# Technology Enhanced Learning in Higher Education:

## How to Enhance Student Engagement through Blended Learning

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**Abstract**

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

**Keywords:** blended learning, student engagement, in-class surveys, lecture recordings, open educational resources, Higher Education.

## Technology enhanced learning in Higher Education: The European landscape

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

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

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

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

## Technology Enhanced Learning in Higher Education through Blended Learning

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

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

elements of the learning environment such as face-to-face, online learning and self-paced learning leads to better student experiences and outcomes, a key metric for prospective students while it can lead to more efficient teaching and course management practice when combined appropriately (Tayebinik & Puteh, 2012).

The face-to–face learning can be blended with both synchronous and asynchronous online approaches (Figure 1). The asynchronous learning is based on a flexible self-paced learning where students complete the work when and where they decide to do it with no time limits (Hrastinski, 2008a). Different teaching activities are included within this type of learning such as journals, videos, discussion forums such as Wikis, and blogs. This type of learning has a very positive impact on the overarching learning for most courses and especially for self-motivated learners as they can spend more time refining their contributions which generally increases its quality (Hrastinski, 2008b). However, one of the major disadvantages of this approach is a reduced engagement as a consequence of feeling disconnected from the group. For this reason, the synchronous e-learning such as videoconferences and webinars can be a more powerful tools in several circumstances. First of all, they are still flexible allowing a greater accessibility than face-to-face courses as the student decides where to study; secondly, they are more cost-effective and overcome physical barriers as questions can be asked and answered in real time allowing e-learners to feel like participants more than isolates and to obtain immediate feedback while collaborating with the instructor and other peers (Hastie, Hung, Chen, & Kinshuk, 2010).

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

As described by other authors (Garrison & Kanuka, 2004; Osguthorpe & Graham, 2003), the key factor is to find the "harmonious balance" of "thoughtful integration" between face-to-face and online components, and therefore, the process of designing blended courses is critical involving a great deal of planning and forethought. Good practice in blended learning does not imply combining a wide range of technologies for a specific course but to use a few tools in effective ways in order to achieve quality in teaching, learning and course management.

Three major approaches have been followed when designing blended learning courses: i) just adding some extra activities to an existing course (low-impact blend), ii) replacing traditional activities with blended activities in an existing course (medium-impact blend) and iii) building the blended course from scratch (high-impact blend) (Alammary et al., 2014). A course can involve blended approaches on "time" when a face-to-face lecture is substituted by recorded lectures, blended approaches to "people" when a lecturer is replaced with a virtual classroom, and blended approaches to "place" where small in-class group tutorials are substituted by online discussion forums, and blended "resources" combining or replacing traditional textbooks with online readings (Bath & Bourke, 2010).

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

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

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

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

satisfaction throughout and the end of the course, a metric that is taking into consideration by many prospective students of Higher Education institutions.

Numerous studies (Beaumont, Gousseau, Sommerfeld, Leitao, & Gooi, 2017; Bode et al., 2015; de Oliveira-Santos, Tirapelli, Rodrigues, Domaneschi, & Caldeira Monteiro, 2017; Grzeskowiak, Thomas, To, Reeve, & Phillips, 2015; Mains, Cofrancesco, Milner, Shah, & Goldberg, 2015; Simmons, Cosio, & Lin, 2015) have shown that ARS have a positive influence on student participation in class as well as conferences and seminars increasing in all cases student attention, classmates' participation, interest and learning. However, this increase in student engagement due to the use of audience response systems does not always translate in higher examinations scores (de Oliveira-Santos et al., 2017; Grzeskowiak et al., 2015). Hence, it is crucial to use this system accordingly and not rely exclusively on them to enhance student performance in assessments.

A major advantage of audience response systems is that they are user-friendly learning tools that allow undertaking in-class test/surveys designed to increase student engagement by enabling instructors and students to interact dynamically in a matter of minutes. There are different strategies to implement this ICT. A wide variety of questionnaires (such as multiple choice, extended matching questions, true or false, short answers) can be easily designed. During the lecture, the instructor asks questions (e.g. to assess if the content of the lecture has been delivered appropriately or if further revision of key concepts is required) and then the students answer questions by means of a clicker or a web-enabled device like smartphones or laptops using a link that the instructor facilitates. In a matter of seconds/minutes, the instructor can display the results in real-time and discuss them with the students. Responses can be anonymous to encourage student participation or can be recorded and fed into a continuous assessment marking scheme (Hoekstra & Mollborn, 2012).

According to Boscardin & Penuel (2012), student engagement is promoted in diverse facets when using this technology (Figure 2). Initially, student is engaged through participation in the test followed by a prompt deeper thinking about the delivered content and answering the question that the instructor has formulated. In this moment, the passive learner enters in an active learning cycle where rational thinking and problem solving governs the environment rather than memory retention (Hoekstra & Mollborn, 2012). Instantaneous feedback is the next key element that determines the success of this technique as humans are by nature curious (Bode et al., 2015; Hughes, 2014). The awakening student curiosity increases the search for an answer. Students at this stage are more likely to be highly motivated to understand the answers facilitating the internalization of knowledge. At the same time, the instructor benefits from the results as he/she immediately knows which areas should be covered again and the process of reinforcement learning starts.

However, the cost of implementing most of the existing technologies can be unaffordable in many Higher Education institutions especially when an individual clicker is needed for each student (Brady, 2012).

