interpreted the impact. In the current study, data analytics and interviews were first conducted independently with a general aim to understand the impact. After the data from both sources were analysed, more questions

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emerged, and further data analytics were conducted for a clearer understanding of the impact.

The retrieval of data for analytics was approved under the university's data governance framework and proper ethical clearance for the project was obtained from the university's ethics committee.

Data Analytics

Data analytics was conducted after retrieving all the data logs from the university LMS. The data analytics arrangements and procedures were informed by the practices used in the original review in 2016 to maximise comparability between data. Only Course A and C requires substantial review so the impact study will focus on only Courses A and C. The objectives are summarised as follows:

- A1. Course A: To investigate the association between Course A assessments and BA1-Grade (Course B Assessment 1 Overall Grade)
- A2. Course A: To compare the language performance in Course B assessments between students taking the course before and after the enhancements
- C1. Course C: To explore the correlation between scores in e-learning components and non-e-learning assessments
- C2. Course C: To compare the language performance in the final essay assessment between students who completed the e-learning language component satisfactorily and those who did not

Participants

The data log retrieved included data logs from 2,545 students. As they were retrieved directly from the LMS that included all students in the cohort, typical sampling principles did not apply. All three courses were taken by undergraduates at the research site in Hong Kong across disciplines, including engineering, applied science, business, health and social sciences, design and hotel and tourism. Students taking Course A obtained Level 3 in the Hong Kong Diploma of Secondary Education (HKDSE) English exam (equivalent to IELTS 5.45–5.65). Based on the university's ability-grouping policy, these students were assigned to take Course A, followed by Course B, to fulfil the language and communication requirement of their undergraduate studies. Students taking Course C obtained Level 5 or above in the HKDSE English exam (equivalent to IELTS 6.81+). Students taking this course in Semester 2 had completed Course

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B and needed to complete Course C to fulfil the same language requirement for their studies.

Data Processing, Screening and Cleansing

After retrieving the data, student results were tabulated. Students who did not complete the course, that is, those who had failed to complete one or more assessments, were removed from the data set. Course A's data set included all assessment component grades for Course A and students' corresponding BA1-Grade. Course C's data set included the overall completion rate for the e-learning component and all assessment component grades. All grading variables were put on a rating scale from 0–4.5 with all e-learning component scores ranging from 0–100 per cent.

To understand the language performance of students in Course C, a new grouping variable was created. Based on the assessment of the subject leader, only students who completed 75 per cent of all language components were considered to have completed the said components satisfactorily. Therefore, students who completed 75 per cent of all four language-related e-learning components were placed into one group and all the other students were in another group. This grouping variable was used for the two-sample independent t-tests for Course C.

Data Analysis

The quantitative data analysis strategies were derived based on strategies used in the review to maximise comparability. All statistical analyses were conducted using R (4.0.3). Normality was assessed with a visual inspection of a histogram. Alpha was set at 0.05.

Course A: To explore the association between Course A assessments and BA1-Grade, a regression line was established using all Course A assessment components as independent variables and BA1-Grade as the dependent variable. Multiple linear regression can help identify the association between variables (Frey 2018) and allow comparisons across models with the adjusted R2. To further explore the difference in language performance, independent t-tests were conducted with the language component scores of the two cohorts of students. Two sample independent t-tests were used to answer this question (Frey 2018).

Course C: To investigate the correlation between the e-learning components and the course assessments, all course assessment component scores and the e-learning overall score were subject to rounds of Pearson correlation tests. To determine whether students who completed the language e-learning component satisfactorily would perform better in their

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language assessment component, a two-sample t-test was conducted with the newly created grouping variable.

Teacher Interviews

Participants

Teachers who had taught any of the three courses in the 2015/16 academic year and again in the 2018/19 academic year were approached to voluntarily give feedback about how they felt the changes impacted the three courses. Three teachers were recruited for each course from the small pool of staff who had taught the course in both years.

Procedures

Nine teachers (T1–T9) were interviewed once each in English over a two-month period during the second semester of the 2018/19 academic year. A standardised open-ended format with minimal interviewer interaction was adopted to minimise undue influence (Martella et al. 2015).

Content Focus

Questions focused on teachers' experiences teaching one of the courses to better understand the effectiveness of the enhancements made as a result of the LCR review. Two to three questions each on specific enhancements were followed by an open-ended question inviting respondents to comment generally on the changes. Each teacher was given access to the set questions in advance of the interview.

