Influence of group dynamics on blended higher-education training

El impacto de las dinámicas de grupo y el aprendizaje mixto en la formación de educación superior

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Abstract

This article explores the benefits of combining blended learning and group dynamics approaches in higher education. While blended learning is known to offer greater efficiency in teaching hours than traditional face-to-face education, it can also result in a lack of communication and relatedness among peers, negatively impacting student well-being and performance. To address this, the study conducted an experiment with Master's students from the European Institute of Innovation and Technology within the EIT Digital knowledge and innovation community. One group was instructed with traditional teaching methodology, while the other group was instructed with group dynamics infused blended learning. The study found that the blended learning students internalized the external motivator of group dynamics. The use of group dynamics infused

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blended learning approach not only sustained the well-being and performance of blended students, but also improved the assimilation of technical and soft skills compared to traditional approaches. Thus, the group dynamics serves as a catalyst for effective teaching in blended learning environments and enhances the students' academic performance of group activities. Overall, the findings of this study suggest that blended learning education can be improved through the use of group dynamics. The article concludes that this work could contribute to the implementation of blended learning education in the post-coronavirus era, as it offers an effective approach for sustaining student well-being and performance while achieving teaching efficiency.

Keywords: blended learning, higher education, group dynamics, efficiency, quantitative analysis, intrinsic motivation.

Resumen

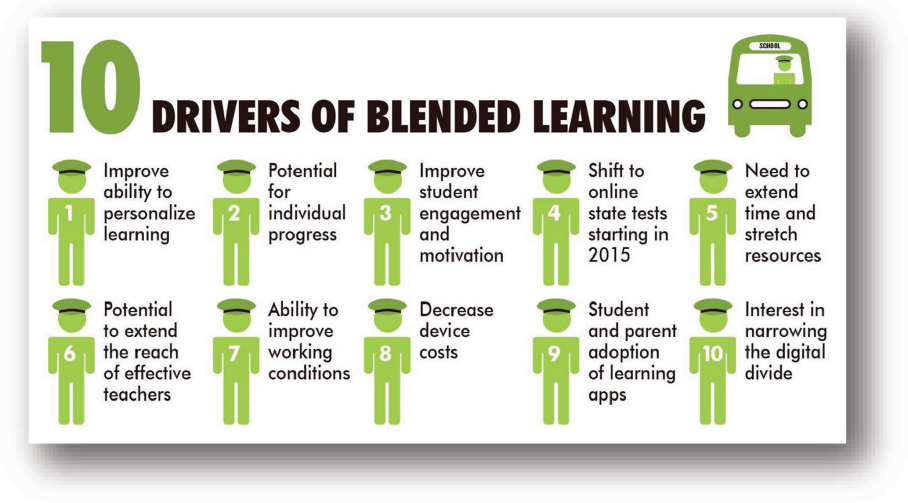
El uso de estudios combinados con el propósito de obtener mejoras significativas en la formación se estudia a gran escala, aunque no tanto su combinación con los enfoques basados en la dinámica de grupo en el sector educativo superior. Este artículo analiza el uso combinado de la formación bimodal y la dinámica de grupo para mejorar la performance en las horas en presencia, algo presumiblemente ayudaría a una mejora en la eficiencia de la formación. Los resultados obtenidos con los estudiantes de Maestría del European Institute of Innovation and Technology dentro del área Digital de EIT, muestran la mejora en su formación, no solo con la mantención de resultados académicos y bienestar, sino también debido a la notable elevación experimentada en la adquisición de habilidades técnicas y sensibles, en comparación con aquellas obtenidas a través de método.

Palabras clave: aprendizaje mixto, educativo superior, dinámica de grupo, eficiencia, análisis cuantitativo, motivación intrínseca.

Introduction

Blended learning is the combination of face-to-face (in the classroom) and online learning (on digital media, such as e-learning platforms) (Buhl-Wiggers et al., 2023; Graham, 2018; Hrastinski, 2019). The concept of blended learning is clearly related to wise combination of on-line and face-to-face concepts in a seamless learning process but also to other relevant concepts in the learning domain as "skills enhancement", "learner centred", "creativity" and "cooperative classroom" to mention some of

FIGURE I. Drivers of blended learning



Source: Bailey et al., 2013.

them, which condition the implementation process and its performance (Banditvilai, 2016; Pisoni, 2019).

