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Technology Enhanced Learning in Higher Education: How to Enhance Student Engagement through Blended Learning

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1 **Abstract**

2 Blended learning has risen in popularity over the last two decades as it has shown to be an
3 effective approach for accommodating an increasingly diverse student population in Higher
4 Education as well as enriching the learning environment through the incorporation of online
5 teaching resources. The act of blending significant elements of the learning environment such as
6 face-to-face, online and self-paced learning leads to better student experiences and outcomes, and
7 more efficient teaching and course management practices if combined appropriately. For this
8 reason, an appropriate systematic and dynamic approach of blended learning design is crucial for
9 a positive outcome starting with planning for integrating blended elements into a course followed
10 by creating blended activities and implementing them. Evaluating their effectiveness and knowing
11 in which environments they work better and finally improving the blended activities designed
12 from both the student's and instructor's perspective is critical for the next delivery of the course.
13 This work aims to provide useful examples and increase awareness of Higher Education educators
14 about how traditional face-to-face learning can be transformed into blended courses with the aim
15 of increasing student engagement with both in-class and online approaches while being time
16 effective for the instructor.

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1 **Technology enhanced learning in Higher Education: The European landscape**

2 Teaching and learning in Higher Education are changing dramatically, and the landscape is
3 constantly evolving. Apart from the ubiquity of digital technologies, many factors are responsible
4 for the revolution at the Higher Education level such as an increasingly diverse student population,
5 high demands on skilled workforce and the need for more flexible learning environments due to
6 continued study throughout people´s working life. In Europe, the ecosystem of Higher Education
7 is constantly changing and growing with changes driven by the influx of students from emerging
8 economies such as China and India which counteracts the declining numbers of 18 year olds in
9 Europe (Organisation for Economic Cooperation and Development, 2018).

10 Even though each EU country is responsible for its own education and training systems, the EU
11 policy has designed a framework for cooperation in education and training (ET 2020) with the
12 aim to overcome common challenges such as skill deficits in workforce, global competition and
13 technological developments.Through the Bologna Process, Europe has been making a significant
14 effort in two major fields: i) the modernisation and assurance of high quality standards of
15 education and training systems to meet the needs of a changing labour market and ii) the
16 harmonisation of Bachelor, Master and Doctorate degrees across EU countries through the
17 reinforcement of learning mobility in order to develop professional, social and intercultural skills
18 and enhance employability (The Bologna Process, 2017). In May 2017, the EC has identified four
19 key goals that need effective implementation in Higher Education such as: promoting excellence
20 in skills development, building inclusive and connected education systems, supporting effective
21 and efficient systems and ensuring that Higher Education institutions contribute to innovation
22 (The Bologna Process, 2017). The implementation of digital technologies in Higher Education
23 institutions is crucial as determines in a great extent the efficiency and effectiveness of the
24 teaching systems which correlates to innovation. However, the implementation of digital
25 technologies in Europe has been slower compared to other countries such as the United States and
26 Japan. One of the reasons is that the total investment in Higher Education in Europe is lower (1.3
27 % of GPD on average, although there are substantially differences between countries) compared
28 to 2.7% in USA, 4.6% in Canada, 3.8% in Australia (OECD, 2018) or 1.5% in Japan (Governance
29 and Funding in Higher Education in Europe, 2017). The EC has identified an urgent need to boost
30 digital skills and competences in Europe and thus it has recently published a Communication on
31 Opening Up Education in which a framework for enhancing learning and teaching through new
32 technologies and open digital content at all levels of education was set up (European Commission,
34 2017).

1   Ignoring the potential impact that innovative teaching technologies can have on the quality of
2   Higher Education is not an option and this was reflected in the   EC published a report on "New
3   modes of learning and teaching in Higher Education" in 2014 to respond to the current challenges
4   and embrace the use of new technologies for European Higher Education institutions by making
5   thirteen policy recommendations (European Commission, 2017). Three recommendations   were
6   specially relevant on technology enhanced learning in Higher Education and involve   the
7   following: i) *The EC should support Member States in developing and   implementing*
8   *comprehensive national frameworks for diversifying provision and integrating new modes of*
9   *learning and teaching across the higher education system*",   ii)"*The integration of digital*
10 *technologies and pedagogies should form an integral element of Higher Education   institutions'*
11 *strategies for teaching and learning"* and iii)"*All staff teaching in Higher Education institutions*
12 *should receive training in relevant digital technologies and pedagogies as part of initial training*
13 *and continuous professional development*".

14 Considering the above policy recommendations and our experience in teaching in Higher
15 Education, we provide in this manuscript useful examples timely effective and easy to implement
16 in a day-to-day basis with the aim of increasing awareness of educators about how traditional
17 face-to-face learning can be transformed into blended courses in order to enhance the quality of
18 teaching and enhance student engagement both with in-class and online approaches. Additionally
19 we propose five points for action that can be easily taken up educators in Higher Education.

20 **Technology Enhanced Learning in Higher Education through Blended Learning**

21 Blended learning evolved from distance and open education movements and the development of
22 online or e-learning has risen in popularity over the last two decades as an effective approach for
23 accommodating an increasingly diverse student population as well as enriching the learning
24 environment through the incorporation of online teaching resources. However, there is an ongoing
25 debate about the definition of blended learning which have led to different understandings and a
26 variety of diverse approaches of the concept (Alammary, Sheard, & Carbone, 2014). One of the
27 most accurate definitions of the term was constructed by Krause, in 2007, describing blended
28 learning as those teaching and learning environments where there is an effective integration of
29 different modes of delivery, models of teaching and styles of learning as a result of adopting a
30 strategic and systematic approach to the use of technology combined with the best features of
31 face-to-face interaction (Krause, 2007).

