At a glance: Blended learning for STEM at levels 3-6 during the COVID-19 pandemic and its implications for pedagogy and skills

This Collaborative Enhancement Project with Leeds College of Building and York College is focused on reviewing the student experience of blended learning during the lockdown periods. The research explores STEM subjects, which do not traditionally lend themselves to blended learning due to the significant practical elements required of students.

This summary document includes details from the research report, including key points from the background research, analysis and conclusions. Further details can be found in the full research report and the key findings document on the QAA website.

Literature review

- Detailed literature review of existing academic and evidence-based practice related to blended learning and curriculum development.
- Theories and models of blended learning development and a detailed overview of evidence-based research into the use of curriculum models and theories of learning.

Evidence around the successes and failures of blended learning presents a mixed picture:

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Blended learning could be more effective than either face-to-face or online learning used separately.	Achievement is higher among face-to-face learners due to increased interaction and reduced isolation.
Blended learning can also support the competences required for success in a digital and networked world including creativity, critical thinking, problem solving and productivity.	Inequalities exist among staff and students in terms of their ability to access and interact with blended learning technologies.

For blended learning to be successful, key barriers need to be identified and overcome.

Research aims

- Review the blended learning experience of students during the COVID-19 lockdown periods.
- Identify developmental activities that support improved progression from studying, into the workplace, with a focus on digital skills.

Research questions

- What impact did the COVID-19 pandemic during 2020 and 2021 have on students' access to further/higher education at Leeds College of Building (LCB) and York College?
- What were the positive aspects (value) of students' blended learning experiences?
- What were the negative aspects (barriers) of students' blended learning experiences?
- How could these barriers be reduced in future in order to enhance access and participation to blended learning?
- How could digital skills and knowledge be enhanced to support better progression into the workplace?
- What developmental activities and materials could be used to support this progression?

Methodology

Multiple case study approach using a purposive (non-probability) sampling technique of student groups from a range of:

- level three (full-time study programmes and advanced apprenticeships), through to level six (higher and degree apprenticeships) in science, technology, engineering and maths (STEM), construction and built environment subject areas

Data about student and alumni perspectives of blended learning during COVID-19 was generated from LCB and York College using a series of focus groups.

Results

Experiences of students at LCB and York College during the COVID-19 pandemic:

- The utilisation of learning management systems (LMS) and virtual learning environments (VLE) among teaching staff was inconsistent (often due to varying degrees of ICT literacy).
- Many students struggled with the technical aspects of studying STEM online (such as computer-aided design (CAD) and engineering maths).
- Students felt that units heavy on theory/legislation were the easiest to learn online, whereas practical sessions such as CAD and surveying were delayed until in-person teaching resumed
- Students struggled with motivation, isolation and access to a productive workspace, particularly at level 3.
- Access to employment varied significantly during the pandemic with full-time level 3 T-Level and BTEC students reporting significant anxiety around arranging work placements during the pandemic.

Positive and negative aspects of students' blended learning experiences

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The use of LMS and VLE provided more flexible learning opportunities and the ability to re-listen/re-watch recorded sessions, which in turn promoted greater reflection.	Inconsistent application of LMS and VLE software, delivery, ICT skills and teaching presence.
Students were positive and forgiving of the difficulties of quickly transitioning online.	The limitations of ICT and digital skills made it challenging for tutors to replicate in-person experiential learning that stimulates all of the senses.
Some students were able to develop the resilience to maintain social connections with peers and even preferred online learning due to convenience and reduced need to travel.	Some students felt it blurred the lines between home, work and education. Students appeared to suffer from a weaker sense of identity, lack of structure and co-presence which had a knock-on impact on motivation, social isolation, social networks and relationships.
In terms of providing individual support to students, evidence of one-to-one support was evident around mental health, maths support, and to facilitate enhanced social interactions.	There appeared to be a prevalence of behaviourist and theoretical approaches which showed that staff and students were surviving rather than thriving. This reinforces the danger that blended learning tools can be overused without thought for pedagogy.
	Home environments were not always conducive to blended learning and students reported finding the online delivery of maths for engineering particularly challenging, especially in managing the transition from level 3 to level 4.

In order to continue the adoption of blended learning across STEM subjects going forwards, developing innovative approaches rather than porting existing ones online will be critical.

Analysis

Analysis includes how the barriers to access and participation in blended learning identified by Boelens et al. (2017) could be reduced.

Barriers	What this would require	How this could be overcome/promoted/supported
Incorporating flexibility	Better incorporation of flexibility in BL provisions would require: • self-discipline from students • trust from staff and employers that those students have the motivation and resilience to take responsibility for their learning (mostly likely at academic levels 5 and 6).	• Flipped classrooms • Complementary training to improve ICT and practical skills • Reinforcing of key concepts from level 3 • Provision of onsite flexible study spaces beyond the classroom.
Stimulating interaction	Better stimulation of interaction in blended learning provisions would require buy-in from staff and students, some of whom spoke negatively about wanting such interaction in this study.	• Providing space for students to actively participate in sessions so that they don't feel they are disrupting the flow of the lesson • Focusing in-person delivery on the more technical and practical aspects of STEM subjects • Ensuring that the relationship between pedagogy, curriculum development and the implementation of online lessons is carefully planned.
Facilitating students' learning processes	Better facilitation of student's learning processes would require further development of successful staff-student relationships to promote openness, confidence and ICT literacy confidence among all concerned.	• Additional staff training and student support • Bespoke set of resources that tutors teaching similar practical/mathematical subjects could share.
Fostering an effective learning climate	Fostering effective learning climates would require on-site alternative study spaces to overcome difficulties around working from home and training to help students' development	Aside from the space itself, additional training and support could be provided for students to: • build resilience • support motivation • promote wellbeing. This could also be supported by regular opportunities for pastoral, mental health and learning needs support, both in-class and online.

The digital skills and knowledge gaps that students required more support with included:

- ICT literacy
- independent learning and critical thinking skills
- self-motivation and resilience
- self-directed software tutorials to complement learning in class for Revit and CAD
- fundamentals of engineering mathematics
- creating and maintaining professional networks.

Recommendations

In order to address this, two interventions are recommended.

1 The development of a linear CPD programme of 20 sessions for tutors to enhance their use of blended learning.

2 A non-accredited course on digital skills and employability for FE and HE students at levels 3-6 made up of 16 modules/tutorials that could be delivered in-person or online.

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