There are various educational reasons to support "blended learning" in the educational context. Figure I (Bailey et al., 2013) schematically depicts ten drivers for that phenomenon. Not all of them have the same relevance in a given context, but all of them have challenged well-consolidated learning processes. At the university level, drivers 1, 2, 3, 5, 6, 7, and 8 seem especially relevant, and they should be considered during the implementation process.

Related to the previous aspects shown in Figure I, the improvement of the quality of learning by using blended learning approaches, and more specifically having the ability to measure this quality improvement, is presented as one of the key aspects to take into account today, since there are many and varied implementations made with a promise based on these quality assumptions, but this assessment relies on subjective views of involved actors (Dey & Bandyopadhyay, 2019; Ginns & Ellis, 2007; Han & Ellis, 2019). That is why this document is focused on measuring the improvement of the quality of blended learning approaches by using a systematic process.

Given that the current trend and post-coronavirus era in education are expected to push towards Blended Learning approaches (Glantz & Gamrat, 2020; Sharma & Shree, 2023), with their corresponding benefits in favour of higher quality education, in this paper is described a work carried out for measuring, at quantitative level, the improvements of the potential quality contributed using Blended Learning approaches. In particular, this paper presents a set of indicators that enable the measurement of the impact of Blended Learning activities within regulated training at university level. Furthermore, as will be described below, these indicators are useful to detect improvement points for new implementations.

The work presented in this document was carried out with the purpose of maximizing the percentage of online hours within the Master programs (Dion et al., 2018; León et al., 2018) currently taught at EIT Digital without losing the benefits o face-to-face interaction and networking. This objective addresses a well-defined strategy by EIT Digital (Pisoni et al., 2018, 2019) for the transformation of training towards Blended Learning approaches. In this way, not only are the benefits of these types of approaches obtained, but it is also possible to take advantage of all the benefits offered by a distributed organization such as the EIT Digital, which has both human and material resources of very high-quality spread across different countries of the European Union.

However, maximizing the teaching efficiency has a trade-off which leaves the responsibility of learning to the student's own will to some extent. Face-to-face learning has a clear advantage on student motivation, real time engagement, and performance assessment compared to online or blended learning. Lack of communication between the students and teacher could thwart the building of emotional bound which is necessary for engagement and well-being (Hu & Li, 2017; Zhu et al., 2023). In this paper, we describe how the administration of group dynamics could develop a relatedness among the student's and mitigate the risk of performance and motivation decrease.

Students' motivation

The motivation of the students is a fundamental aspect to take into account to obtain the maximum results in education. Students with good

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motivation tend to achieve superior results and higher levels of interest to achieve their learning objectives, and fulfil their goals (Mo, 2019).

With respect to the concept of student motivation, Self-determination theory (SDT), (R. M. Ryan & Deci, 2000) explains the sources of motivation mediated by the autonomy-control continuum and categorized these sources into two main branches. Respectively, intrinsic, and extrinsic. Intrinsic motivations are the basic psychological needs of humans which are "competence," "autonomy" and "relatedness" when satisfied, they lead towards greater personal growth, well-being, and engagement (Reeve, 2017; R. M. Ryan & Deci, 2000, 2018). In contrast, extrinsic motivations refer to the "performance of an activity in order to attain some separable outcome." The extrinsic motivations are varied into four level according to the autonomy-control continuum. From autonomous to controlled, they are: "integrated regulation," "identified regulation," "introjected regulation," and "external regulation". Among these four, "integrated regulation" and "identified regulation" are internalized sources of external motivations and serve as a tool to reach intrinsic needs.

In the area of education, controlled motivation fosters the external regulations and diminishes the intrinsic motive of learning which can cause issues like anxiety, disengagement or drop-out from the course (R. M. Ryan & Deci, 2018). Hence, the need for "competence," "autonomy", and "relatedness" should be satisfied, and extrinsic regulations should be internalized for positive academic outcomes (Hornstra et al., 2018).

Students attend to educational courses either because the student finds the course interesting and enjoyable (intrinsic), or the course can contribute to a greater personal goal (extrinsic-integrated), or the student should do (extrinsic-introjected) or have to do (extrinsic-external) (R. Ryan & Moller, 2017). Whatever the reason is, facilitating the satisfaction of "competence," "autonomy" and "relatedness" is essential for educational engagement. Especially for the internalization process of extrinsically motivated students (Niemiec & Ryan, 2009).

