

Enabling peer-to-peer collaboration within online learning environments and virtual laboratories.

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Rationale and Background Context

I wish to articulate an informed perspective that will illustrate the opportunities and challenges afforded by digital technology, specifically within online and blended learning environments. There will be a particular focus on critical analysis and discussion afforded to variations on academic practice. This literature review will provide a foundation for future research into the emerging *cloud campus* within The University of Glasgow. I have previously described the *cloud campus* concept as a working definition, used to describe the node between located (face-to-face) learning and virtual learning through the use of digital technologies (Dunn, 2016:29). There have been similar constructs established by other academics in the past (Knowles, 1984; Kopp and Hill, 2008; Urban-Woldron, 2013). These constructs tend to be based on recognised theories of learning; for example, connectivism (Siemens, 2005) and the time-tested epistemological frameworks described by Piaget (1963) and Vygotsky (1978) through cognitivism and constructivism (including social- constructivism). This review will provide a synthesis of key papers and it will argue the case for peer-to-peer collaboration within virtual spaces. Specifically, it will argue for the use of technology to support such collaboration within online virtual learning environments and within physical learning spaces as newly defined ‘virtual laboratories’. The paper will present the arguments by illustrating the opportunities and challenges within teacher agency and in physical space design. I have adopted this stance following the discourse of my studies into this particular field of learning and teaching and as informed by the literature provided throughout the programme of study, to date. I have drawn upon aspects of communities of practice (where learning resides), student-centred learning and threshold concepts.

This review is important to my own academic practice, where I am responsible for digital learning and teaching within The School of Education. I am a reflective practitioner and I wish to continue to build and develop my teaching. This paper will be included in the emerging strategy for TELT within the College of Social Sciences. It will also contribute to a wider evaluation across the University of Glasgow, on the use of new TEAL (Technology Enabled Active Learning) spaces,

as part of the future campus-wide development and my involvement in Workstream 7 – designing new learning spaces. Although not within the immediate scope of this review, there will be some consideration given to the conditions that nurture digital culture within academic institutions. I have included this, as it is a fundamental principle that underpins the student experience (Dunn, 2013).

Aims and Objectives

The aim of this literature review is to explore emerging technologies that may support peer-to-peer collaboration within TEAL and online learning environments, seeking to establish the opportunities and challenges in adopting technology, whilst maintaining or improving the student learning experience. The specific objectives are:

1. To discuss aspects of peer-to-peer collaboration through technology, within learning and teaching in Higher Education;
2. To identify the opportunities and challenges that build the conditions for nurturing a culture of digital learning that may lead to improved student experiences within a TEAL space or a virtual laboratory.

Approach, Methodology and Design

The structure of this paper is designed to lead from broad concepts of digital learning into deeper understanding on the effective use of technology. The review has adopted a research protocol known as Rapid Evidence Assessment (REA). This review uses a systematic methodology that interrogates a range of evidence sources. These constitute the conceptual framework. The protocol includes search criteria, configured to seek out robust information from a range of sources. Typically, priority has been given to literature that draws conclusions from meta-reviews and from peer-reviewed material. Likewise, studies that used mixed methods will be considered valid, where the validity of qualitative and quantitative data can be verified. The full inclusion criteria have been omitted, but typically, adopted sources have been categorised into three spheres of influence; *technology enhanced learning and teaching*, *learning theories and collaboration*, and *technology enabled spaces* (both physical and virtual). All referenced material meets the requirements as set out in the review methodology.

Bibliography: Identified [Key] Literature

The available literature is extensive. The bibliography (Table 1) is not intended to be exhaustive but rather it offers an illustration on the key papers that have informed this literature review. Other

citations will be used to scaffold and synthesise the discussion and a full list of references has been included. Initially, a large number of papers were identified (n=48) from the REA process. The papers included here, have been narrowed down using the search protocols. They are the most appropriate and relevant to the aims and objectives of this review and they can be positioned within each sphere of influence.

Table 1: Key papers as identified from the REA.