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

Several free tools are proposed below as an alternative to marketed proprietary audience response technologies such as i-clicker (MacMillan learning, New York, USA) and turning point technologies (Turning Technologies, Arizona, USA) (Gousseau, Sommerfeld, & Gooi, 2016; i-clicker, 2017, "Turning technologies, 2017). A free solution involves the use of Google Docs Forms (Google, California, USA), when the instructors can send the students a link to a form they have created in Google Forms (Brady, 2012; George, Dreibelbis, & Aumiller, 2013). The requirements to use this learning tool are basically three: i) instructors should make themselves aware of new skills as they will need a Google account in order to create this form and knowledge on how to create and modify forms; ii) students need a web-enabled device such as a smartphone, tablet or laptop to access the form (with no need to create an account or log into a site) and iii) good internet connection in the classroom to pull through all the responses together in a matter of seconds.

The advantages of this technology are multiple (Brigham, 2014). It is easy to use and no installation of any software is required. As a free tool, it can be implemented in a large number of schools, colleges and institutions at a very low price as no direct cost are involved and minimum training is required. Additionally, there is no need for a base station, receiver or an annual subscription unlike other technologies in the market such as i-clicker technology where every remote control necessary to answer the questions has a minimum cost of 45$ per student (i-clicker., 2017 ). In addition, the Google Docs platform allows complete control over the design and ownership of the survey /questionnaire/ test and allows much greater integration into other technologies than other common survey tools such as Surveymonkey (California, USA) and PollEverywhere (California, USA). Google Docs can be used for both synchronous and asynchronous audience response and polling, while being reliable to use even if other in-class test are ongoing in nearby classrooms. Responses can be tracked and saved as a spreadsheet which makes it useful for both anonymous formative or summative assessments. The Forms can be uploaded directly into Blackboard, Moodle or other educational software used by the institution facilitating student access to the questionnaires. In figure 3, an example of the output of an in-class multiple choice questionnaire from Google Doc Form is illustrated. The results are plotted immediately in the spreadsheet which can be shown directly to the students allowing the instructor to address any issues/concerns encountered with the content delivered.

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

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

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

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

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

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

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

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

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

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

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

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

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

**Figure 4. Flipped classroom model.**

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

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

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

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

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

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

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

## Reflections and recommendations for the future

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

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

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

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

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

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

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

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

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

We propose a five-point action plan:

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

## Conflict of interest

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

## References


Alammary, A., Sheard, J., & Carbone, A. (2014). Blended learning in higher education: Three different design approaches. *Australas J EdTech, 30*(4), 440-454. doi:10.14742/ajet.693

Anderson, L. W., Krathwohl, D. R., Airasian, P. W., Cruikshank, K. A., Mayer, R. E., Pintrich, P. R., Wittrock, M. C. (2001). *A taxonomy for learning, teaching, and assessing: A revision of Bloom's Taxonomy of Educational Objectives (Complete edition). New York: Longman.*

Bacro, T. R., Gebregziabher, M., & Fitzharris, T. P. (2010). Evaluation of a lecture recording system in a medical curriculum. *Anat Sci Educ, 3*(6), 300-308. doi:10.1002/ase.183

Ballantyne, R., Hughes, K., & Mylonas, A. (2002). Developing procedures for implementing peer assessment in large classes using an action research process. *Assess Eval High Educ, 27*(5), 427-441. doi:10.1080/0260293022000009302

Bath, D., & Bourke, J. (2010). Getting started with blended learning. Griffith Institute for Higher Education. Retrieved September 12, 2017 from: https://www.dkit.ie/system/files/Getting%20started%20with%20blended%20learning%20Griffith%20University%20AU_0.pdf

Beaumont, A., Gousseau, M., Sommerfeld, C., Leitao, D., & Gooi, A. (2017). Mobile Audience Response Systems at a Continuing Medical Education Conference. *Stud Health Technol Inform, 234*, 24-28. doi:10.3233/978-1-61499-742-9-24

Best, M., & Neuhauser, D. (2006). Walter A Shewhart, 1924, and the Hawthorne factory. *Qual Saf Health Care, 15*(2), 142-143. doi:10.1136/qshc.2006.018093

Bird, E. C., Osheroff, N., Pettepher, C. C., Cutrer, W. B., & Carnahan, R. H. (2017). Using Small Case-Based Learning Groups as a Setting for Teaching Medical Students How to Provide and Receive Peer Feedback. *Med Sci Educ, 27*(4), 759-765. doi:10.1007/s40670-017-0461-x

Bode, S. F., Straub, C., Giesler, M., Biller, S., Forster, J., & Kruger, M. (2015). Audience-response systems for evaluation of pediatric lectures--comparison with a classic end-of-term online-based evaluation. *GMS Z Med Ausbild, 32*(2), Doc18. doi:10.3205/zma000960

Boscardin, C., & Penuel, W. (2012). Exploring benefits of audience-response systems on learning: a review of the literature. *Acad Psychiatry, 36*(5), 401-407. doi:10.1176/appi.ap.10080110

Brady, A. (2012). Alternatives to Physical Clickers in the Classroom. Retrieved September 12, 2017 from: https://blogs.princeton.edu/etc/2012/04/10/alternatives-to-physical-clickers-in-the-classroom/.

Brigham, T. J. (2014). Taking Advantage of Google's Web-Based Applications and Services. *Medl Ref Services Quart, 33*(2), 202-210. doi:10.1080/02763869.2014.897521

Byrne, R. (2011). Three Alternatives to Clicker Response Systems. Retrieved from: http://www.freetech4teachers.com/2011/10/three-alternatives-to-clicker-response.html#.VVsxEvlViko. *Free Tech Teachers*.

Camtasia [computer software]. Retrieved November 11, 2017 from: https://www.techsmith.com/camtasia.html.