Data Analysis

The interviews were audio-recorded, transcribed and analysed thematically by the interviewer using an inductive approach (Thomas 2006).

Results

Course A

After re-designing Course A, a stronger connection between its assessments and BA1-Grade (Course B's Assessment 1 Overall Grade) was expected. Both data analytics and interviews were conducted to explore the connection. Since the interview responses suggested that there was a potential impact on the language proficiency of students, supplementary analytics were conducted to understand the change of the students' language performance.

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Course A: Interviews

One key theme identified was how the enhancements affected the ability to cater to students' language proficiency needs. Two of the teachers interviewed about Course A (T1 and T2) felt that the shift in focus from language proficiency to process writing and speaking meant that the course neglected students' specific language learning needs. They felt that students doing Course A needed help with a wider range of language proficiency issues than those supported in the newer version of the course. T3 felt that whilst the amount, scope and pace of activities made the course 'too ambitious' for students with lower proficiency levels and included elements that may have been unnecessary for some, moving away from a grammar-focused approach was 'necessary' to help prepare students for academic writing at university. This need was echoed by T2. T1 added that the change from language skills to process writing 'lost the … essential thing that their language proficiency needs at this level'.

Course A: Data Analytics

To understand the connection between Course A and Course B, a linear regression equation was established. Similar to the analytics conducted in 2016, all assessment component grades in Course A were the independent variables and BA1-Grade was the dependent variable. Table 11.2 presents the model statistics and the estimates for predictors. While the model was considered adequate ($R^2 = 0.17$, $p < 0.01$) and it explained 17 per cent of the variance, only two predictors were statistically significant. In other words, after enhancements were implemented, the new model could explain only another 7 per cent. Even though there was a 7 per cent increase, the total variance explained is still considered 'small' based on Plonsky and Ghanbar (2018) (while a variance that explained 18 per cent would be considered 'medium'). It is interesting to note that the significant predictor was the grammar score of the new assessment; however, the beta value was smaller than the grammar test in the previous regression equation.

Because the teachers described a potential change in language ability, a further investigation was conducted to explore how language competence may have been affected. As Course A was revamped and it was not possible to compare the language scores between the two cohorts of students in Course A, a comparison was made between the two cohorts of students who progressed to Course B. Two two-sample t-tests were conducted on the language scores of the Course B written assessments, the 'In-class Problem Solution Essay' and the 'take-home Discursive Essay', among

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Table 11.2. *Predictors for course A progression in 2018*

Course A in 2018	Unstandardised coefficients	t[a]
Assessment – Assessment components	Beta	
(Constant)	1.32	6.23
Paragraph writing – grammar	0.14	1.97
Digital story – conventions	0.06	2.72

[a]Only independent variables that were statistically significant were reported.

the two cohorts of students, and these revealed a statistically significant increase for both the in-class problem-solution essay (by 0.13; $t\,[1138.8] = 4.73$; $p < 0.01$) and the take-home discursive essay (by 0.21; $t\,[1085.8] = 7.04$; $p < 0.01$) where a grade change of 0.5 denotes one grade change after the changes were made. This seems to refute the concerns teachers raised over the decreased focus on language proficiency in the revised version of Course A.

Course C

The review in 2016 showed that it was necessary to redesign the e-learning component of Course C to help develop students' language skills. Thus, an e-learning package with ten videos and online quizzes was designed and implemented. These quizzes and videos focused on four language-related components (hedging, complex noun phrases, sentence structure and academic style) and other learning goals of the course.

Course C: Data Analytics

One round of Pearson correlation analysis was conducted on all assessment component grades and the total scores in the e-learning component in order to explore the relationships between the variables. The average of all correlation coefficients was 0.21 with the strongest one being 0.38. The average of the correlation coefficients was considered weak with the highest coefficient being considered only moderate (Courtney 2018). While there was no strong relationship between the e-learning components and assessment scores, the relationships between them were stronger than those in the earlier review. This suggests that students in the current cohort may have found the e-learning components more relevant than their counterparts who had taken the course before the enhancements.

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To further explore the impact of the new e-learning components in language (ELL), comparisons were made between those who did well in the ELL and those who did not. Students who took Course C were divided into two groups: those who achieved 75 per cent in each ELL and those who did not. A round of independent sample t-tests was conducted on the language scores in the final essay assessment between these two groups showing that there was a statistically significant difference (0.19 out of 4.5; $t\ (74.33) = 2.63$, $p < 0.05$) between the two groups of students. This suggest that students who were more engaged in the ELL performed better in the language assessment components.