Sphere of influence	Key literature used within this review
Technology Enhanced Learning and Teaching	Baepler, P., and Walker, J.D. (2014) Active Learning Classrooms and Educational Alliances: Changing Relationships to Improve Learning, <i>New Directions for Teaching and Learning</i> , 137. pp. 27-39.
Learning Theories and Collaboration	Dawley, L., and Dede, C. (2015). Situated learning in virtual worlds and immersive simulations. In J.M Spector, M.D. Merrill, J. Elenm and M.J. Bishop (Eds), <i>The Handbook of Research for Educational Communications and Technology</i> (4 th ed.). New York: Springer.
Technology Enabled Spaces	Fisher, K., & Newton, C. (2014) Transforming the twenty-first- century campus to enhance the net-generation student learning experience: using evidence-based design to determine what works and why in virtual/physical teaching spaces, <i>Higher Education Research & Development</i> , 33:5, 903-920

Synthesis: Analysis and Discussion

The integration of technology into our lives has changed the way that we work. The need for a broader understanding of technology has never been greater. Likewise, we also need to continue our efforts to deepen our knowledge of the technology that we use and to understand the technological, pedagogical knowledge that resides in learning (Dunn, 2017). Learners within Higher Education (HE) are starting to turn towards streaming media as a node for learning, where traditional search engines are no longer the norm and where learning resides in online systems (Siemens, 2006). This has bought around new pedagogies for emerging technologies. The facsimile approach to TELT is being challenged in many HE institutions and the University of Glasgow is no exception. The recent launch of the *consultation on learning and teaching* within the School of Education provides a catalyst to explore the equilibrium between pedagogy, policy and curriculum; empowering academic staff to truly reflect on *when, how* and *why* they should use digital technology. There are many misconceptions within digital learning and teaching

(Wheeler, 2015; Henderson and Romeo, 2015; Younie and Leask, 2013) and over the last twenty years or so, we have built a strong academic profession that is built upon a mutual understanding between disciplines, with more attention given to the multi-disciplinary approaches to teaching that we know are conducive to learning.

Baepler and Walker describe their research, which was focused on the interpersonal relationships between the learner and the teacher when using technology to support and enhance learning. They draw upon the work produced by Amedeo, Golledge and Stimson (cited in Baeplar and Walker, 2014) who develop a line of enquiry based upon the theory that the design of the learning space and the integration of technology will have a significant impact upon human level interaction. They call this theory an *educational alliance*, where the relationship between the learner and the teacher is directly related to the learning experience and to the outcomes that students achieve. This theory is based on the idea that the use of technology within these spaces can break down barriers that tend to divide teachers and learners within the traditional classroom environment. There are also intrinsic links to be made to self-esteem, self-determination and towards motivation. Baepler and Walker go on to cite key literature from Beichner et al. 2007; Brooks, 2011; Dori and Belcher, 2005 (cited pp.27). This teaching agency is also a common theme explored by other researchers. Younie and Leask place teacher and student interaction at the heart of their book on *Teaching Technologies* (2013), where they make wider connections to objectivism, pragmatism and interpretivism as a learning theory (Siemans, 2008; cited in Kopp and Hill, 2008). Essentially, it's recognised that the teacher facilitates learning through online nodes by setting out the conditions and activities that allow the learner to source reliable information, engage in the acquisition of knowledge and use social media or peer interaction to distribute knowledge. The report from the Open University on *Innovating Pedagogy* (Sharples et al, 2015) explores teaching, learning and assessment in post-school learning environments. It seeks to identify emerging trends that may impact upon teaching within the next ten years. Some of the key concepts within the paper illustrate scalability e.g. MOOCS (Massive Open Online Courses) and the pedagogy of online networking and social conversation. Interestingly and perhaps more relevant to this paper, there is some discussion around *rhizomatic learning*, a term used to describe peer-led curriculum design and the modes in which students can engage with learning content. It is suggested that this approach to student-centred learning works best when learning becomes seamless. That is, when learning is connected across multiple locations and within different time zones. This style of asynchronous learning allows the student to access content at a time appropriate to their needs; ergo, it is an underlying principle within the flipped classroom approach – a pedagogy that has been widely adopted within virtual learning environments.

