La voz del alumnado en el (re)diseño de asignaturas para incentivar su engagement mediante un enfoque cualitativo

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TESIS DOCTORAL

Título	La voz del alumnado en el (re)diseño de asignaturas para incentivar su *engagement* mediante un enfoque cualitativo
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RESUMEN

Esta investigación tiene como objetivo presentar una propuesta orientada a potenciar el *engagement* del alumnado mediante el (re)diseño de programas de asignaturas a partir de la práctica de toda una serie de actividades específicas durante la primera sesión de clase de una asignatura, así como mediante el análisis del análisis de las opiniones del alumnado al finalizar el programa formativo, todo ello a partir de mecanismos en los que el alumnado juega un papel destacado. Los programas de ingeniería incluyen en mayor o menor medida conceptos y temáticas relacionadas con el ámbito de la gestión empresarial, dada su relevancia en la formación integral del futuro ingeniero. De acuerdo con numerosos trabajos de investigación, tanto los conocimientos específicos del área empresarial como la adquisición de competencias y habilidades requeridas en dicho entorno resultan especialmente útiles tanto en el proceso de entrada al entorno laboral ingenieril como en el posterior desarrollo de su actividad profesional. No obstante, una parte del alumnado de ingeniería no encara con entusiasmo las asignaturas y las actividades formativas diseñadas a tal efecto. Así pues, resultan relevantes todos los esfuerzos destinados a revertir dicha situación para mejorar el grado de *engagement* del alumnado en todas las asignaturas y, de forma especial, en las materias de gestión empresarial en las que se han detectado déficits específicos en este ámbito.

Un conjunto de condicionantes quedan reflejados en este estudio: 1) desde el año 2019, La Salle-*Universitat Ramon Llull* (URL) inició la implementación y el desarrollo del modelo denominado Nuevo Contexto de Aprendizaje (NCA), con el objetivo de revolucionar y adecuar el proceso de aprendizaje del alumnado nativo digital; 2) la irrupción de la *COVID-19* (*Coronavirus Disease* 2019) acabó generando a principios de 2020 una pandemia global que comportó la adopción de diversas medidas de carácter restrictivo en lo relativo al contacto personal y que derivó en restricciones de acceso físico a los centros educativos, efectos que a nivel de las enseñanzas de grado universitario se soslayaron en una primera instancia en La Salle-URL mediante la adopción y despliegue de una solución *ERT* (*Emergency Remote Teaching*), en substitución de la modalidad *F2F* (*Face-to-face*); 3) la implementación de una tecnología *SC* (*Smart Classroom*) en el curso académico 2020-2021 en substitución de la solución *ERT*, para posibilitar sesiones formativas en un formato remoto que ofreciesen al alumnado una experiencia de aprendizaje lo más similar posible al formato presencial.

Con el objetivo de incrementar el *engagement* del alumnado, se propone un modelo en el que mediante técnicas cualitativas se recojan las percepciones del alumnado dándole voz, y así poderlas integrar con las percepciones del profesorado y proceder a un (re)diseño de la asignatura analizada. Los experimentos plasmados en los artículos de investigación de esta tesis por compendio se han focalizado en las asignaturas de gestión empresarial dentro del contexto de programas de ingeniería, ya que surge de forma especial la necesidad de fomentar el *engagement* en dichas materias. Las opiniones del alumnado se han recogido en dos momentos especialmente significativos: el primer día de clase de una asignatura y, una vez el alumnado ha finalizado la asignatura, mediante técnicas de *User Experience* (*UX*). Dada la adopción de la tecnología SC por parte de la Institución, se ha recogido de forma explícita la percepción del alumnado una vez estos han experimentado tres despliegues tecnológicos en tres semestres consecutivos, a saber: *F2F*, *ERT* y *SC*. De los experimentos realizados se puede concluir que el modelo propuesto reporta una serie de hallazgos susceptibles de ser incorporados al (re)diseño de asignaturas con la finalidad de incrementar el *engagement*.

Palabras Clave

COVID-19; Dando voz al alumnado; Educación universitaria, *Engagement*; Gestión empresarial; Ingeniería TIC; Motivación; Primer día de clase; *Smart Classroom*, *User Experience*.