Cheng-lin, H. (2015). A study about flipped classroom teaching support system design. *Eur J Res Reflect Ed Sci, 3*(1), 42-46.

de Oliveira-Santos, C., Tirapelli, C., Rodrigues, C. T., Domaneschi, C., & Caldeira Monteiro, S. A. (2017). Interactive audience response systems in oral and maxillofacial radiology undergraduate lectures. *Eur J Dent Educ*, 22(1), e63-e69. doi:10.1111/eje.12258

Duers, L. E. (2017). The learner as co-creator: A new peer review and self-assessment feedback form created by student nurses. *Nurse Educ Today, 58*, 47-52. doi:10.1016/j.nedt.2017.08.002

European Commission: "Opening Up Education". Retrieved November 11, 2017 from: http://europa.eu/rapid/press-release_IP-13-859_en.htm.

European Commission. Report to the European Commission on New modes of learning and teaching in higher education. Retrieved November 11, 2017 from http://ec.europa.eu/dgs/education_culture/repository/education/library/reports/modernisation-universities_en.pdf. Luxembourg: Publications Office of the European Union.

Fete, M. G., Haight, R. C., Clapp, P., & McCollum, M. (2017). Peer Evaluation Instrument Development, Administration, and Assessment in a Team-based Learning Curriculum. *Am J Pharm Educ, 81*(4), 68. doi:10.5688/ajpe81468

Garrison, D. R., & Kanuka, H. (2004). Blended learning: Uncovering its transformative potential in higher education. *Internet High Educ, 7*, 95-105. doi:10.1016/j.iheduc.2004.02.001

Gauci, S. A., Dantas, A. M., Williams, D. A., & Kemm, R. E. (2009). Promoting student-centered active learning in lectures with a personal response system. *Adv Physiol Educ, 33*, 60-71. doi:10.1152/advan.00109.2007.

Gehringer, E. (2000). Strategies and mechanisms for electronic peer review. *In Frontiers in Education Conference, FIE 2000. 30th Annual, 1, F1B/2–F1B/7 (Vol. 1). Kansas City, MO: IEEE.*

George, D. R., Dreibelbis, T. D., & Aumiller, B. (2013). How we used two social media tools to enhance aspects of active learning during lectures. *Med Teach, 35*(12), 985-988. doi:10.3109/0142159X.2013.818631

Gousseau, M., Sommerfeld, C., & Gooi, A. (2016). Tips for using mobile audience response systems in medical education. *Adv Med Educ Pract, 7*, 647-652. doi:10.2147/AMEP.S96320

Governance and Funding in Higher Education in Europe. Retrieved Novermber 11, 2017 from: http://ec.europa.eu/education/policy/higher-education/governance-funding_en.

Grzeskowiak, L. E., Thomas, A. E., To, J., Reeve, E., & Phillips, A. J. (2015). Enhancing continuing education activities using audience response systems: a single-blind controlled trial. *J Contin Educ Health Prof, 35*(1), 38-45. doi:10.1002/chp.21269

Hadjianastasis, M., & Nightingale, K. P. (2016). Podcasting in the STEM disciplines: the implications of supplementary lecture recording and 'lecture flipping'. *FEMS Microbiol Lett, 363*(4). doi:10.1093/femsle/fnw006

Hamer, J., Cutts, Q., Jackova, J., Luxton-Reilly, A., McCartney, R., Purchase, H., Sheard, J. (2008). Contributing student pedagogy. *SIGCSE Bulletin, 40*(4), 194-212. doi:10.1080/08993408.2012.727709

Hastie, M., Hung, I. C., Chen, N. S., & Kinshuk. (2010). A blended synchronous learning model for educational international collaboration. *Innov Educ Teach Int, 47*(1), 9-24. doi:10.1080/14703290903525812

Ho, H. T., Chang, K. E., Sung, Y. T., & Chiou, S. K. (2003). Web-SPA: A Web-Based Self/Peer Assessment System with multiple functions and friendly interface for teachers. In C. Crawford, N. Davis, J. Price, R. Weber & D. Willis (Eds.), Proceedings of SITE 2003--Society for Information Technology & Teacher Education International Conference. Albuquerque, New Mexico, USA: Association for the Advancement of Computing in Education (AACE). Retrieved November 19, 2017 from https://www.learntechlib.org/p/18222. pp. 1557-1560.

Hoekstra, A., & Mollborn, S. (2012). How clicker use facilitates existing pedagogical practices in higher education: data from interdisciplinary research on student response systems. *Learn Media Tech, 37*(3), 303-320. doi:10.1080/17439884.2011.568493

Hrastinski, S. (2008a). Asynchronous and synchronous E-learning. Retrieved November 12, 2017 from https://er.educause.edu/articles/2008/11/asynchronous-and-synchronous-elearning. *Educause Quarterly, 4*, 51-55.

Hrastinski, S. (2008b). The potential of synchronous communication to enhance participation in online discussions: A case study of two e-learning courses. *Inform Manag, 45*(7), 499-506. doi:10.1016/j.im.2008.07.005

Hughes, C. (2014). Awakening Student Curiosity. *OECD/CCR/Ecolint Character for a Challenging Century Conference at Geneva. Retrieved November 15, 2017 from: http://curriculumredesign.org/wp-content/uploads/Awakening-Student-Curiosity-Conrad-Hughes.pdf*, 1-17.

i- clicker Technologies. Retrieved November 15, 2017 from: https://www1.iclicker.com/.