These constructs tend to require a BOYD (Bring Your Own Device) or BOYT (Bring Your Own Technology) policy. Crucially, they also require academic staff to adopt their use within the located learning environment, where the conditions allow for a dynamic digital culture to thrive. This culture needs to allow further development for digital leadership, training, support and resource / infrastructure building (Dunn, 2016). It is central to the on-going curriculum development within HE and these kinds of teaching methods lead to institutional improvement where threshold concepts could open up new ways of thinking about solutions to the erected barriers to learning (Glisczinski, 2007). One such barrier exists in fair access to specialised labs and resources on campus. This is particularly apparent in the ongoing campus redevelopment within the University of Glasgow.

Where the focus is on intellectual cognition, procedure and conceptual understanding, laboratory work could be configured to run online, through virtual labs within a TEAL space (or remotely from another location) without the need to have physical and located interaction with the lab equipment. The teacher would require less time to set up the experiments and instead can spend more time supporting the learner. Fischbacher-Smith and Spaeth carried out some recent research into innovative pedagogies within other universities (2015). They discovered a range of principles that seemed to underpin the design of evolving learning spaces, to allow for better interaction between learners (peer collaboration) and between the learner and the teacher. These can be described as:

- Active learning and technology-enabled spaces often replace passive listening;
- Class time is used for activities and problems rather than didactic teaching (the flipped classroom);
- The classroom is de-centred, facilitating two-way communication;
- Students work in teams, emphasising group work and enabling students to build relationships with one another (teacher facilitated learning). Cooperative learning techniques are not new within education and have been deployed at all stages of learning and in all disciplines. Group work is often used as an emotional trigger to enable discussion and collaboration in the classroom environment. Specifically, the integration of technology would provide an additional layer of resource that would allow the teacher to facilitate the learning, or to allow the student to facilitate this on their behalf (Dunn, 2012). Likewise, 'flipped' style teaching is becoming more popular, with evidence suggesting that it provides opportunities within timetabled sessions, for the students to interact and discuss key concepts and theories with their peers and with their tutor. Dunn once suggested that there is a fundamental difference between *teaching with technology* and *learning with technology* (2012). That is, the traditional norm or didactic style

interfacing with a class allows the teacher to control the equipment within a room e.g. the computer, projection system and so forth. Learning with technology requires a shift in culture and in practice, thus allowing the learner control over their portable devices, as and when required. It is an essential point to note that the literature suggests in most instances, that there is no 'silver bullet' with technology-enabled learning. Rather, the experience must be personalised and tailored to each individual and their immediate learning need. Students are more likely to watch podcasts using a plethora of technologies. There is a fine line between formal timetabled sessions and study and this is now reflected in the design and management of space. For example, the physical learning environment must support a variety of activities to include formal teaching input and breakout areas for group discussion, as well as for individual study. Each area must be enabled for wifi and system connectivity, to a range of devices that can be separated into their component parts or pulled together for whole class discussion. This type of arrangement would allow for a multi-purpose learning space that produces access to virtual labs as well as to the traditional seminar style teaching that already exists within HE. This would prove attractive to the institution where physical space is at a premium and the use of real lab equipment can be expensive. There have been studies on TEAL spaces and virtual labs where the conclusions of such work seems to indicate that there are many opportunities to be afforded by these types of technology enabled environments (Sauter, et al. 2013; Fisher and Newton, 2014). The literature also points towards the use of digital technologies as a means of accessing the online resources through a virtual learning environment as part of teacher professional development (Simao, et al. 2014; Singer et al. 2014; Zacharia et al. 2015; cited in Sharples, et al. 2015).

One area yet to be fully explored within HE, is the application of portable and wearable technology through augmented and virtual reality. Although this is a significant research area within the gaming industry, there has been very little study into the academic application and potential within subject disciplines (Dawley and Dede, 2015). This is an obvious avenue of exploration in further developing TEAL spaces in the future. It is also a crucial aspect in designing and delivering virtual laboratories. Virtual worlds and simulated laboratories adopt immersive technologies that are readily available on the market and there are many affordances to be gained within education. Dawley and Dede describe the following emergent themes in their paper (2015:17-39).