PREFACIO

Esta investigación se ha realizado a caballo de dos grupos de investigación: *GRETEL* (*Grup de Recerca en Technology Enhanced Learning*) y *DS4DS* (*Data Science for Digital Society*), y se ha orientado al diseño de un modelo de (re)diseño de programas de asignaturas de ingeniería, con la finalidad última de mejorar el *engagement* del alumnado. En el escrito se presentan los hallazgos obtenidos en el marco de este trabajo que resultan de aplicación tanto en la mejora de las asignaturas de gestión empresarial, como al resto de asignaturas impartidas en los siete programas de ingeniería del ámbito de las TIC (Tecnologías de la Información y de la Comunicación) en La Salle-URL. La investigación se ha focalizado en el contexto de asignaturas de gestión empresarial, dada la especial problemática que estas presentan en relación con el *engagement* del alumnado de ingeniería, lo que no excluye el traslado de los hallazgos obtenidos a asignaturas de otros ámbitos de conocimiento. Las investigaciones realizadas dentro del contexto de las asignaturas de gestión empresarial han permitido la obtención de datos y hallazgos susceptibles de ser replicados a partir del curso 2021-2022 en otras asignaturas de los programas de ingeniería, al generar un conocimiento útil, tanto a nivel de coordinación de programa universitario, como de coordinación de asignatura.

El impacto derivado a partir de los hallazgos realizados, previsibles *ex-ante* una vez se idearon los objetivos de la investigación, ha sido un acicate importante de cara a los esfuerzos invertidos en este trabajo de doctorado, dado el rol de coordinador del grado de ingeniería en Organización de las TIC que desempeño, junto con una alta dosis de motivación interna asociada a completar estos estudios de tercer ciclo como punto y seguido a mi formación académica. El aprendizaje de cosas nuevas, partiendo de mi curiosidad, me ha reportado siempre una gran satisfacción a nivel personal, en la medida que el nuevo conocimiento me ha permitido adquirir un nuevo bagaje que ha complementado y potenciado todo el aprendizaje previo que he tenido la oportunidad de adquirir en distintos ámbitos. En el caso de los estudios de doctorado, quisiera destacar dos consideraciones, a mi juicio muy valiosas: 1) la adquisición de unos conocimientos específicos a partir de conceptualizaciones y prácticas asociadas a la enseñanza, derivados del estudio y del análisis de contribuciones académicas de otros autores; 2) el aprendizaje y la aplicación de técnicas de investigación, potenciadas a partir de la riqueza intelectual y personal de todos aquellos con los que tenido el honor y el placer de colaborar en el marco de este programa de doctorado.

En este apartado suelen reflejarse agradecimientos a figuras clave en la vida del doctorando. En mi caso, quisiera destacar, en primer lugar, a toda mi familia sin excepción, con un recuerdo especial a Dolors y Bernat, dos de mis abuelos que ya no están entre nosotros. A un nivel más personal, quisiera nombrar a Clara, Francesc, Joaquim, Josep Maria, Montserrat, … con quienes me une una amistad que valoro en gran medida. A nivel formativo y académico, las primeras personas que vienen a mi mente son las figuras de mis progenitores Rosa María y Joan, este último excelente ingeniero de profesión y aún mejor padre y persona. Mencionar, asimismo, diversas personas que han contribuido a mi desarrollo personal y académico: doctor Joan Bahí Sabartés, profesor Planas, hermano Antonio Vallejo, hermano Daniel Cabedo, hermano Josep Martí, doctor Jaume Filella, doctor Màxim Borrell, doctor Carlos J. Maluquer de Motes, doctor Guillem López-Casasnovas, doctor Xavier Vilasís... Junto a todos ellos, quisiera mencionar a mis colegas de La Salle-URL, con los que me une relación profesional a la vez que personal en muchos de los casos, a los que no voy a citar nominalmente en este apartado, para evitar olvidarme de alguno de ellos; no obstante, y de forma excepcional, quisiera citar de forma explícita a Xevi y a Ignasi. De forma especial, quiero expresar mi gratitud a todas aquellas personas que se han implicado de alguna forma en mi doctorado, jugando un papel destacado mis dos directores de tesis y todos los que han colaborado en los trabajos de investigación. Finalmente, agradecer los comentarios y sugerencias aportados por los miembros del tribunal de lectura y defensa de esta tesis.

ÍNDICE

ACRÓNIMOS

ABET: *Accreditation Board for Engineering and Technology*

ANECA: Agencia Nacional de Evaluación de la Calidad y Acreditación

AQU: *Agència per a la Qualitat del Sistema Universitari de Catalunya*

AQUIB: *Agència de Qualitat Universitària de les Illes Balears*

BLA: *Bipolar Laddering*

BMC: *Business Model Canvas*

COVID-19: Corona Virus Disease 2019

DS4DS: *Data Science for Digital Society*

EEES: Espacio Europeo de Educación Superior

ERT: *Emergency Remote Teaching*

ESD: *Education for Sustainable Development*

F2F: *Face-to-face*

GRETEL: *Grup de Recerca en Technology Enhanced Learning*

LMS: Learning Management System

JCR: *Journal Citation Report*

NCA: Nuevo Contexto de Aprendizaje; en inglés, *New Learning Context, NLC*.