32 The effective and integrating use of Information and Communication Technologies (ICT) into
33 course design is key to enhance the learning environment for both students and teachers by
34 enabling them to engage in ways that would not have been feasible in their primarily environment
35 (face-to-face or distance approaches) (Krause, 2007). The act of blending three significant

1   elements of the learning environment such as face-to-face, online learning and self-paced learning

2   leads to better student experiences and outcomes, a key metric for prospective students while   it

3   can lead to more efficient teaching and course management practice when combined appropriately

4   (Tayebinik & Puteh, 2012).

5   The face-to–face learning can be blended with both synchronous and asynchronous online

6   approaches (Figure 1). The asynchronous learning is based on a flexible self-paced learning where

7   students complete the work when and where they decide to do it with no time limits (Hrastinski,

8   2008a). Different teaching activities are included within this type of learning such as journals,

9   videos, discussion forums such as Wikis, and blogs. This type of learning has a very positive

10   impact on the overarching learning for most courses and especially for self-motivated learners as

11   they can spend more time refining their contributions which generally increases its quality

12   (Hrastinski, 2008b). However, one of the major disadvantages of this approach is a reduced

13   engagement as a consequence of feeling disconnected from the group. For this reason, the

14   synchronous e-learning such as videoconferences and webinars can be a more powerful tools   in

15   several circumstances. First of all, they are still flexible allowing a greater accessibility than face-

16   to-face courses as the student decides where to study; secondly, they are more cost-effective and

17   overcome physical barriers as questions can be asked and answered in real time allowing e-

18   learners to feel like participants more than isolates and to obtain immediate feedback while

19   collaborating with the instructor and other peers (Hastie, Hung, Chen, & Kinshuk, 2010).

20   **Figure 1**. **Blended learning environment.**

21   As described by other authors (Garrison & Kanuka, 2004; Osguthorpe & Graham, 2003), the key

22   factor is to find the "harmonious balance" of "thoughtful integration" between face-to-face   and

23   online components, and therefore, the process of designing blended courses is critical   involving

24   a great deal of planning and forethought. Good practice in blended learning does not imply

25   combining a wide range of technologies for a specific course but to use a few tools in   effective

26   ways in order to achieve quality in teaching, learning and course management.

27   Three major approaches have been followed when designing blended learning courses: i) just

28   adding some extra activities to an existing course (low-impact blend), ii) replacing traditional

29   activities with blended activities in an existing course (medium-impact blend) and iii)   building

30   the blended course from scratch (high-impact blend) (Alammary et al., 2014). A course can

31   involve blended approaches on "time" when a face-to-face lecture is substituted by recorded

32   lectures, blended approaches to "people" when a lecturer is replaced with a virtual classroom, and

33   blended approaches to "place" where small in-class group tutorials are substituted by online

34   discussion forums, and blended "resources" combining or replacing traditional textbooks with

35   online readings (Bath & Bourke, 2010).

1   When developing and implementing a new blended course, the instructor faces two major
2   challenges: first of all, the correct blending of the four elements "time, people, place and
3   resources" and secondly, the extra time added to the instructor's working load to introduce extra
4   in-class and online activities. In this manuscript, we aim to increase the awareness of educators
5   about how traditional face-to-face learning can be transformed into blended courses in a feasible
6   and timely effective manner by making use of ICT and we propose five points of action that can
7   be implemented by educators of Higher Education. As in a standard Higher Education setting, the
8   instructor's role can be summarised in delivery of face-to-face classes, designing and marking
9   assessments (formative and summative) and providing written extra material for student self-
10 paced studying. We propose blended learning approaches that can be incorporated at different
11 instructor levels such as the introduction of audience response systems (ARS) as an in-class tool
12 to promote student engagement which are easy to implement and can be considered as high impact
13 approach on "people", the incorporation of self and peer-assessment (blended activity on people
14 and place usually with high impact) over the classical student evaluation systems, flipped
15 classroom methodologies as a medium impact blended approach on time, people and place and
16 the uploading of lecture recordings as extra material designed to enrich self-paced learning (low
17 impact blended approach on time).

18 **In-class approach: audience response systems (ARS)**

19 Several studies (Bird, Osheroff, Pettepher, Cutrer, & Carnahan, 2017; Jones, 2007; Kitchen, 2012;
20 Michael, 2006; Qamar, Rehman, & Khan, 2016; Yoder & Hochevar, 2005) have demonstrated
21 the effectiveness of active learning in small group sessions in enhancing student learning and
22 performance. Nevertheless, promoting active learning in large size classes is by far more
23 challenging thus information are delivered in a traditional lecture format with reduced student
24 interaction which facilitates student focus on memory retention more than understanding, logical
25 thinking and solving problem (Gauci, Dantas, Williams, & Kemm, 2009).

26 Purpose-driven student response technology is proven to enhance key indicators of student
27 success including retention, motivation and attendance. In our era, mobile student response
28 preparedness is a fact (Nugent, 2015). Audience response systems (ARS) are a way to promote
29 an active learning environment in which the student can learn to reconstruct and synthesise the
30 new information and the prior knowledge into new knowledge and practice (Treesa & Jacksona,
31 2007). This tool is especially powerful for instructors teaching large or medium size-classes due
32 to its success in: i) monitoring students learning and understanding of content in real-time
33 allowing the identification of areas that should be revised and adjusting the pace of the course
34 appropriately and ii) providing students with immediate feedback to help them to monitor their
35 own understanding (Mellon, 2014). Additionally, ARS can be a powerful to assess student

1   satisfaction throughout and the end of the course, a metric that is taking into consideration by

2   many prospective students of Higher Education institutions.