Ihm, J., Choi, H., & Roh, S. (2017). Flipped-learning course design and evaluation through student self-assessment in a predental science class. *Korean J Med Educ, 29*(2), 93-100. doi:10.3946/kjme.2017.56

Johnston, A. N., Massa, H., & Burne, T. H. (2013). Digital lecture recording: a cautionary tale. *Nurse Educ Pract, 13*(1), 40-47. doi:10.1016/j.nepr.2012.07.004

Jones, R. W. (2007). Learning and teaching in small groups: characteristics, benefits, problems and approaches. Retrieved January 11, 2018 from http://www.aaic.net.au/document/?D=2007175. *Anaesth Intensive Care, 35*(4), 587-592.

Khan, R., Payne, M. W. C., & Chahine, S. (2017). Peer assessment in the objective structured clinical examination: A scoping review. *Med Teach, 39*(7), 745-756. doi:10.1080/0142159X.2017.1309375

Kitchen, M. (2012). Facilitating small groups: how to encourage student learning. *Clin Teach, 9*(1), 3-8. doi:10.1111/j.1743-498X.2011.00493.x

Krause, K. (2007). Blended Learning Strategy. Getting started with blended learning. Retrieved November 18, 2017 from: https://www.griffith.edu.au/__data/assets/pdf_file/0004/267178/Getting_started_with_blended_learning_guide.pdf.

Luxton-Reilly, A. (2009). A systematic review of tools that support peer assessment. *Computer Sci Educ, 19*(4), 209-232. doi:10.1080/08993400903384844

Mains, T. E., Cofrancesco, J., Milner, S. M., Shah, N. G., & Goldberg, H. (2015). Do questions help? The impact of audience response systems on medical student learning: a randomised controlled trial. *Postgrad Med J, 91*(1077), 361-367. doi:10.1136/postgradmedj-2014-132987

Maynor, L. M., Barrickman, A. L., Stamatakis, M. K., & Elliott, D. P. (2013). Student and faculty perceptions of lecture recording in a doctor of pharmacy curriculum. *Am J Pharm Educ, 77*(8), 165. doi:10.5688/ajpe778165

McNally, B., Chipperfield, J., Dorsett, P., Del Fabbro, L., Frommolt, V., Goetz, S., Rung, A. (2016). Flipped classroom experiences: student preferences and flip strategy in a higher education context. *Higher Education*, 73(2), 281-98. doi.org/10.1007/s10734-016-0014-z

Mellon, C. (2014). What are clickers and how can we effectively use them? Retrieved November 11, 2017 from: https://www.cmu.edu/teaching/clickers/pdfs/clickers-pedagogicalvalue.pdf.

Merlot II [open educational resources]. Retrieved Novermber 11, 2017 from: http://www.merlot.org/merlot/index.htm.

Michael, J. (2006). Where's the evidence that active learning works? *Adv Physiol Educ, 30*, 159-167. doi:10.1152/advan.00053.2006

Monroe, K. S. (2016). The relationship between assessment methods and self-directed learning readiness in medical education. *Int J Med Educ, 7*, 75-80. doi:10.5116/ijme.56bd.b282

Moore, C., Westwater-Wood, S., & Kerry, R. (2016). Academic performance and perception of learning following a peer coaching teaching and assessment strategy. *Adv Health Sci Educ Theory Pract, 21*(1), 121-130. doi:10.1007/s10459-015-9618-9

Nugent, J. (2015). Understanding mobile student response preparedness: important facts. Retrieved November 11, 2017 from: https://www.turningtechnologies.com/pdf/HE/WHITE_PAPER_MOBILE_FINAL.pdf.

OECD Data. Public spending on education. Retrieved February 6, 2018 from: https://data.oecd.org/eduresource/public-spending-on-education.htm.

OER Commons. Retrieved November 14, 2017 from: https://www.oercommons.org/.

Open Broadcaster [computer software]. Retrieved November 13, 2017 from: https://obsproject.com/.

Organisation for Economic Cooperation and Development. How is the global talent pool changing? Education Indicators in focus. Retrieved January 13, 2018 from:http://www.oecd.org/edu/50495363.pdf.

Osguthorpe, R. T., & Graham, C. R. (2003). Blended learning environments: Definitions and directions. Quart Rev Dist Educ, 4(3), 227. Retrieved January 13, 2018 from https://www.learntechlib.org/p/97576/.

Oz, H. H. (2005). A Simple System for Producing, Recording and Broadcasting Lectures and Presentations. *J Visual Com Med, 28*(3), 114-118. doi: 10.1080/01405110500462318.

Qamar, K., Rehman, S., & Khan, M. A. (2016). Effectiveness of Case-Based Learning During Small Groups Sessions at Army Medical College. *J Coll Physicians Surg Pak, 26*(3), 232-233. doi:03.2016/JCPSP.232233

Roberts, C., Jorm, C., Gentilcore, S., & Crossley, J. (2017). Peer assessment of professional behaviours in problem-based learning groups. *Med Educ, 51*(4), 390-400. doi:10.1111/medu.13151

Selvabarathi, E., & Govindarajan, K. (2016). Flipped classroom a new generation classroom in higher education. *I Educ Res J, 2*(9), 26-27.

Shewhart, W. A. (1931). Economic control of quality of manufactured product. New York: Van Nostrand. doi:0.1002/j.1538-7305

Shi-Chun, D. U., Ze-Tian, F. U., & Wang, Y. (2014). The Flipped Classroom–Advantages and Challenges. In Proceedings of the 2014 International Conference on Economic Management and Trade Cooperation, (Vol 107), 1*7-20*.

Simmons, E. B., Cosio, D., & Lin, E. H. (2015). Using Audience Response Systems to Enhance Chronic, Noncancer Pain Knowledge Acquisition Among Veterans. *Telemed J E Health, 21*(7), 557-563. doi:10.1089/tmj.2014.0160

Socrative [computer sofware]. Retrieved Novermber 12, 2017 from: http://www.socrative.com.