OTIC: Organización de las Tecnologías de la Información y la Comunicación

PBL: *Project-Based Learning*

SaP: *Students as Partners*

SC: Smart Classroom

SDL: Service-*Dominant Logic*

TEEM: Technological Ecosystems for Enhancing Multiculturality

TIC: Tecnologías de la Información y la Comunicación

UNIBASQ: Agencia de Calidad del Sistema Universitario Vasco

URL: *Universitat Ramon Llull*

UX: *User Experience*

VSMA: Verificación, Seguimiento, Modificación, Acreditación

1. INTRODUCCIÓN

El rol de coordinador del grado de Ingeniería en Organización de las TIC (Tecnologías de la Información y la Comunicación) que desempeño en La Salle Universitat Ramon Llull (La Salle-URL), junto con la coordinación e impartición de asignaturas del ámbito de la gestión empresarial en los distintos grados de ingeniería del ámbito TIC, han motivado que el presente trabajo de investigación se focalice en la mejora continua y el desarrollo de las asignaturas de ingeniería, con el fin último de incrementar la calidad de la enseñanza ofrecida al alumnado. La investigación se orienta a la experimentación y el desarrollo de un modelo de (re)diseño de asignaturas basado en la propuesta de escuchar al alumnado incorporando nuevos mecanismos a los que habitualmente ya se han venido empleando en La Salle-URL.

Este documento de tesis por compendio se centra en la articulación de una propuesta de (re)diseño de programas de asignaturas de ingeniería que conduzca a incrementar el nivel de *engagement* del alumnado. A nivel de investigación, esta se focaliza en las asignaturas de gestión empresarial de programas de ingeniería impartidos en La Salle-URL, al tratarse de materias que gran parte del alumnado de ingeniería considera alejadas de sus intereses iniciales. Una formación básica en el ámbito de empresa y gestión resulta fundamental para completar la formación y facilitar tanto la empleabilidad como el mismo acceso al mercado laboral del futuro ingeniero. En el contexto de esta investigación, dos elementos inciden de forma específica en este estudio: 1) la implantación del denominado Nuevo Contexto de Aprendizaje (NCA), un nuevo modelo educativo introducido recientemente en la comunidad educativa de La Salle para potenciar el aprendizaje del alumnado, basado en una serie de principios pedagógicos que se articulan mediante diferentes ámbitos de aprendizaje; 2) la adopción de la tecnología *Smart Classroom* (SC) en las aulas y los laboratorios, desplegada como elemento de choque para superar las limitaciones de acceso físico al Campus impuestas a resultas de la pandemia generada por el *COVID-19* (*Corona Virus Disease 2019*), y que posibilita la implantación de diferentes mecanismos y estrategias educativas. De esta situación surge la necesidad de investigar qué mecanismos se pueden incorporar en las sesiones de clase para potenciar el *engagement* y la motivación del alumnado. El término en inglés *engagement* puede traducirse como 'implicación' o bien como 'compromiso', presentado ciertos matices semánticos que nos ha llevado a mantener la nomenclatura en inglés en este escrito. Las actividades de investigación se han llevado a cabo con la participación de estudiantes de los siete programas de ingeniería del ámbito TIC impartidos en La Salle-URL. Desde un punto de visto conceptual, se ha optado por 'dar voz al alumnado' (en inglés, *students' voice*), para incidir en el proceso de mejora de los programas de las asignaturas, al ser el alumno el protagonista central al que se orientan la lógica y todos los esfuerzos formativos. Ello ha permitido conceptualizar al alumnado como usuario o receptor de un servicio en forma de asignatura, por lo que se ha optado por incorporar técnicas de experiencia de usuario (*UX,* acrónimo en inglés de *User Experience*) para recabar los datos de esta investigación.