3   Numerous studies (Beaumont, Gousseau, Sommerfeld, Leitao, & Gooi, 2017; Bode et al., 2015;

4   de Oliveira-Santos, Tirapelli, Rodrigues, Domaneschi, & Caldeira Monteiro, 2017; Grzeskowiak,

5   Thomas, To, Reeve, & Phillips, 2015; Mains, Cofrancesco, Milner, Shah, & Goldberg, 2015;

6   Simmons, Cosio, & Lin, 2015) have shown that ARS have a positive influence on student

7   participation in class as well as conferences and seminars increasing in all cases student attention,

8   classmates' participation, interest and learning. However, this increase in student engagement due

9   to the use of audience response systems does not always translate in higher examinations scores

10   (de Oliveira-Santos et al., 2017; Grzeskowiak et al., 2015). Hence, it is crucial to use this system

11   accordingly and not rely exclusively on them to enhance student performance in assessments.

12   A major advantage of audience response systems is that they are user-friendly learning tools that

13   allow undertaking in-class test/surveys designed to increase student engagement by enabling

14   instructors and students to interact dynamically in a matter of minutes. There are different

15   strategies to implement this ICT. A wide variety of questionnaires (such as multiple choice,

16   extended matching questions, true or false, short answers) can be easily designed. During the

17   lecture, the instructor asks questions (e.g. to assess if the content of the lecture has been delivered

18   appropriately or if further revision of key concepts is required) and then the students answer

19   questions by means of a clicker or a web-enabled device like smartphones or laptops using a link

20   that the instructor facilitates. In a matter of seconds/minutes, the instructor can display the results

21   in real-time and discuss them with the students. Responses can be anonymous to encourage

22   student participation or can be recorded and fed into a continuous assessment marking scheme

23   (Hoekstra & Mollborn, 2012).

24   According to Boscardin & Penuel (2012), student engagement is promoted in diverse facets when

25   using this technology (Figure 2). Initially, student is engaged through participation in the test

26   followed by a prompt deeper thinking about the delivered content and answering the question that

27   the instructor has formulated. In this moment, the passive learner enters in an active learning cycle

28   where rational thinking and problem solving governs the environment rather than memory

29   retention (Hoekstra & Mollborn, 2012). Instantaneous feedback is the next key element that

30   determines the success of this technique as humans are by nature curious (Bode et al., 2015;

31   Hughes, 2014). The awakening student curiosity increases the search for an answer. Students at

32   this stage are more likely to be highly motivated to understand the answers facilitating the

33   internalization of knowledge. At the same time, the instructor benefits from the results as he/she

34   immediately knows which areas should be covered again and the process of reinforcement

35   learning starts.

1 However, the cost of implementing most of the existing technologies can be unaffordable in many

2 Higher Education institutions especially when an individual clicker is needed for each student

3 (Brady, 2012).

4 **Figure 2. Audience response systems aiming to increase student engagement.**

5 Several free tools are proposed below as an alternative to marketed proprietary audience response

6 technologies such as i-clicker (MacMillan learning, New York, USA) and turning   point

7 technologies (Turning Technologies, Arizona, USA) (Gousseau, Sommerfeld, & Gooi, 2016; i-

8 clicker, 2017, "Turning technologies, 2017). A free solution involves the use of Google Docs

9 Forms (Google, California, USA), when the instructors can send the students a link to a form they

10 have created in Google Forms (Brady, 2012; George, Dreibelbis, & Aumiller, 2013). The

11 requirements to use this learning tool are basically three: i) instructors should make   themselves

12 aware of new skills as they will need a Google account in order to create this form and knowledge

13 on how to create and modify forms; ii) students need a web-enabled device such as a smartphone,

14 tablet or laptop to access the form (with no need to create an account or log into a site) and iii)

15 good internet connection in the classroom to pull through all the responses together in a matter of

16 seconds.

17 The advantages of this technology are multiple (Brigham, 2014). It is easy to use and no

18 installation of any software is required. As a free tool, it can be implemented in a large   number

19 of schools, colleges and institutions at a very low price as no direct cost are involved and minimum

20 training is required. Additionally, there is no need for a base station, receiver or an   annual

21 subscription unlike other technologies in the market such as i-clicker technology where every

22 remote control necessary to answer the questions has a minimum cost of 45$ per student (i-

23 clicker., 2017). In addition, the Google Docs platform allows complete control over the   design

24 and ownership of the survey /questionnaire/ test and allows much greater integration into   other

25 technologies than other common survey tools such as Surveymonkey (California, USA) and

26 PollEverywhere (California, USA). Google Docs can be used for both synchronous   and

27 asynchronous audience response and polling, while being reliable to use even if other in-class test

28 are ongoing in nearby classrooms. Responses can be   tracked and saved as a spreadsheet which

29 makes it useful for both anonymous formative or summative assessments. The Forms can be

30 uploaded directly into Blackboard, Moodle or other educational software used by the institution

31 facilitating student access to the questionnaires. In figure 3, an example of the output of an in-

32 class multiple choice questionnaire from Google Doc Form is illustrated. The results are plotted

33 immediately in the spreadsheet which can be shown directly to the students allowing the instructor

34 to address any issues/concerns encountered with the content delivered.