Strategic framework – Education & Training 2020. Retrieved Novermber 11, 2017 from: http://ec.europa.eu/education/policy/strategic-framework_en..

Sung, Y. T., Chang, K. E., Chiou, S. K., & Hou, H. T. (2005). The design and application of a web-based self- and peer-assessment system. *Computer Educ, 45*(2), 187-202. doi:10.1016/j.compedu.2004.07.002.

The Bologna Process. Education and training. Retrieved November 11, 2017 from: http://ec.europa.eu/education/policy/higher-education_en.

Tayebinik, M., & Puteh, M. (2012). Blended learning or E-learning?. Retrieved Januray 13, 2018 from https://arxiv.org/abs/1306.4085. *IMACST, 3*(1), 103-110.

Treesa, A. R., & Jacksona, M. H. (2007). The learning environment in clicker classrooms: student processes of learning and involvement in large university-level courses using student response systems. *Learn Media Tech, 32*(1), 21-40. doi:10.1080/17439880601141179

Turning technologies. Student response for higher education technologies. Retrieved June 12, 2017 from: https://www.turningtechnologies.com/higher-education.

Van Vliet, E. A., Winnips, J. C., & Brouwer, N. (2015). Flipped-Class Pedagogy Enhances Student Metacognition and Collaborative-Learning Strategies in Higher Education But Effect Does Not Persist. *CBE—Life Sci Educ 14*, 1-10. doi: 10.1187/cbe.14-09-0141.

Wellman, B. (2002). Little boxes, glocalization, and networked individualism. In M. Tanabe, P. van den Besselaar, & T. Ishida (Eds.), Digital cities II: Computational and sociological approaches. Berlin: Springer.

Willemsa, J., & Bossub, C. (2012). Equity considerations for open educational resources in the glocalization of education. *Dist Educ, 33*(2), 185-199. doi:10.1080/01587919.2012.692051

Willeya, K., & Gardnera, A. (2010). Investigating the capacity of self and peer assessment activities to engage students and promote learning. *Eur J Eng Educ, 35*(4), 429-443. doi:10.1080/03043797.2010.490577

Yoder, J. D., & Hochevar, C. M. (2005). Encouraging active learning can improve students' performance on examinations. *Teach Psychol, 32*, 91-95. doi:10.1207/s15328023top3202_2

Yoon, C., Oatesa, G., & Sneddona, J. (2014). Undergraduate mathematics students' reasons for attending live lectures when recordings are available. *I J Math Educ Sci Tech, 45*(2), 227-240. doi:10.1080/0020739X.2013.822578