A nivel práctico, el estudio se centra en el estudio y diseño de mecanismos para potenciar el *engagement* del alumnado de ingeniería en las asignaturas del ámbito de la gestión empresarial, dada la especial problemática que presentan, y se articula a partir de actividades de investigación realizadas en el contexto de la implantación generalizada tanto del NCA como de la tecnología SC en el Campus La Salle-URL. El objetivo asociado el presente trabajo se traduce en una serie de investigaciones, a saber: 1) estudiar las percepciones del alumnado con relación a sus vivencias de aprendizaje, una vez han experimentado tres sistemas instrumentalizados a partir de diferentes tecnologías: *Face-to-face* (*F2F*), *Emergency Remote Teaching* (*ERT*) y *Smart Clasroom* (*SC*); 2) realizar un estudio empírico en la primera sesión de clase de una asignatura, tanto de las actividades y prácticas que gustan (*likes*), así

como las que no gustan (*dislikes*) al alumnado de ingeniería, para (re)orientar el diseño de primeras sesiones de clase de forma consistente con el marco del Nuevo Contexto de Aprendizaje (NCA); 3) experimentar actividades de primer día de clase con el objetivo de potenciar el *engagement* del alumnado; 4) proponer mecanismos de ajuste del contenido de las asignaturas de gestión empresarial en programas de ingeniería, basados en dar voz al alumnado mediante el despliegue de técnicas de experiencia de usuario, para así incidir de forma positiva en el aprendizaje del alumnado.

Así pues, el objetivo de esta tesis es el de presentar una propuesta que constituya un modelo de mejora continuo en el (re)diseño y la mejora de los programas de las asignaturas impartidas en los grados de ingeniería TIC, orientada a fomentar el *engagement* del alumnado. Para ello, se propone recabar tanto la información cualitativa generada por el alumnado a partir de su experiencia de usuario una vez a cursado la asignatura, como las percepciones y valoraciones asociadas a distintas actividades específicas llevadas a cabo en el contexto de la asignatura. La finalidad última se orienta al incremento del *engagement* del alumnado, consistentemente con los hallazgos postulados en otras investigaciones, quedando fuera del objeto de esta tesis de investigación la cuantificación concreta del *engagement*.

En este documento de tesis se presentan una serie de contribuciones académicas en forma de artículos de investigación (Petchamé, Iriondo, Canaleta, et al., 2021; Petchamé, Iriondo, Villegas, Fonseca, et al., 2021; Petchamé, Iriondo, Villegas, Riu, et al., 2021), todas ellas alineadas con el objetivo enunciado. La presentación de hallazgos y resultados de esta memoria de investigación se organiza a partir de la siguiente estructura formal: 1) Marco teórico del estudio; 2) Contextualización, delimitación y técnicas empleadas en la investigación; 3) Síntesis de los hallazgos y los resultados obtenidos en las distintas contribuciones académicas generadas en el marco de este estudio, desgranadas por publicación; 4) Aspectos Éticos; 5) Discusión y contribución; 6) Conclusiones, limitaciones y líneas de futuro.

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Las tres contribuciones *peer-reviewed* asociadas a esta tesis doctoral por compendio han sido publicadas en revistas indexadas en el *JCR* (*Journal Citation Report*), dos de ellas incluidas en el cuartil *Q2*[1] (publicaciones 1 y 2) y la otra en el cuartil *Q1*[2] (publicación 3). Los artículos que conforman esta investigación son los siguientes:

- **Publicación 1**: Petchamé, J.; Iriondo, I.; Villegas, E.; Riu, D.; Fonseca, D. Comparing Face-to-Face, Emergency Remote Teaching and Smart Classroom: A Qualitative Exploratory Research Based on Students' Experience during the COVID-19 Pandemic. Sustainability 2021, 13, 6625. https://doi.org/10.3390/su13126625

  Incluida en el Special Issue 'Information Systems, E-learning and Knowledge Management'.

- **Publicación 2**: Petchamé, J.; Iriondo, I.; Canaleta, X.; Riu, D.; Necchi, S. Engaging ICT Engineering Undergraduates in a Management Subject through First Day of Class Activities: An Empirical Study. Sustainability 2021, 13, 7440. https://doi.org/10.3390/su13137440

  Incluida en el Special Issue 'Engaging Students in Sustainable Science Education'.

[1] Cuartil 2 en el *JCR* del año 2020, según última actualización disponible del ranking de dicho índice.
[2] Cuartil 1 en el *JCR* del año 2020, según última actualización disponible del ranking de dicho índice.

- **Publicación 3**: Petchamé, J.; Iriondo, I.; Villegas, E.; Fonseca, D.; Romero Yesa, S.; Aláez, M. A Qualitative Approach to Help Adjust the Design of Management Subjects in ICT Engineering Undergraduate Programs through User Experience in a Smart Classroom Context. Sensors 2021, 21, 4762. https://doi.org/10.3390/s21144762

  Incluida en el Special Issue: 'Human-Computer Interaction in Pervasive Computing Environments'.