Group Dynamics to improve the motivation and performance of blended learning students

Collaborative learning is one of the ways of fostering the satisfaction of psychological needs, student engagement, student empowerment

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and active learning (Monteiro & Morrison, 2015). Collaborative classwork activities of small groups (typically 3 to 4) can lead to a situational interest, which becomes a common mission or activity among the group members, constructing a social bond between them (Hakami et al., 2022; Hmelo-Silver et al., 2013; R. M. Ryan & Deci, 2018). If this bond is trustworthy and not abused by others, it satisfies the need for relatedness. Moreover, the students become more autonomous as the controlling factor of the teacher decreases –in case, the students can express themselves freely within the group- and they feel more competent when they share their contributions or knowledge to the rest of the group or to all the classmates.

Intrinsic motivation is essential for an effective learning outcome. However, the efficient productivity should be sustained. Collaborative group activity has both incremental (process gain) and decremental (process loss) consequences on the performance (Forsyth, 2018). In his research, Steiner has defined two mediators for process loss: "suboptimal coordination" and "reduced motivation" (Steiner, 1972). The Coordination loss is defined as the inability of individuals to put optimal potential due to social interaction processes (e.g. "production blocking" or "non-simultaneous individual activity") and the Motivation loss refers to the decreased willingness of the individual to contribute with the optimal potential in the group settings (e.g. "free-riding", "social loafing") (Brodbeck & Greitemeyer, 2000). On the other hand, a group environment can yield increased energy, creativity, new insights, and solutions that can contribute to the process gains (Forsyth, 2018) (e.g., Brainstorming). Therefore, the mathematical equation of this relationship is expressed as follows: actual productivity = potential productivity – process loss + process gain (Forsyth, 2018).

Face-to-face education has a greater advantage in order to eliminate process losses compared to pure on-line education. The group members are in the same physical location during some activities, and they have increased interaction within the group, which contributes to the construction of the group dynamics. However, the online learning environment limits the interaction and mutual understanding due to a lack of sensual information. Hence, positive social relations within the group members are harder to build (Rothwell, 2012). Likewise, significantly lower perceived relatedness among peers has been reported in the blended learning environment compared to traditional face-to-face education (Raes et

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al., 2020). Therefore, blended learning can be a solution to this dilemma by its hybrid learning sessions. The teacher can advocate for extended "group dynamics activities."

Group dynamics have as main objective the connection of the components of a group of people. At the level of behaviour, with this type of activities, we seek to explain the internal changes that occur as a result of the forces and conditions that influence the groups of students as a whole, as well as the reactions produced by their different members. This type of activity is often highly motivating for group members, giving them the opportunity to work together to solve specific objectives and to increase their creativity. The dynamics are highly recommended group in educational contexts, in general and in university students in particular, for the development of their competences (Arashpour et al., 2020; Ishimura & Fitzgibbons, 2023; Washington et al., 2013). These dynamics promote self-knowledge, through the observation of one's own behaviour, but also the behaviour of the other members of the group, within a set of previously defined parameters and norms of behaviour (Forsyth, 2018; Ishimura & Fitzgibbons, 2023).

In the present work, group dynamics were used only in the blended learning students (experiment group). One of the objectives pursued was to maximize the performance of face-to-face hours, first for the opportunity to work more skills meanwhile maximizing the intrinsic motivation of students, but also for the possibility offered by this type of tools to carry out classroom activities in combination with online content (blended approach). In particular, these are the activities carried out during the group dynamics: 1) Introduction to Technology Watch by the teacher, 2). Groups creation and preparation (Identification of experts and read content; Experts meeting to exchange read content; and groups meeting to share knowledge), 3) Groups facing the resolution of different tests (a quiz of Technology Watch and problem solving of a short-written case).

Purpose of the study

The underlying idea of this work is to reduce face-to-face hours as much as possible but maximizing the performance of those remaining

face-to-face hours, with which, as a hypothesis, the quality of learning is expected to improve.

For this purpose, dynamic group activities are used in combination with online contents, as it is described above. From the measurement of perceptions questionnaires, student performance, and teaching hours, we seek to assess whether group dynamics maintain intrinsic motivation, relatedness, competence, autonomy, value, performance, and increase the overall teaching efficiency of blended group compared to face-to-face. Our specified hypotheses to address this are as follows:

- H1: Intrinsic Motivation (Perceived Competence, Perceived Relatedness, Perceived Autonomy) of the experiment group (blended with group dynamics) will result greater than the threshold (4 out of 7) and there will not be significant difference compared to face-to-face group (control group).
- H2: Extrinsic motivator of Group Dynamics will be internalized (Perceived Importance, Perceived Value) by experiment group.
- H3: There will be no significant difference on the performance of the experiment group (blended with group dynamics) and face-to-face group (control group).
- H4: Blended teaching will result in greater teaching efficiency compared to face-to-face when group dynamics applied.