Figure 1

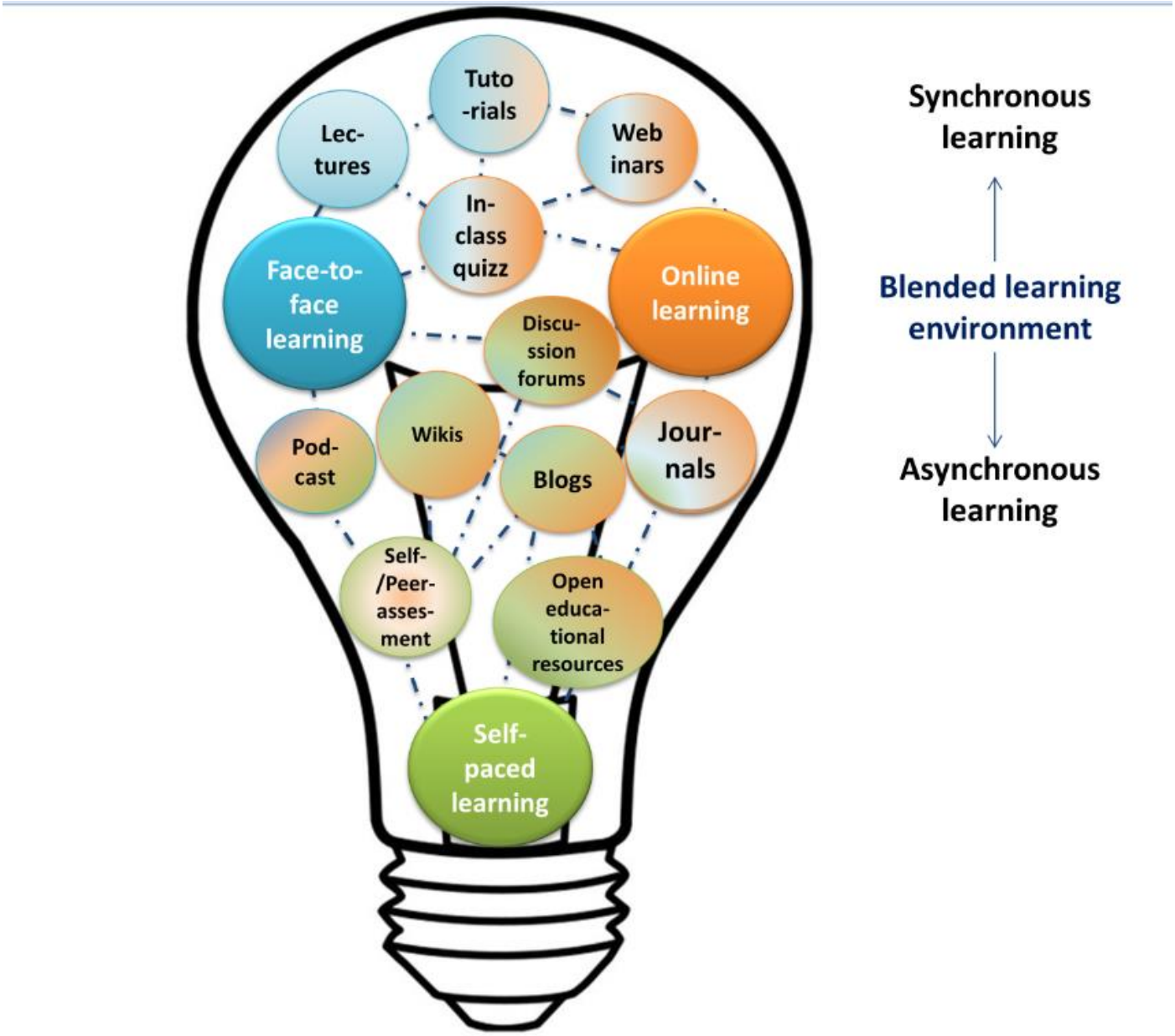

Tuto -rials
Lec- tures
Web inars
In- class quizz
Face-to- face learning
Online learning
Discu- ssion forums
Pod- cast
Wikis
Blogs
Jour- nals
Self- /Peer- asses- ment
Open educa- tional resources
Self- paced learning
Synchronous learning
Blended learning environment
Asynchronous learning

Figure 2

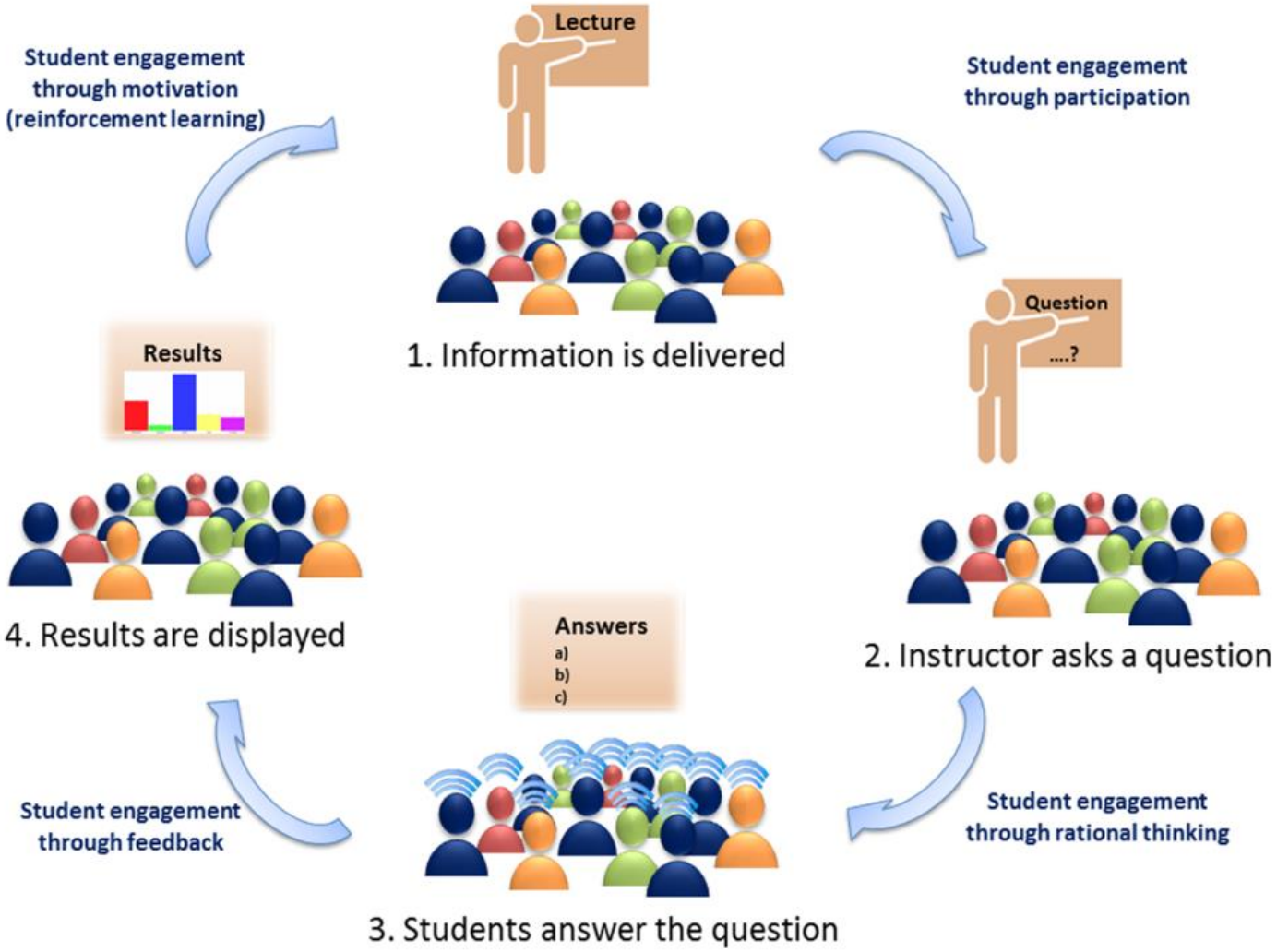

Lecture
1. Information is delivered
Student engagement through participation
Question
....?
2. Instructor asks a question
Student engagement through rational thinking
Answers
a)
b)
c)
3. Students answer the question
Student engagement through feedback
Results
4. Results are displayed
Student engagement through motivation (reinforcement learning)