Otros documentos relacionados de forma directa con este documento de tesis lo constituyen dos contribuciones académicas *peer-reviewed* indexadas en SCOPUS, presentadas en la conferencia internacional *Technological Ecosystems for Enhancing Multiculturality* 2020 (TEEM'20):

- **Publicación 4**: Petchamé, J., Iriondo, I., Riu, D., Masi, T., Almajano, A., & Fonseca, D. (2020, octubre). Project Based Learning or the Rethinking of an Engineering Subject: Measuring Motivation. En F. J. García-Peñalvo (Eds.), Proceedings of the *Eighth International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 267-272). https://doi.org/10.1145/3434780.3436542

  TEEM'20. Incluida en el Track 6: 'Educational Innovation'.

- **Publicación 5**: Petchamé, J., Iriondo, I., Riu, D., Masi, T., Almajano, A., & Fonseca, D. (2020, octubre). Self & Peer to Peer Assessment: Evaluating Oral Presentations in a Final Year Engineering Subject. En F. J. García-Peñalvo (Eds.), Proceedings of the *Eighth International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 784-790). https://doi.org/10.1145/3434780.3436552

  TEEM'20. Incluida en el Track 13: 'Evaluation in education and guidance'.

2. MARCO TEÓRICO

El marco teórico de la tesis presentada en este escrito se orienta a la captura de las percepciones del alumnado en relación con diversas actividades y prácticas para proceder a un (re)diseño continuo de asignaturas. En este apartado se presenta un conjunto de aportaciones teóricas a tener en consideración.

2.1 CONSTRUCTIVISMO Y *STUDENT-CENTERED APPROACH*

El punto de partida teórico de este documento de tesis lo constituye la teoría de aprendizaje sobre la cual se sustenta y articula la propuesta presentada en este escrito. Una taxonomía de las teorías clásicas de aprendizaje incluye el conductismo, el cognitivismo y el constructivismo (Kay & Kibble, 2016). A dichas teorías clásicas cabe añadir la teoría de aprendizaje del conectivismo, ya que la implantación de la tecnología SC posibilita incorporar de forma efectiva el acceso al conocimiento mediante el uso de redes que soportan contenidos digitales (Corbett & Spinello, 2020; Goldie, 2016). En un primer estadio se ha partido de una conceptualización basada en el constructivismo, teoría basada en cimentar la formación del alumnado a partir de distintas actividades de aprendizaje (Biggs, 2013), y que se plasma de forma práctica, entre otros, en la adopción de la metodología del *Project-Based Learning* (Grant, 2002; Gülbahar & Tinmaz, 2006). Dadas las posibilidades derivadas tanto de la adopción del marco NCA como de la tecnología SC en las aulas y los laboratorios, cabe tener presente las propuestas de la teoría de aprendizaje conectivismo, al posibilitar la tecnología SC la incorporación dentro del aula el acceso al conocimiento mediante redes que soportan contenidos digitales de una forma efectiva (Corbett & Spinello, 2020).

El elemento de referencia central de este trabajo es el alumnado, y la tesis pivota sobre la búsqueda, adopción e implementación de mecanismos potenciadores de su *engagement* a partir de dar voz al alumnado, ya sea mediante actividades de primer día de clase, ya mediante la adopción de mecanismos que permitan la mejora continua de los programas de las asignaturas. Así pues, y de forma consistente con los objetivos de este trabajo de investigación, pueden destacarse un conjunto de actividades y prácticas que tienen como protagonista central al alumnado: 1) encuesta de la primera sesión de clase (‘*likes*’ y ‘*dislikes*’); 2) una entrevista alumnado-instructor seguida de una entrevista instructor-alumnado (en inglés, *Reciprocal Interview Activity*) durante la primera sesión de clase; 3) Encuesta de percepción de las tres modalidades de clase asociadas a cada uno de los contextos tecnológicos específicos vividos por el alumnado durante tres semestres consecutivos, de acuerdo con la siguiente cronología: *F2F*, *ERT* y *SC*; 4) Experiencia de usuario (*UX*) del alumnado una vez ha completado su formación en la asignatura.

2.2 ENGAGEMENT Y MOTIVACIÓN DEL ALUMNADO

En este apartado se presenta la conceptualización del constructo *engagement*, así como los mecanismos empleados en esta investigación para la potencialización de este.