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1 **Figure 3**. **Output of an example of a poll question answered by first year pharmacy**
2 **students via Google Doc Form**

3 Other free alternatives to clicker response systems which are similar in concept   to Google Doc
4 Forms are Kahoot! (Norwegian University of Science and technology, Oslo, Norway)   or
5 Socrative (MasteryConnect, Cambridge, USA). These allow posting of as many questions as the
6 instructor desires in a variety of formats. One of the formats "the space race" allows students   to
7 work both individually or in teams answering questions as rapidly as possible (Socrative, 2017).
8 GoSoapBox (Go Education, Chicago, USA) is another free learning tool available for gathering
9 instant feedback from student with unique features such as: i) the confusion barometer (which
10 allows students to define their status in terms of "I get it" or "I'm confused"), ii) the smart filter
11 (that searches for similar questions in order to avoid duplicates) and iii) the profanity filter (that
12 blocks inappropriate language from being posted in the backchannel) (Byrne, 2011).

13 However, a limitation of free ARS is that a collapse can occur in real time when collecting answers
14 by submitting forms from a large number of students (i.e. greater than 100) at the same time,
15 particularly if the web connection is not reliable. In this case the questionnaire can be utilised
16 before or after the lecture to assess the knowledge gained for the students and uploaded separately.
17 Results can be backed up into a spreadsheet and that can be uploaded into Blackboard/   Moodle
18 or any other equivalent platform in order to track student learning and facilitate the formative and
19 summative assessments by automatically saving the score of each student.

20 **Mixed approach: Self and peer-assessment**

21 The massification of higher education has impacted on both quality and quantity of interactions
22 between students and instructors (Ballantyne, Hughes, & Mylonas, 2002) and negatively impacts
23 on the ability of instructors to provide detailed feedback on student's work. In order to face this
24 challenge, contributing student pedagogy can be implemented encouraging the students to
25 contribute to their learning and the learning of others as well as to value the contributions of others
26 (Hamer et al., 2008). Using self and peer assessment tools, a great number of benefits can be
27 obtained for both instructors as their workload is reduced and students as they can gain a high
28 degree of individualised feedback (Luxton-Reilly, 2009). Moreover, these learning tools help
29 students to develop generic skills such as communication, lifelong learning and autonomy and
30 also, to develop a sense of community and forge a culture collaborative learning.

31 The effectiveness of using self and peer assessment to improve learning outcomes by providing
32 opportunities to practise, assess and provide feedback on students' attribute development has been
33 demonstrated by numerous studies (Duers, 2017; Fete, Haight, Clapp, & McCollum, 2017; Ihm,
34 Choi, & Roh, 2017; Khan, Payne, & Chahine, 2017; Luxton-Reilly, 2009; Moore, Westwater-

1   Wood, & Kerry, 2016; Willeya & Gardnera, 2010). However, some authors (Monroe, 2016;
2   Roberts, Jorm, Gentilcore, & Crossley, 2017), have highlighted some issues relating to self and
3   peer assessment in terms of the accuracy of the evaluation as it is not always reliable.

4   Students benefit from the analytical experience of evaluating submission against defined criteria
5   providing feedback on the assignments submitted by other peers. In order to make this technology
6   successful, it is crucial that the instructor plans the activity in advance and defines clearly the
7   learning outcome that will be addressed and the criteria that students should take into account
8   during the evaluation process, ie. Is it required that the submission meet the word count?, How
9   many marks are allocated into every question?, When is it considered that the question is fully
10 answered?, etc. Provision of model responses can be very useful and facilitates the evaluation
11 process itself as well as the comprehension of the subject.

12 The rationale behind this strategy is that the student should be able to master key concepts
13 fostering higher-ordered thinking skills when comparing their own ~~work~~ and their peers works
14 against criteria and standards set by the instructor. To provide an account of examples is highly
15 recommended. The assessment is more authentic and provides an open environment when
16 multiple answers are correct. A model answer including a marking scheme is also useful. After
17 this activity, a face-to-face tutorial can be arranged with those students that have faced problems
18 during the process. Actually, a large number of platforms have been designed in order to be highly
19 configurable and allow efficient implementation of self and peer assessment activities even in
20 large classes in a wide range of disciplines. Examples are: the i) SPARKplus (developed by
21 University of Technology Sydney, Australia) which is especially useful with large classes and
22 enables the feedback loop to be closed (Willeya & Gardnera, 2010); ii) PeerGrader (Peergrade
23 ApS, København, Copenhangen) with the advantage that allows students to submit an arbitrary
24 number of webpages and multimedia resources for review and also facilitates anonymously
25 communication between reviewers and author before the grades are allocated (Gehringer, 2000)
26 or iii) Web-SPA (developed by (Ho, Chang, Sung, & Chiou, 2003) which allows instructors to
27 configure the type of activity by configuring parameters such as setting a group or individual
28 assignment and defining the method of scoring by a rubric like discrete scale, percentage or no
29 scoring. Web-SPA uses a fixed workflow to progressively engage students in the activity and will
30 randomly present each student with examples of the best and the worst cases selected by other
31 group of students (Sung, Chang, Chiou, & Hou, 2005).

32 The flipped classroom (also known as inverted classroom) is another educational strategy that
33 combines self and peer assessment by introducing online activities before a face-to-face class, in
34 the form of reading materials and other artefacts (Figure 4). This teaching model, originated in
35 American Woodland Park High School and is nowadays highly implemented in Higher

1   Education. A flipped classroom involves the flipping over the traditional classroom teaching
2   structure (Anderson et al., 2001; Cheng-lin, 2015; Van Vliet, Winnips, & Brouwer, 2015) and in
3   this respect both autonomous and interactive group learning are combined. Outside the class, the
4   first stage of flipped classroom is initiated (autonomous learning). Students have to collect
5   information and recall theoretical concepts at home through computer-based   individual
6   instruction (i.e. video lectures, reading, quizzes, tutorials, practice exercises). Inside the class, the
7   second stage of this pedagogical method takes place (Interactive group learning). Students
8   discuss, analyse and evaluate the theoretical content learned and assimilated at home through
9   different activities that can include problem solving, answering (clicker) questions or quizzes,
10   peer instructions and debates.