This document is organised as follows: after this introductory section, the materials and methods used to measure the quality of application of blended learning approaches are presented. After that, the results of the application to the case study are presented to demonstrate the effectiveness and validity of the methods. Finally, conclusions are outlined.

Method

Context and participants

Within the EIT Digital knowledge and innovation community of the EIT Digital Academy and specifically in the implementation of the Master, Doctoral and Professional schools, there is a strong commitment to support innovative learning approaches by combining face-to-face and

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on-line techniques in the so-called "blending learning approach." The hope is to bring together the best of both worlds in a cost-effective and productive approach.

Based on the general goals, and as a part of the development of the priority lines of EIT Digital, relevant on-line contents for I&E (Innovation and Entrepreneurship) subjects have been produced and used in regular education in the last five years (Pisoni et al., 2018). The objective is to get these contents regularly used by partner universities (materials are provided by individual universities to be used by all universities in the network), which committed efforts to "going-blended" by merging them with more conventional approaches.

Nevertheless, present implementation hints of blended approaches depend too much on the experience and wishes of individual teachers and/or common practices found in engaged universities to ensure smooth formal grading according to their internal rules. For that reason, a common and homogeneous EIT Digital approach for blended learning was defined (the going blended strategy of EIT Digital) (EIT Digital, 2020), looking for top leap forward digital education in Europe. In this section is showed an activity, which is implemented using online contents, group dynamics and perception tests for improving the quality of classes.

Within the "Technology Watch" seminar of 1 ECTS credit, included in the "Introduction to Innovation & Entrepreneurship Management" course, an experiment was conducted to improve the quality of the classes taught in the I&E subjects of the Master of Digital EIT using blended learning approaches. The students ranged in age from 23 to 25 and came from various European countries. They were enrolled in the "Introduction to Innovation & Entrepreneurship Management" course at the Universidad Politécnica de Madrid, Spain, as part of the EIT Digital Master's program. To conduct this experiment, the contents of the seminar on "Technology Watch" were taught using two different approaches in two different group of students. In particular:

- In the control group, 8 hours of class were taught in a traditional way (face-to-face classes), using a set of slides that were delivered to the students. The first part of the seminar was a theoretical introduction to make students aware of the necessary concepts, later moving on to a part of group work on the contents to develop

a Technology Watch (TW) report and ending with the presentation of the reports made by the groups. During these sessions, the following skills were developed:

- Teamwork
  - Technical competences of Technology Watch (TW)
  - Decision making (when developing the TW group report on a specific case study)
  - Communication (with the presentation of the group report in class)
  - Critical thinking (within the presentation of the reports of other groups)
- On the other hand, 6 hours of classes were taught at the experiment group, applying a blended learning approach by using online materials uploaded to the EIT Digital e-learning platform (Sakai). The first part of the seminar consisted of group dynamics, where students faced as a group different activities and problems presented by the teacher and supported by online contents. Next, the groups of students worked autonomously and completely online in the development of their TW reports. Finally, student groups presented their reports in class (face-to-face). During these sessions, the following skills were developed:
  - Team building (in a group dynamic, sharing knowledge learned individually from the online content for group knowledge improvement).
  - Teamwork (working in different group dynamics and in the development of the group report in a virtual way, using the e-learning platform, WhatsApp, etc.).
  - Digital skills (necessary to access online content and learn, but also to work in groups for the development of the group report).
  - Decision making (when developing the TW group report on a specific case study).
    - Complex problem solving (in a group dynamic to solve a test and a complex problem as a group, using their TW knowledge).
    - Autonomous work (within group dynamics and when students work on the development of the TW report based on the online content).
    - Technical competences of TW.

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- Communication (with the presentation of the group report in class).
- Critical thinking (in the peer evaluation of the test conducted in groups, group dynamics, but also during the presentation of reports from other groups).