De acuerdo con los modelos generados a partir de diferentes propuestas teóricas (Cook & Artino, 2016), *engagement* y ‘motivación para aprender’ se encuentran relacionados, consistentemente con los modelos generados a partir de diferentes propuestas teóricas, pudiéndose incluso incorporar la tecnología en esta relación (D. Peters et al., 2018). El constructo *engagement* se ha definido por parte de diversos autores, incluyendo cada uno de ellos diversos matices (Christenson et al., 2012; Groccia, 2018), y a cuya conceptualización se han asociado diferentes componentes, como pueden ser las conductuales, las cognitivas y las afectivas (Fredricks et al., 2004). Distintas definiciones se han propuesto en relación al término *engagement* (Christenson et al., 2012; Groccia, 2018). En esta

investigación se adopta una propuesta que incluye de forma explícita los conceptos de actividad y entorno de aprendizaje, nucleares en este estudio de investigación:

> El *engagement* del alumnado es la energía y el esfuerzo que los estudiantes emplean dentro de su comunidad de aprendizaje, observable a través de indicadores conductuales, cognitivos o afectivos en un continuo. Está conformado por una variedad de influencias estructurales e internas, incluida la compleja interacción de relaciones, actividades de aprendizaje y el entorno de aprendizaje. (Melissa Bond et al., 2020)

Se ha observado en diferentes investigaciones una incidencia positiva del *engagement* del alumnado en sus resultados académicos (Gunuc, 2014; Lei et al., 2018; Linnenbrink & Pintrich, 2002; Wigfield et al., 2015), a pesar de encontrarse algunas paradojas en alguna investigación (Shernoff & Schmidt, 2008). Diversos autores han propuesto distintas técnicas y prácticas ideadas con la finalidad de incrementar el *engagement* del alumnado (Barkley & Major, 2020; Christopoulos et al., 2018; Heller et al., 2010; H. Peters et al., 2018). Por otra parte, cabe destacar el papel relevante que juega la relación instructor-alumnado en el *engagement* (Klem & Connell, 2004; Roorda et al., 2011, 2017).

En lo relativo a la motivación, y en concreto a la 'motivación para aprender', esta puede articularse a partir de diversas teorías contemporáneas tal y como se recoge en (Cook & Artino, 2016): la teoría de la expectativa del valor (en inglés*, Expectancy-Value Theory*), la teoría de la atribución (en inglés, *Attribution Theory*), la teoría social-cognitiva (en inglés, *Social-Cognitive Theory*), o la teoría de la orientación al objetivo (en inglés, *Goal-Orientation Theory*). A partir de distintas definiciones, puede apuntarse que el constructo motivación para aprender "tiene que ver con identificar por qué se opta por un determinado comportamiento por parte de un individuo, comportamiento orientado a alcanzar el objetivo de un determinado aprendizaje" (Petchamé et al., 2020a). Al estudiar el constructo 'motivación para aprender' aparecen dos conceptos teóricos relevantes: 1) motivación intrínseca, o cuando el comportamiento es consecuencia de percibir algo como interesante por sí mismo; 2) motivación extrínseca, o cuando el comportamiento se asocia al beneficio de recibir una recompensa o bien al hecho de evitar un castigo o penosidad (Ryan & Deci, 2000).

De acuerdo con la corriente teórica mayoritaria, tal y como se recoge en Bond et al. (M. Bond et al., 2020), se puede apuntar que la motivación se asocia a un elemento inobservable que impulsa a un comportamiento, constituyendo un antecedente de un comportamiento observable, el *engagement*. Ambos conceptos se encuentran relacionados, de forma que el *engagement* del alumnado incide de forma positiva tanto en la satisfacción, así como en la motivación para aprender del alumno y en sus resultados (F. Martin & Bolliger, 2018). Así pues, resultará de interés la búsqueda de estrategias tendentes a potenciar el *engagement* del estudiantado, casuística investigada en distintas contribuciones académicas (Abou-Khalil et al., 2021; Dunne & Owen, 2013; F. Martin & Bolliger, 2018).