11   Numerous studies (Ihm et al., 2017; McNally et al., 2016; Selvabarathi & Govindarajan,   2016;
12   Shi-Chun, Ze-Tian, & Wang, 2014) have shown that a flipped classroom methodology is able to
13   provide many advantages on active learning such as: improvement of critical   thinking,
14   interactions among peers and instructor, peer learning and tasks value, personalized learning
15   adapted to individual work rhythms, deeper learning of the subject, encouraging collaboration
16   skills, enhancement of students' protagonism of their own learning and also promoting centred-
17   learning and no centred-teaching. The flipped classroom can be invaluable to the teaching of
18   mathematics and statistics (a key graduate skill), as well as chemistry, biology and physics
19   principles that might need to be revisited for successful learning of first year students that are
20   increasingly entering Higher Education with a diverse range of qualifications.

21   Some authors (McNally et al., 2016; Selvabarathi & Govindarajan, 2016; Shi-Chun et al., 2014),
22   have also described several disadvantages and challenges associated to the practicality of this tool.
23   For example, computer and internet access are essential technological requirements in order   to
24   implement this methodology. Also, student resistance can be encountered as students need to be
25   motivated to participate in the activity and in this respect the educator might need the support of
26   all faculty members including the personal tutors. However, engagement with flipped classroom
27   activities can be monitored via learning platforms such as Moodle. Preparing flipped classroom
28   artefacts can be time-consuming for the instructor as more preparation is required to provide high
29   quality extra material for the students to access at the first stage of the flipped classroom.

30   **Figure 4. Flipped classroom model.**

31   **Enriching Self-paced Learning via Online Educational Resources: Lecture Recordings**

32   The recording of lectures is becoming a common practice in Higher Education institutions but are
33   not intended to replace in-class teaching lectures except for fully online courses. There are several
34   reasons behind its increasing popularity: i) recorded lectures is a cost-effective provision of

1   information; ii) the workload of the instructor can be reduced as the lecture recordings can be
2   reused for future reference, following semesters or courses and iii) the student learning is
3   facilitated especially when the content is difficult or highly technical, for students that have   not
4   been able to attend class and for those international students that are taught in languages other
5   than their mother tongues who can benefit from listening the recordings at their own pace
6   (Hadjianastasis & Nightingale, 2016; Krause, 2007; Oz, 2005).

7   An obvious concern is the fact that video lectures may encourage students to not attend live
8   lectures and only access the recordings instead (Maynor, Barrickman, Stamatakis, & Elliott,
9   2013). Surprisingly, some authors (Yoon, Oatesa, & Sneddona, 2014) have shown that a
10 significant number of students prefer live class rather than recorded lectures as the last ones   are
11 more superfluous and do not allow the possibility of interaction with the teacher and other fellow
12 students being perceived as a complementary resource. Apart from that, viewing a recorded
13 lecture takes as much or even more time as a live lecture. The use of recorded lectures   requires
14 improved and applied time management practices by students and caution on the part of the
15 academic staff involved ensuring high quality recordings. Actually, some authors (Bacro,
16 Gebregziabher, & Fitzharris, 2010; Johnston, Massa, & Burne, 2013) have shown no correlation
17 between the final grades and the usage of lecture recordings, while other authors (Johnston et al.,
18 2013) have demonstrated a correlation between poorer overall academic student performance and
19 access to recorded lectures.

20 The lecture recordings can be either created by the instructor or obtained from open educational
21 resources databases. On the one hand, there are several online tools to generate live streaming and
22 recording such as open broadcaster software (Github, California, USA) (Open Broadcaster, 2017)
23 which is a free and open source software or Camtasia (Techsmith, Michigan, USA)   (Camtasia,
24 2017) that allows a more advance customisation and editing of the recording content but requires
25 a subscription. One of the advantages of these technologies is that they are user-friendly and   do
26 not required high computer skills to create the recordings; however, the instructor workload can
27 be intense especially at the beginning till they become familiar with the technique.

28 On the other hand, recorded lectures can be obtained directly from open educational databases
29 such as Multimedia and Educational Resource for Learning and Online Teaching (Merlot II)
30 (Merlot II, 2017) or Open Educational Resources (OER Commons) (OER Commons, 2017).
31 Open educational resources (OER) have become new buzzwords in the globalization of education.
32 The aims of OER are to support open access to learning and teaching resources in the era of the
33 glocalization of higher education (Willemsa & Bossub, 2012). The new term "glocalization" has
34 been created to refer to the interplay between local, regional and global interactions showing the
35 overlapping among spheres of society, technology and the World Wide Web (Wellman,   2002).

1   The main advantage is that the material is ready to be used. However, it is critical that the
2   instructor identifies suitable resources for a specific activity of high quality tailored to the
3   intended learning outcomes necessitating that the instructor scrutinises the content   from
4   beginning to end.

5   **Reflections and recommendations for the future**

6   Higher Education is constantly changing with current technologies evolving and new
7   technologies constantly added to arsenal of educators (Bath & Bourke, 2010). Through the
8   Bologna Process, European countries are making a significant effort in the modernisation of
9   Higher Education institutions supporting effective and efficient systems in order to promote
10 excellence and employability of future graduates (The Bologna Process, 2017). The
11 implementation of digital technologies plays a key role within the teaching systems as correlates
12 with innovation and hence, traditional courses should be revised in order to ensure student
13 engagement ensuring better learning experiences.