At the end of the workshop, participants were asked to complete a perception survey to address hypotheses 1 and 2 regarding intrinsic motivations and perceived value. To avoid bias, the survey was done after all course activities and student assessments were completed, but before the course grades were published. In addition, the grades of the students (both individual and group grades) have been collected in order to answer hypotheses 3 and 4. The survey findings and performance of the control and experiment groups were compared using the Student's t-test for the analysis.

Data sources and instruments

- The data obtained to carry out the activity come from the following instruments:
  - Perception questionnaire. A 13-question questionnaire based on a 7-point Likert scale with questions to learn about students' perceptions on intrinsic motivation (perceived competence, relatedness, pressure, importance, and value).
  - Assessment of the control (N=19) group, in which was used the traditional approach.
  - Assessment of the experiment (N=19) group, in which was used the blended learning approach.
- Students' grades (academic performance).
  - Based on both groups, control, and experiment.
- Indicator of performance.
  - This indicator is based on other two sub-indicators: time performance and results performance.

Perception questionnaire

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The perception questionnaires in blended learning approaches have already been used previously, as well as proven their reliability and validity, as can be extracted from the literature (Akkoyunlu & Yilmaz-Soylu, 2008; Han & Ellis, 2020). In particular, in the present work was used the Intrinsic Motivation Inventory (IMI) (Center for Self-Determination Theory, 2020). It is a multidimensional measurement instrument intended to assess participants' subjective experiences related to target activity in experiments. This instrument assesses several subscales or categories, such as participants' interest/enjoyment, perceived competence, effort, etc. The IMI consists of varied numbers of questions from these categories, all of which have been shown to be factor analytically coherent and stable across a variety of tasks, conditions, and settings. In this activity, 13 items have been rated on a 7-point Likert scale, ranging from 1(not at all true) to 7 (very true), and the midpoint 4 indicating the threshold value (somewhat true). The following categories have been assessed (Deci et al., 1994; Reeve, 2017; R. M. Ryan & Deci, 2000; R. Ryan & Moller, 2017):

- Perceived Importance (3 items, e.g., "I think Technology Watch is an important activity"): Extrinsic motivations do not diminish intrinsic motivation if they are perceived by the person with a value or importance (R. M. Ryan, 1995). Perceived Importance is measured to assess internalization of Group Dynamics.
- Perceived Value/Usefulness (3 items, e.g., "I think doing this seminar could help me to make better decisions about technological projects in future"): Value/Usefulness category measures "integrated regulation" and "identified regulation". These two regulations are important to measure to what extent people internalized the activity.
- Perceived Pressure/Tension (2 items, e.g., "I felt pressured while doing this seminar"): Satisfaction of autonomy need is the experience of one own choice and direction. The behaviour is self-determined if it is volitional and wholeheartedly self-endorsed. Internal (e.g., feeling of shame or guilt, etc.) or external (e.g., rewards and punishments, etc.) control decreases the level of self-determination. "Perceived Pressure/Tension" measures the level of the control feeling; therefore, the less pressure signifies more feeling of autonomy.

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- Perceived Competence (4 items, e.g., "I think I am pretty good at Technology Watch"): Competence is intrinsically rewarding for the human being, and it is related to the experience of mastery or seeking mastery challenges. It plays as a leading role for intrinsic motivation and is crucial for human development. Perceived Competence measures the students' mastery of the related activity.
- Perceived Relatedness (1 item, e.g., "I felt really distant to the rest of members of my group" (*reverse)): Relatedness is the need to settle an emotional bond and attachment with others. It includes bilateral trust and caring for others' wellbeing. Responsiveness and social bond are essential for the satisfaction of the relatedness. In this research, the Perceived Relatedness is measured to assess if Group Dynamics managed to establish a bond among blended students.

Student's grades (academic performance)

The academic results of the students (instructor was the same to avoid biases) of both groups are based on the grades obtained from the different activities carried out in the different groups, according to the following rule:

- *Total Grade*: Technology Watch report development and presentation (75%) ("*Group Grade*") + individual final quiz (25%) *("Individual Quiz Grade")*

Indicator of performance

This indicator evaluates the effectiveness of group dynamics in combination with the use of online contents to improve the quality of the courses (blended learning approach). The indicator is calculated as follows: (Time performance) "Use of class hours" x (Results performance) "improvement of student results". Therefore, the indicator depends on the values of two sub-indicators:

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- (Time performance) "Use of class hours" for group work of the contents of the course:
  - Objective: reduction of hours of contents explanation by the teacher to maximize the time of work of the contents by the students (working in groups).
  - Resources used: group dynamics in-class and use of online contents.
  - How to obtain the quantitative value of this indicator: number of hours dedicated to content work / number of total class hours.
- (Results performance) "Improvement of student results." Of the two groups of students, only group dynamics were applied in the experiment group.
  - Objective: to improve the results of students in the course.
  - Resources used: academic results of the students.
  - How to obtain the quantitative value of this indicator: comparative of the results obtained by the students of the group where the group dynamics were applied (experiment) and the other group where they were not applied (control), to show the performance / improvement. That is, results obtained by students belonging to the group dynamics (experiment group) / results obtained by students of the control group.

Results

Perception questionnaire results

For the perception questionnaire, the perception categories of control and experiment students are compared (Students t-test) one-by-one to measure the motivational differences between face-to-face and blended students. Furthermore, t-test has been applied for the score of the experiment students to assess if they are above the threshold level. Descriptive statistics and Students t-test results are presented in Table I. Three students from the control group were not evaluated because they did not participate in the survey.

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TABLE I. Descriptive Statistics and Students' t-test of perception questionnaire

	Control (N=16)		Experiment (N=19)		Threshold (M=4) vs experiment	Control vs experiment
Perception	min-max	M±SD	min-max	M±SD	p-value (t-test)	p-value (t-test)
Competence[a]	3.5-6.75	5.03±0.80	3.25-6	4.97±0.79	*<0.01	0.41
Relatedness[a]	4-7	6.18±0.98	2-7	5.63±1.46	*<0.01	0.11
Pressure/ Tension[a]	2-6	3.56±1.41	1-6	3.42±1.42	*0.04	0.38
Importance[a]	3.5-6	4.87±0.84	3.5-7	5.60±0.89	*<0.01	*<0.01
Value[a]	4-7	5.89±0.84	3.6-6.6	5.59±0.94	*<0.01	0.16

[a] *Threshold for the variables is M= 4. All representing the confirmation level of the relevant variable within the range of [0-7]. Belove the threshold implies disagreement and above implies the agreement degree. *p<0.05*
Source: Compiled by author.

▪ Testing for H1

Perceived Competence, Perceived Relatedness, and Perceived Pressure have been measured for the inspection of the intrinsic motivation. First remarkable result is that students in the experiment group have significantly higher perceived competence (M=4.97, p<0.01, ES=1.23 indicating large effect size), relatedness (M=5.63, p<0.01, ES=1.12 indicating large effect size), and significantly lesser perceived pressure (M=3.42, p=0.04, ES=0.41 indicating small effect size) compared to threshold. Moreover, there is no significant (p=0.41) difference between the experiment students (M=4.97) and control students (M=5.03) have been observed in the means of perceived competence. Likewise, both groups have indicated a high score on the perceived relatedness. The score of the control group (M=6.18) was higher compared to experiment (M=5.63) but was not significant (p=0.11). For the final component of the intrinsic motivation, perceived pressure has been compared. For this specific case, lower results represent greater autonomy. Thus, the scores should have been lower than threshold. Both experiment (M= 3.42) and control (M= 3.56) groups perceived lesser pressure than the threshold and there were no significant (p=0.38) differences observed within their means. All the results of the three variables of experiment group were significantly (partly for the

Perceived Pressure) above the threshold, and there was no significant difference compared to control group, thus H1 was supported.

▪ Testing for H2

Perceived Value and Importance have been measured for observing the internalization process of the activity. Experiment group (M=5.60) had a high score on the perceived value which is significantly ($p<0.01$) higher than threshold. Like the previous results, there were no significant ($p=0.16$) differences occurred among the groups (Control, M=5.89). Second remarkable result has been observed on perceived importance. experiment group (M=5.60) give significantly ($p<0.01$, ES=0.80 indicating large effect size) more importance on the activity than control ones (M=4.87), and their score is significantly higher than threshold ($p<0.01$) both of which demonstrates the internalization of group dynamics by experiment students.

Results of both variables of experiment group were above the threshold level, and there was no significant difference on the Perceived Value compared to control students, and Perceived Importance of the experiment group were significantly higher compared to control group, thus H2 was supported.