Course C: Interviews

Generally positive feedback was received regarding the changes to the e-learning component of Course C. One key theme emerging from the interviews was the increased value and relevance of the e-learning materials for students. All three interviewees (T7–T9) welcomed how the new e-learning topics were more closely related to the course content. T7 remarked that that the change from a previous, relatively ineffective reflective task that students tended to complete 'mechanically', to language tasks more closely related to the assessment, was advantageous. T7 felt that the new language-focused e-learning quizzes would help students develop their advanced academic English skills. Another benefit mentioned by T7 was the students' familiarity with the format of e-learning quizzes, as students had completed similar activities for the e-learning component of Course B and therefore did not need to 'readapt' to a new learning mode.

T9 remarked that the e-learning activities 'consolidate students learning throughout the entire course and help guide students to . . . achieve the course learning objectives and outcomes'. Conversely, whilst T8 noted that the new e-learning activities were more relevant to the course content than the previous reflective tasks, the teacher was unsure of their impact, given that they had observed students often leaving language-related tasks until just before the end-of-semester deadline. This suggests that the impact of the changes to the e-learning component of Course C may depend on student engagement.

Summary of Findings

To summarise the results, the improved Course A shows there was an empirically stronger relationship with Course B after the curriculum enhancements. Despite the teachers' concerns about the lack of language

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proficiency development in Course A, the analytics revealed that students in fact performed better in language assessment in the enhanced version. Analytics also showed the effectiveness of the newly implemented e-learning component in Course C, and this was echoed in the views of the interviewed teachers. Analytics did not rely solely on the results of e-learning component completion but included a range of components within Course C, such as language assessment performance and the actual scores in individual language tasks in the e-learning component.

Discussion

The findings presented above show how digitalised data was used in two important stages of the review – first, as one of the measures adopted in a comprehensive review of a new curriculum and, second, as part of an evaluation conducted three years later to explore the effectiveness of the changes made after the comprehensive review. In both reviews, digitalised data was shown to be of immense value in at least three ways.

First, the learning analytics of digitalised data in the comprehensive curriculum review provided inter- and intra-course information that could not have been obtained from other means of quality assurance, such as student and teacher surveys. From the inter-course investigation, LA indicated a lack of connection between two consecutive courses, the first of which was a pre-requisite that should have prepared the students for the second. From the intra-course investigation, LA showed good alignment between the e-learning components and students' achievement of learning outcomes in Course B and a lack of such alignment in Course A. These insights brought by LA can increase subject leaders' confidence and determination to make changes to their course materials and e-learning components after a curriculum review.

In the second stage of this study, LA showed a statistically significant increase in students' language grades after they took the revised pre-requisite course and also revealed a stronger connection between the same two consecutive courses that had shown a lack of connection in the first review. LA also demonstrated that there were significant differences in the assessment grades between students who completed 75 per cent of the revised e-learning components in Course C and those who did not. These findings reveal that the changes made to the courses according to the findings of the previous comprehensive curriculum review led to improvement in students' assessment grades and a more noticeable progression from one course to the next.

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A further advantage of using digitalised data lies in its effectiveness in confirming or refuting stakeholders' perceptions and concerns. Our interviews with teachers revealed their concerns about some of the changes to Course A, chiefly that the changes might have weakened students' language abilities. LA, however, showed the contrary, that students' language scores significantly increased, which should allay teachers' concerns. Teachers of Course C expressed a different feeling about their course from those who taught Course A, in that they felt the changes made to the e-learning component of Course C were appropriate and welcome. In this case, LA results supported these teachers' perceptions by showing a positive relationship between student engagement in the e-learning activities and students' course assessment grades.

Conclusion

The rapid rise in the availability of digitalised data in the age of e-learning allows the leveraging of such data to make evidence-based pedagogic decisions for timely improvements to learning and teaching. This study, which encompassed a comprehensive curriculum review and subsequent changes made to three language courses and their e-learning components, reveals the value of using LA to advise on course revisions. Through generating actionable insights, LA provides teachers with the confidence to prioritise change in their courses. When compared with teacher intuition and surveys, which rely on perceptions and memory, LA produces convincing evidence about the aspects of teaching or materials that work well and those that need revising. It also offers tools to evaluate the impact of those revisions. The use of digitalised data can be viewed as a significant addition to regular educational QA measures that gauges stakeholders' perceptions. Future studies may move from exploring digitalised data-supported processes to digitalised data-led initiatives.

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