Figure 3

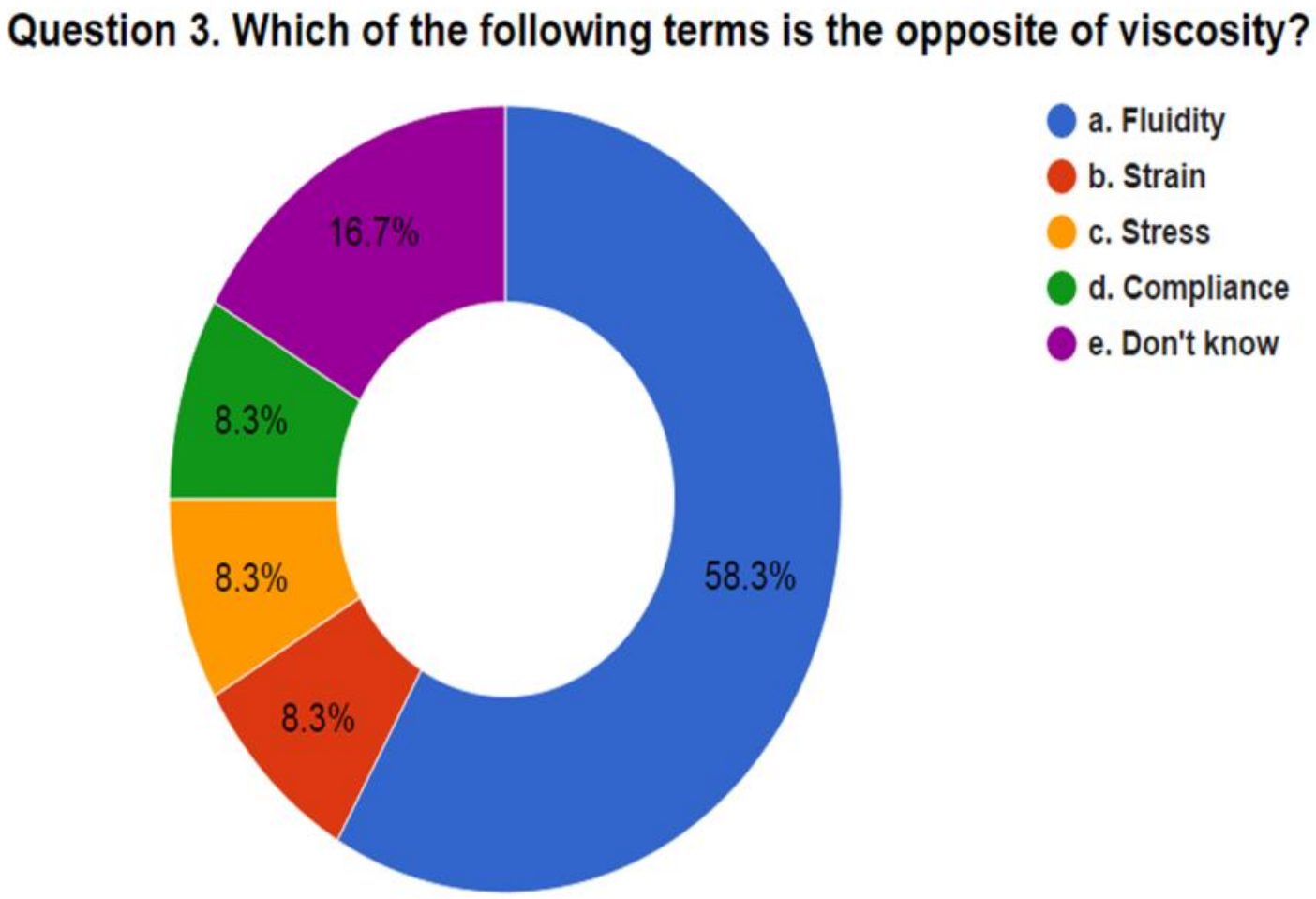

Question 3. Which of the following terms is the opposite of viscosity?
16.7%
8.3%
8.3%
8.3%
58.3%
a. Fluidity
b. Strain
c. Stress
d. Compliance
e. Don't know