TABLE II. Grades of students

	Control (N=19)		Experiment (N=19)		Control vs experiment
	min-max	M±SD	min-max	M±SD	p-value
GG[a]	5.00-8.60	7.91±0.97	8.10-8.50	8.37±0.17	*0.01
IQG[b]	5.00-10.00	7.36±1.37	5.0.-10.00	7.89±1.64	0.14
TG[c]	5.40-8.80	7.77±0.86	7.32-8.87	8.25±0.46	*0.02

[a] *Group Grades.* [b] *Individual Quiz Grade.* [c] *Total Grade. All variables are within the range of [0-10]. *p<0.05*
Source: Compiled by author.

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Students' grades

A total of eight groups (4 group control, 4 group experiment) with four to six members were assigned for a team project. Each student had also individual quiz at the end of the activity. Descriptive Statistics and the t-test results obtained by evaluating from group assignment, individual quiz, and final grades are summarized in the Table II:

▪ Testing for H3

Remarkably, Group Grades of the experiment students (M=8.37) were significantly (p=0.01, ES=0.66 indicating large effect size) higher than the control ones (M=7.91) which reflects the effect of perceived importance on Group Dynamics in the collaborative assignment. Likewise, experiment (M=8.25) group have received higher grades on the Total Grade than control students (M=7.77) with the p=0.02 significance. Moreover, the Individual Quiz Score of the experiment (M=7.89) was even higher compared to control (M=7.36) yet was not significant (p=0.14, ES=0.70 indicating large effect size).

As a result, there were no performance degradation on the blended-approach teaching. On the opposite, experiment group performed better on the group assignment and total grade, thus H3 is also supported. Sustaining the motivation and performance (additionally, improved performance) of the experiment group enabled us to measure the final hypothesis of teaching efficiency.

Results of the indicators

▪ Testing for H4

For the fourth hypothesis, the "indicator of performance" metric described in the methodology was utilized to compare the teaching efficiency of each group. With this objective in mind, primarily, "Time performance" sub-indicator has been calculated to determine the efficiency of the instructor's class hours.

"Use of class hours" for group work of the contents of the course:

- Use of control group hours "Time performance" (traditional approach) = 4 hours of theory by instructor (face-to-face) + 4 hours of content work among groups (face-to-face) = 4 (hours of work in class) / 8 (total class hours) = 0.5
- Use of experiment group hours "Time performance" (blended approach) = 1 hour of theory by instructor (face-to-face) + 5 hours of content work among groups (face-to-face) + 2 hours content work among groups (online) = 7 (hours of work) / 8 (total class hours) = 0.88

The experimental group spent seven hours on group content work compared to the control group's four hours. This yields a "Time performance" efficiency of 88% (experiment) to 50% (control) for total face-to-face class hours. Second, the "Result Performance" sub-indicator has been measured for the purpose of comparing students' academic performance. The "Total Grade" of the students was used for calculation, and the grades can be seen below;

- "Results Performance" of the experiment group = 8.3
- "Results performance" of the control group = 7.8
- Improvement of student results = Average experiment group grades (blended learning approach) / Average control group grades (traditional approach) = 8.3 (blended learning approach) / 7.8 (traditional approach) = 1.064

The improvement in student performance indicates that the experiment group received 0.064% higher grades than the control group. After having both "Time performance" and "Results performance" sub-indicators, it is finally possible to calculate the "Indicator of Performance" for overall efficacy. The calculation for the "Performance Indicator" is provided below;

"Time Performance"= " Time performance " x "Results Performance":

- Indicator of performance of the control group (traditional approach) = 0.5 (time performance) x 0.78 (results performance) = 0.39 (39%)
- Indicator of performance of experiment group (blended learning approach) = 0.88 (time performance) x 0.81 (results performance) = 0.73 (73%)

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"Time Performance" results signifies that the teaching efficiency obtained using the blended learning approach is higher than the performance obtained with the traditional approach=73% (experiment) > 39% (control), thus this result supports the final hypotheses of H4.

Discussion

In this study, the effect of Group Dynamics on the motivation and performance of students was examined in order to observe the instructional efficiency of the blended learning environment. For this objective, four hypotheses were evaluated.

First, the effect of group dynamics on intrinsic motivation was examined to determine if group dynamics may mitigate the typical problem of the lack of communication in blended learning environment which could diminish well-being, relatedness, and emotional link among the group members (Hu & Li, 2017; Zhu et al., 2023). From the results of the IMI questionnaire, there is no significant difference on the perceived relatedness, competence, and autonomy between experiment and control students. Moreover, experiment group had significantly higher scores compared to the threshold on these three variables (partially for the autonomy). Consequently, the evaluation of the first hypothesis presented that Group Dynamics have managed to sustain the well-being and established a team bond among the experiment group which especially prevented the diminishing effect on the relatedness among the peers due to the lack of communication and feeling loneliness.