14 Audience response systems are one of the most time effective ICT tools and are easy to implement
15 in a blended course. Apart from improving student engagement in class, they can serve as a track
16 record of student learning facilitating formative and summative assessments. Audience response
17 systems are powerful in assessing student satisfaction and providing a dynamic tool   for
18 responding to the student needs. Our recommendation regarding the use of this strategy is to start
19 by adding a couple of integrated questionnaires at the end of the class. Once, the educator   feels
20 more comfortable with the use of this technique, questionnaires can be displayed in a very
21 effective manner at the beginning and also in the middle of the class without endangering precious
22 face-to-face contact time that is limited. Additionally, in our experience, this tool has been very
23 useful to track student attendance in an indirect manner and significantly enhance student
24 engagement.

25 Self and peer assessment embraces the idea of teaching and learning and shifts the power balance
26 from the educator to the learner. Self and peer assessment can be applied to laboratory classes
27 effectively when combined with clear marking criteria for providing quick formative personalised
28 feedback while it remains an excellent tool for courses with a large number of students such   as
29 open online courses to reduce time constraints on the instructor for providing personalised
30 feedback. To overcome concerns of reliability of scores, it is crucial that the activity is   planned
31 in advance and students are provided with a well-defined criteria or self-assessment scheme.   A
32 good alternative is to combine both self and peer assessment within the same learning activity, so
33 the instructor has only to address cases in which the score between the self and the peer assessment
34 differs significantly (e.g. more than 10%).

1   The implementation of flipped classroom methodologies is more successful in scientific and
2   healthcare related courses prior to laboratory practicals or clinical workshops than traditional
3   face-to-face classes where theoretical concepts are delivered. Flipped classroom methodology can
4   be extremely useful to first year students especially as students enter Higher Education with varied
5   qualifications. For example mathematical skills, which are a pre-requisite for a variety of courses,
6   can be enhanced and harmonised by utilising good quality online material, videos, quizzes   and
7   workbooks, with which students can learn, revise and bring their knowledge and skills up to
8   speed, allowing classroom time to be spent in deepening   their learning through problem-based
9   activities. Planning a number of resources to make each lesson engaging and interesting (e.g.
10   videos, Camtasia videos, workbooks) and aligning that with online quizzes after every lesson can
11   help students to revise or grasp new concepts.

12   Finally, recorded lectures are considered as a low impact blended approach   on time. However,
13   their use is encouraged as although contradictory in terms of examination performance, they are
14   highly demanded by students and can be extremely useful for large-size classes especially when
15   a high number of international students are forming the student body that might not   necessarily
16   possess the language skills needed to fully cope with traditional lectures.

17   Before starting to modify any teaching course, a deep reflection based on previous experiences is
18   required. Implementation of the Shewhart cycle is recommended as it does not focused only   in
19   the initial intervention but also in the evaluation of the performed actions and future
20   improvements. This cycle (PLAN-DO-CHECK-ACT) illustrates how blended learning activities
21   can be introduced in classical teaching systems and help to better define different actions (Best &
22   Neuhauser, 2006; Shewhart, 1931) (Figure 5). The cycle involves four stages: i) "Planning" to
23   identify what can be improved and what changes are necessary; ii) "applying or doing" to
24   implement the design change; iii) "Checking or evaluating" to assess and measure the   outcome
25   and iv) "Improving or acting" when the results are not as hoped for (Best & Neuhauser, 2006). In
26   our experience, an extra "designing" step should be added especially when developing new
27   blended courses from scratch or improving an existing course (high-impact blend). As a   cycle,
28   this process is never ending and should be utilised to lead improvement in a continuous manner
29   during the instructors´ teaching life.

30   **Figure 5. Shewhart cycle for blended learning.**

31   Designing for blended learning requires a systematic and dynamic approach and it involves
32   planning for integrating blended learning elements into the course (i.e. which content is difficult
33   to deliver by using a traditional approach?, can blended activities make the process of   learning
34   easier?, which blended activities are more appropriate?) followed by creating the blended
35   activities (i.e. using some of the learning tools commented previously) and implementing them.

1 Evaluating their effectiveness in order to appreciate in which context they would work better (eg.
2 flipped classroom methodologies work usually better in smaller than in larger groups) can
3 improve significantly blended activities and serve both the student as well as the instructor's
4 perspective. Academic student performance and student feedback are key elements to bear in
5 mind when evaluating the effectiveness of new blended course.

6 We propose a five-point action plan:

7 1.   Consultation with staff based on student feedback and their experiences and with the
8   involvement of student representatives prior the development of a school/institute
9   blended teaching strategy.
10 2. Co-ordinate which blended approaches are more appropriate and feasible and develop a
11   blended learning platform.
12 3.   Support and facilitate blended learning needs in terms of finances and staff time while
13   considerations can be given towards appointing a blended learning co-ordinator.
14 4. Ensure policy is clear in copyright, contact hours and using open educational resources.
15 5. Educate staff on blended learning, offer demonstrations on how it can be applied and how
16   these digital technologies can be used in a time efficient and cost-effective manner while
17   ensure that their uptake is justified/explained to both staff and students.