2.3 LA VOZ DEL ALUMNADO

En el ámbito educativo, el dar voz al alumnado (en inglés, *students' voice*) constituye una práctica que se ha venido empleando en diferentes investigaciones con diversas finalidades y objetivos (Biasutti, 2011, 2017; Brooman et al., 2015; Young & Jerome, 2020), orientado en ocasiones a constituir un motor generador de cambios a nivel educativo (Mitra, 2018; Pearce & Wood, 2019). El solo hecho de preguntar al alumnado implica por sí mismo el envío de un mensaje por parte del instructor de que este último está interesado en oír las opiniones del estudiantado; si además el alumnado percibe que dichas opiniones son valoradas y tenidas en cuenta por parte de los instructores, se transmite una idea de interés susceptible de revertir en *engagement* (Elliott et al., 2020; Matthews et al., 2019; Seale, 2016; Smyth, 2006). De lo apuntado puede desprenderse que el fomento de la participación del alumnado desde distintos roles y ámbitos constituye una fuente de *engagement*, tal y como se apunta

en (Harrington et al., 2014). La participación del alumnado es susceptible de ser categorizada en cuatro grandes bloques (Dunne & Zandstra, 2011): 1) partícipes en procesos de toma de decisiones; 2) agentes del cambio; 3) socios, cocreadores y expertos; 4) sujetos evaluadores de su experiencia de aprendizaje. En uno de estos segmentos, el tercero, encaja con el concepto *Students as Partners* (*SaP*), englobado dentro del marco de dar voz al alumnado (Matthews et al., 2019). *SaP* postula un rol activo del alumnado que va más allá de la mera recepción de conocimientos al contribuir y enriquecer la propuesta de enseñanza (Cook-Sather et al., 2018). Por otra parte, en el segmento mencionado en cuarto lugar el alumnado evalúa distintos aspectos de su experiencia educativa, y es el que constituye el encaje teórico en el que se enmarca este documento de tesis.

Al hilo de lo apuntado en este apartado cabe mencionar que diversas contribuciones académicas han teorizado sobre la idoneidad o no de considerar al alumnado como un cliente desde la perspectiva del marketing y las implicaciones que ello conlleva (Bunce et al., 2017; Díaz-Méndez et al., 2019; Guilbault, 2018). En los últimos años ha ganado terreno en entornos educativos la denominada lógica *service-dominant* (*SDL*), que va más allá de la consideración del alumnado como simple cliente, al incorporar dicha lógica roles de participación por parte de quien recibe el servicio, constituyendo un marco que permite un encaje adecuado de la educación superior, ya sea desde una perspectiva de sector privado o de un enfoque de políticas públicas (Díaz-Méndez et al., 2019). Sin ser el objeto de este escrito el desarrollar los postulados de la *SDL*, resulta pertinente hacer referencia a los fundamentos básicos de la misma y que son presentados en (Vargo & Lusch, 2017).

En este punto conviene apuntar la existencia de diversas contribuciones académicas recientes donde se analizan los efectos e implicaciones derivados de la participación del alumnado (Bland & Atweh, 2007; Bovill et al., 2011; Cook-Sather et al., 2018; Maurer et al., 2021), más allá del ámbito de estudio de esta investigación.

3. ANTECEDENTES DE LA INVESTIGACIÓN

En este apartado se incluyen elementos que permiten contextualizar y delimitar la investigación, a la vez que presentar las técnicas que se han empleado.

3.1 CONTEXTO DE LA INVESTIGACIÓN

Tres elementos han marcado de forma significativa la investigación que se presenta en este documento de tesis: 1) la adopción del denominado Nuevo Contexto de Aprendizaje (NCA), en inglés *New Learning Context* (*NLC*), a raíz de una decisión estratégica planificada por parte de la Institución; 2) la irrupción imprevista de la pandemia generada por el *COVID-19*; 3) los condicionantes normativos asociados a las titulaciones oficiales de los programas educativos. De forma sucinta se presentan a continuación las implicaciones derivadas de los mismos, junto con las decisiones adoptadas y su impacto a los efectos de la tesis aquí presentada.

3.1.1 Nuevo Contexto de Aprendizaje

El alumnado que hoy en día accede a los estudios universitarios lo constituye de forma mayoritaria una generación que ha nacido en un momento en el que un conjunto de tecnologías digitales ya se habían desplegado de un modo efectivo en la sociedad, y han sido denominados como 'nativos digitales' (Prensky, 2001), o bien como miembros pertenecientes a la '*Net generation*' (Tapscott, 2008). Se les asocia una familiaridad en el uso de las TIC (Hargittai, 2010; Jones et al., 2010), a pesar de no poseer necesariamente un nivel de conocimientos y destrezas homogéneos entre todos ellos (Hargittai, 2010). Otra parte menos significativa del alumnado que accede a enseñanzas universitarias vendría categorizada dentro de la denominación 'inmigrantes digitales' (Ransdell et al., 2011), de quienes de igual forma no se podría predicar la homogeneidad en lo relativo al uso y habilidades de las TIC (Jones et al., 2010; Prensky, 2001). Una clasificación alternativa a la presentada por Presky la constituye la que categoriza al usuario de la tecnología como *'visitor'* o como *'resident'* según sea el contexto y su motivación, en lugar de considerar como criterio discriminatorio únicamente la edad y su *background* (White & Le Cornu, 2011). Por otro lado, cabe destacar que en la actualidad existe un amplio abanico de dispositivos tecnológicos y de *software* que posibilitan potenciar y desarrollar distintos formatos de enseñanza (Godlewska et al., 2019; Hwang, 2014; Kwet & Prinsloo, 2020; Saini & Goel, 2019).