Second, we must be sure that the implemented Group Dynamics would be internalized by the experiment students as external regulations may result in disengagement and a decline in intrinsic motivation and academic performance (R. M. Ryan & Deci, 2018). In this regard, Perceived Value and Importance of the experiment students were above the threshold level. It demonstrates the experience of the internalization process. Moreover, experiment students put more importance on the activity compared to the control ones. Both Perceived Importance and Value signify the internalization of the Group Dynamics by the experiment students. This result is promising since the internalized external regulations could lead to positive academic outcomes (Hornstra et al., 2018).

Third, the effect of Group Dynamics on the academic outcomes has been observed. Internalization of the Group Dynamics reflects itself on the grades of the group activities and experiment students performed significantly higher compared to control ones. Remarkably, experiment students also had greater results in Individual Quiz and Total Grades (partly significant). As a result, Group Dynamics not only prevented the performance degradation in individual quiz, but also improved the performance of group activities and total grades. This finding This finding reinforced the notion that group dynamics not only push self-academic outcomes, but also the behaviour of other members of the group (Forsyth, 2018; Ishimura & Fitzgibbons, 2023).

Group Dynamics has been internalized by experiment students, sustained well-being, and improved performance, thus, enabled us to measure the teaching efficiency of the blended education. From the results obtained from the indicator of performance, as can be seen, the performance obtained using the blended learning approach is higher than the performance obtained with the traditional approach = 73% (experiment) > 39% (control). This result demonstrates that with the blended learning approach it is possible to improve the performance within the course, which, consequently, results in greater teaching efficiency.

Conclusion

Blended and online learning clearly have a greater efficiency in the aspect of teaching hours compared to the face-to-face education. More students could have access to the course contents and train themselves within a flexible working hour. However, this autonomy leaves the responsibility on the student's hand which could result in lack of communication among peers, diminish the relatedness, well-being, and eventually performance degradation. In this aspect, teaching efficiency is meaningless without teaching effectiveness. In this paper, we have demonstrated that Group Dynamics could sustain well-being and performance of the blended students.

At a more specific level, in the 6 hours of work conducted in face-to-face classes with blended-approach (experiment) students, 9 types of skills have been developed, both soft and hard; while with the students of traditional-approach (control), 8 hours have been worked and 5 types

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of competencies have been developed. Therefore, even having less face-to-face classes with the blended learning approach, the number of the skills of the students was improved, what result in an important improvement of the classes.

The perception survey results indicated that the experiment group's well-being has been sustained and that the group activity has been internalized. Consequently, group activity could serve as a catalyst for effective teaching in blended learning environment.

The performance of the experiment group is greater than that of the control. The average grade of the experiment group is higher than that of the control group by 0.5 points (8.3 vs 7.8), which has even more impact in the group grades by 0.5 points (8.4 vs 7.9). In the same way, the performance obtained using the new approach with group dynamics and online contents is higher than the performance obtained with the traditional approach (73% > 39%, almost double). This reflects the relevance to use Group Dynamics in blended learning approaches.

This article has demonstrated the possibility of quantitatively measuring the improvement in efficiency and quality offered by blended learning approaches through Group Dynamics. With this fact, well-being, and performance of the blended students have been sustained, and the teaching efficiency of the blended learning has been presented. We believe this work would contribute for the required actions taken for the expected blended learning education in the post-coronavirus era.

Limitation and Future Work

One of the main limitations of this study is the small sample size used for each group, which consisted solely of European students aged 23-25. This may limit the extrapolation of the findings to other populations. Additionally, no pre-test was conducted to assess the participants' baseline perceptions, which could have influenced the results.

Another limitation of the study is the number of items in some categories of the perception questionnaire, which was less than three. This limited the dimension and factor analysis, which could have led to an incomplete understanding of the relationships between variables.

To address these limitations, future studies should aim to increase the sample size and include a more diverse range of participants, including

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international students. Additionally, a pre-test should be conducted to establish baseline perceptions and ensure that the study is measuring changes in perception over time. Finally, including more items in the categories of the questionnaire could help to provide a more comprehensive understanding of the relationships between variables.

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