- Identity exploration
- Communication and Collaboration
- Spatial Simulation

- Experiential Learning
- Assessment and Feedback

The opportunity to use data to track and monitor student performance is attractive. These technologies allow for innovative systems to do so, whereby students are able to log into a lab, perform experiments and complete an assessment under set conditions. The ability to create sophisticated algorithms to provide real time feedback would add real value to any such approach, enriching the student learning experience and closing the loop on assessment (Dede, 2012; cited in Dawley and Dede, 2015:40). These technologies do not come without their limitations and concerns. Academics often work in a learning and teaching culture that is traditional in nature, leaving little room or time on workload models to develop their knowledge and skills in virtual learning environment design (Dunn, 2016). There are many barriers regarding privacy, infrastructure, training, resource and scalability that are yet to be addressed, as are issues related to staff and student dispositions and attitude, commonly seen in relation to social communications tools and online media (Dunn, 2013; Dawley, 2009). The use of virtual laboratories within TEAL spaces can be tied to theories of learning and also to evidenced strategies for instructional design. Pedagogical models that provide learners with an identity, a rich narrative that includes embodied participation and virtual observations for triangulation and assessment, are apparent. They also exist beyond teaching and can be deployed into research, where design-based methodologies are used to establish theoretical frameworks. Virtual spaces are already used to capture dialogue, knowledge exchange and to record data analysis through cloud based services. Situated learning is an essential component in any lesson design. Brown, Collins and Duguid (1989) argue that learning is a product of the context, culture and applied activity in which knowledge is exchanged. This would imply that any adoption of virtual technologies to support learning, would need to include social collaboration tools to support a community of practice or forum whereby learners can work together, thus applying the principles of social constructivism as mentioned previously within this literature review. Brown *et al* describe a context where shared cognition or apprenticeship forms a core within a community, thus allowing a novice to learn from an expert in the applied domain. This, it could be argued, forms the *educational alliance* also described by Baeplar and Walker (2014). There is a generally accepted norm that the majority of learning resides within a community (Leve and Wenger, 1991) and this norm exists within theories of connectivism, where there is interaction between people or between nodes of learning. There needs to be an opportunity for learners to exchange discourse with their peers and with their tutors, so that concepts and ideas can be explored in a safe environment. This is how HE works in traditional, located settings. The use of immersive technologies is simply an extension to this norm.

Conclusion and Key Findings

This literature review set out to explore emerging technologies that may enhance the student experience within TEAL spaces. The aim included exploration of peer-to- peer collaboration and the opportunities and challenges inherent within virtual laboratories.

Key findings from the literature can be summarised as follows:

1. There is a growing demand, need and expectation within HE (and the University of Glasgow) to adopt more generic, flexible learning spaces and less specialised teaching facilities.
2. New learning spaces need to be technology-enabled and bring diverse infrastructure that allows students to engage in blended learning.
3. The pedagogies adopted within these new spaces must be grounded within theories of learning; it is widely recognised that there are many advantages that can be afforded by technology.
4. Technologies are not confined to any specific manufacturer but there is less focus on tablet computers and an increasing emphasis on exploring virtual and augmented reality via immersive resources.
5. There continues a plethora of institutional barriers – specifically, barriers that reside within teachers and learners (personal dispositions) and those associated with digital culture across the institution: leadership; people; support; infrastructure and resource.
6. Peer collaboration within TEAL spaces and as part of the emerging pedagogy within virtual labs is an essential component in the learning process and in the future design of the student experience.

There are also wider considerations to be made in the use of such technology-rich collaborative experiences. The graduate attributes encompass both professional and personal characteristics and the sense of community and belonging within online learning environments and virtual laboratories needs to be carefully mapped out. It needs to be taken seriously, as it follows a future trajectory within HE that is under scrutiny in every academic institution. There is a clear argument that peer-to-peer collaboration exists in all communities of practice and that it is a core design principle within online learning spaces, however we have yet to determine the basic principles of cooperative learning when modality is asynchronous.

The range of literature available allows one to be selective in determining a line of argument,

however the majority of localised studies can be traced back to origins from institutions such as the Massachusetts Institute of Technology, where the early development of blended learning and virtual laboratories were tested under robust conditions (Fisher and Newton, 2014). The argument made within this review is not new, but it does illustrate an evidence informed perspective that has been derived from critical reflection of the available literature, which has been sifted through the REA search protocol and methodology. A common thread within all the papers read, explores the student learning experience as central to any pedagogy established through peer-to-peer collaboration within online learning environments and virtual laboratories.

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