Figure 4

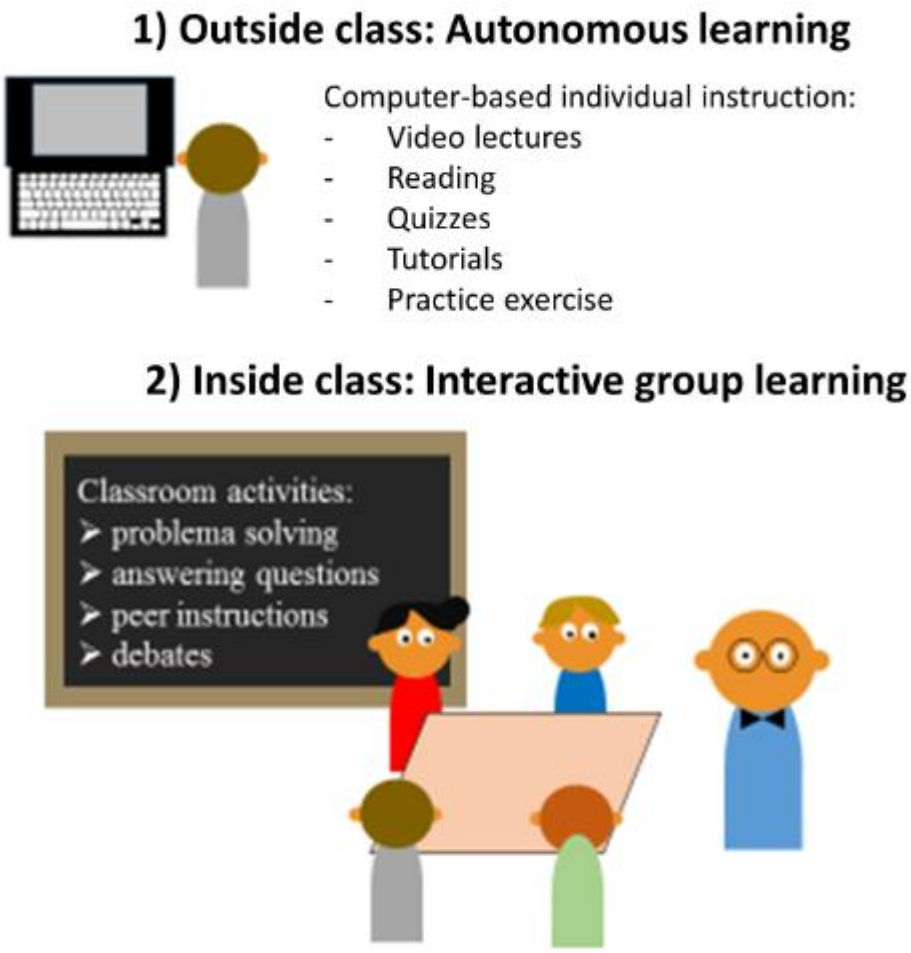
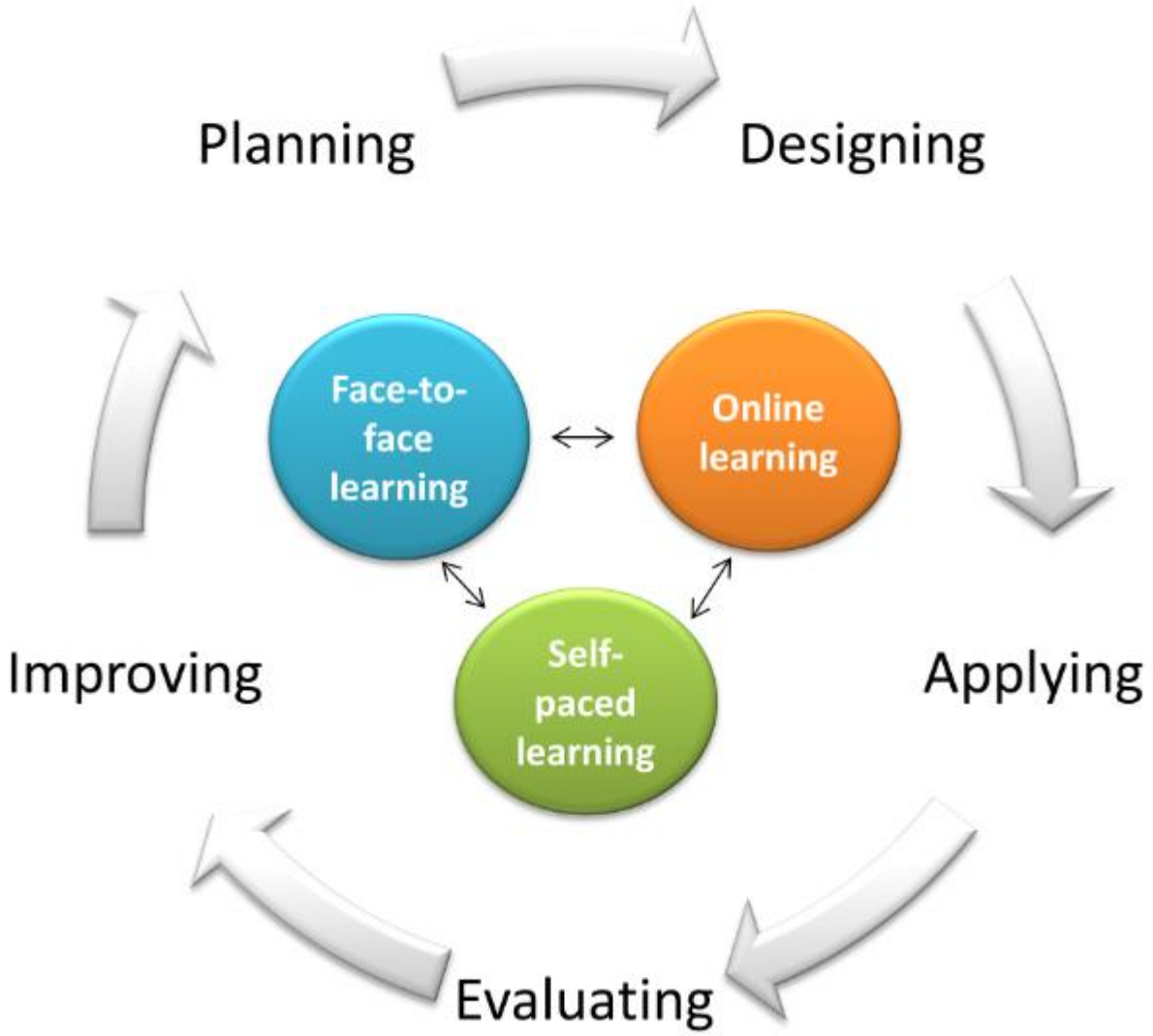

1) Outside class: Autonomous learning
Computer-based individual instruction:
- Video lectures
- Reading
- Quizzes
- Tutorials
- Practice exercise
2) Inside class: Interactive group learning
Classroom activities:
➢ problema solving
➢ answering questions
➢ peer instructions
➢ debates

Figure 5


Planning
Designing
Face-to-face learning
Online learning
Self-paced learning
Improving
Applying
Evaluating