18 **Conflict of interest**

19 Authors declare that have no conflict of interest or financial gain.

20

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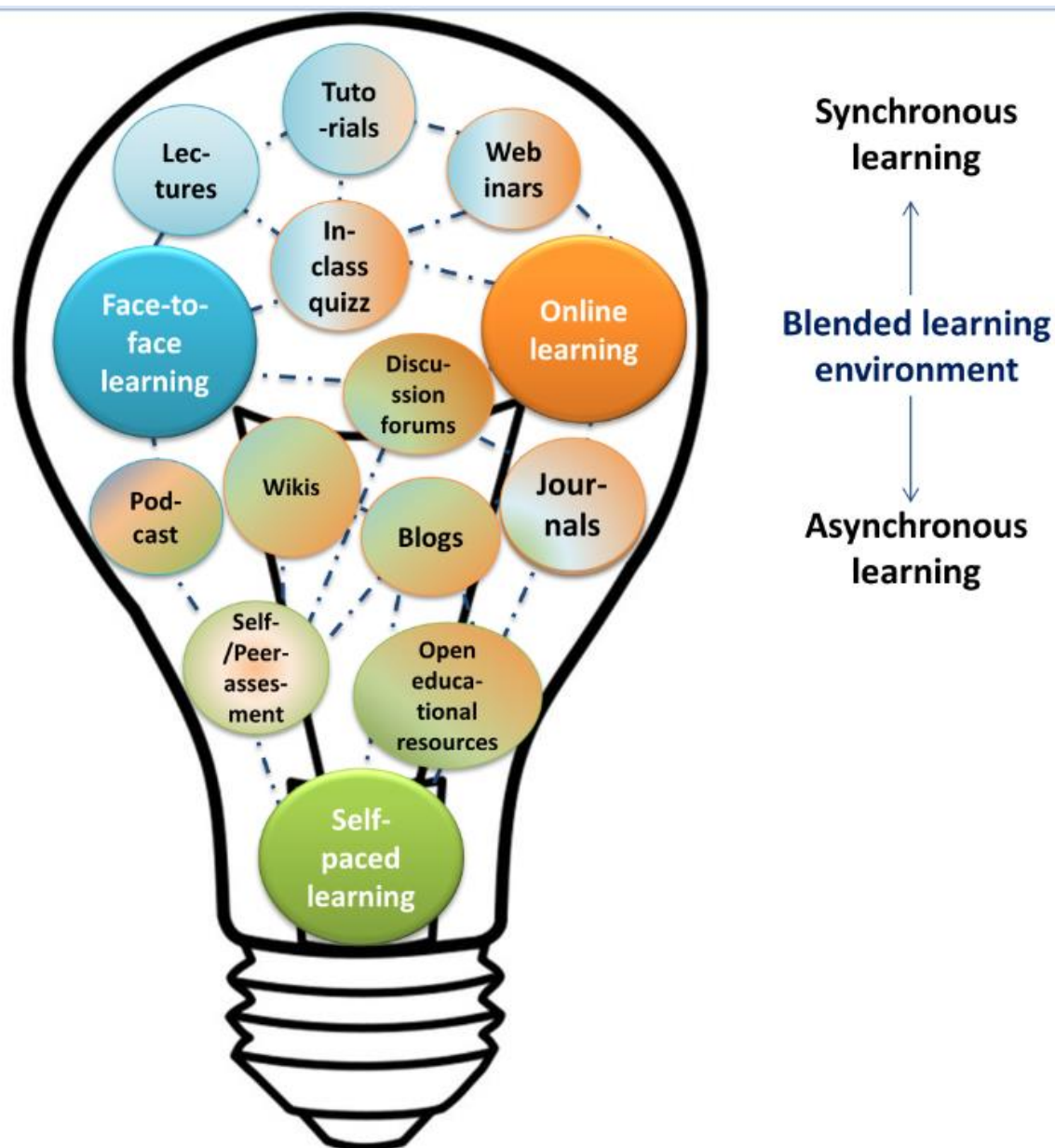
Figure 1

Figure 2

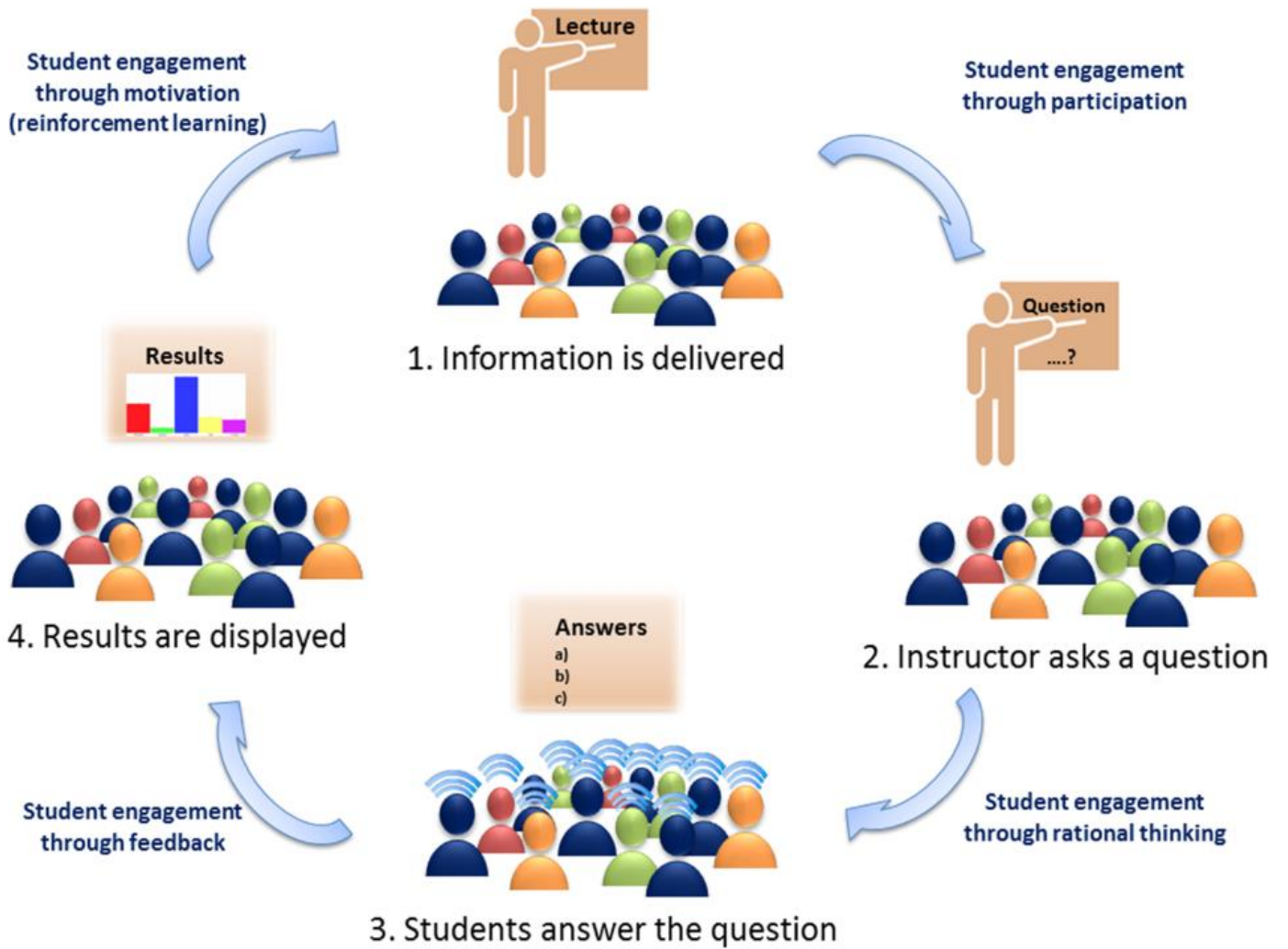Figure 3

Question 3. Which of the following terms is the opposite of viscosity?

Legend:
- a. Fluidity
- b. Strain
- c. Stress
- d. Compliance
- e. Don't know

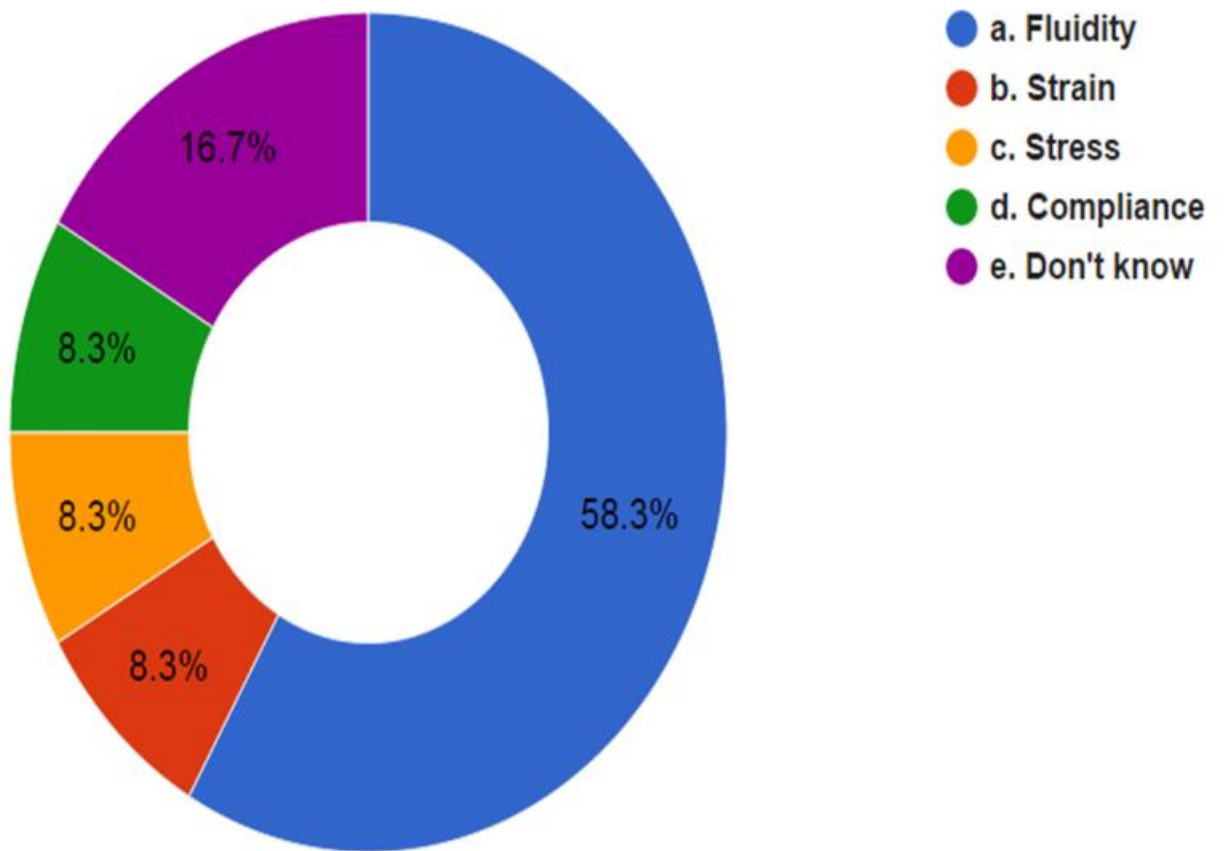Values shown: 58.3%, 16.7%, 8.3%, 8.3%, 8.3%

Figure 4

1) Outside class: Autonomous learning

Computer-based individual instruction:
- Video lectures
- Reading
- Quizzes
- Tutorials
- Practice exercise

2) Inside class: Interactive group learning

Classroom activities:
➢ problema solving
➢ answering questions
➢ peer instructions
➢ debates

Figure 5