En diciembre de 2018 La Salle AMEL aprobó el denominado Nuevo Contexto de Aprendizaje (NCA), un modelo de aprendizaje aplicable en las diferentes etapas educativas, incluyendo las enseñanzas universitarias (La Salle Distrito ARLEP, 2018, 2020). El objetivo del diseño e implementación del NCA es el de adecuar el modo de enseñar al alumnado actual, siendo consciente de las TIC disponibles en cada momento. Así pues, un perfil de alumnado ya habituado a un entorno tecnológico dentro del contexto de una sociedad altamente digitalizada y tecnificada posibilita la adopción de un modelo NCA que permite explotar todas las posibilidades tecnológicas existentes, al efecto de potenciar el aprendizaje del alumnado. No es la meta de esta tesis el detallar la conceptualización del modelo NCA. No obstante, y dado el objetivo de este trabajo de investigación, una descripción sintética de los elementos nucleares del NCA se hace necesaria, ya que la investigación llevada a cabo en esta tesis incide de forma específica en el despliegue y el desarrollo de dos de los ámbitos de aprendizaje constitutivos del marco NCA. Sucintamente descrito, desde un punto de vista conceptual el marco del modelo NCA puede presentarse a partir de los elementos incluidos en la Figura 1.

Figura 1. Esquema nuclear de la estructura del Nuevo Contexto de Aprendizaje (NCA): Principios pedagógicos y ámbitos de aprendizaje. Fuente: (Petchamé, Iriondo, Canaleta, et al., 2021)

Así pues, y descrito de forma esquemática, el modelo NCA se basa en los cinco principios pedagógicos presentados en la Figura 1, que sustentan y se cristalizan en cinco ámbitos de aprendizaje presentados y desarrollados *ex novo* en uno de los artículos incluidos en este documento de tesis (Petchamé, Iriondo, Canaleta, et al., 2021), motivo por el cual dicho artículo se ha incluido y referenciado en este apartado del marco teórico. Los principios pedagógicos actúan a modo de lógica y base en el diseño y conceptualización de los ámbitos de aprendizaje, desgranándose estos últimos en los elementos que acaban conformando el diseño efectivo de los distintas asignaturas o módulos de aprendizaje que acaban configurando un programa formativo específico. Los ámbitos de aprendizaje que caracterizan el modelo NCA son: acogida, seminario, taller, proyecto y cierre. A destacar que el ámbito de aprendizaje denominado 'acogida' es susceptible de incorporar toda la serie de elementos muy relevantes al inicio de una asignatura o módulo de aprendizaje, al incidir en diversos aspectos condicionantes del desarrollo de toda la asignatura tales como la motivación del alumnado, su *engagement*, el clima que se estable en clase entre instructor y estudiantado, etc. (Bennett, 2004; Bruce, 2013; Case et al., 2008; Iannarelli et al., 2010; Kreizinger, 2006; Sandy Maisel & Dineen, 2018; Wilson, 2006; Wilson & Wilson, 2007).

Concluir, a partir de todo lo apuntado, que el modelo NCA se orienta en una línea consistente con lo que se ha venido denominando como lógica *ESD* (*Education for Sustainable Development*), ya que se pretende impulsar una transformación educativa orientada al *engagement* del alumnado, la evaluación formativa y las metodologías activas (Cebrián et al., 2020).

3.1.2 El impacto del COVID-19 en los sistemas educativos

A inicios de 2020 se declaró una pandemia derivada de la afectación entre la población a escala global del *COVID-19* (Cucinotta & Vanelli, 2020). Los efectos de dicha pandemia comportaron múltiples afectaciones negativas en diversos ámbitos: económico (Fernandes, 2020; Nicola et al., 2020); salud, en forma de estrés (Rudenstine et al., 2020; Wang et al., 2020), depresión y ansiedad (Cheung et al., 2020), etc. Distintos estamentos gubernamentales adoptaron diversas medidas para intentar contener la pandemia con la intención de aliviar las tensiones asistenciales que sufrían la mayoría de los sistemas sanitarios (Parker et al., 2021; Pearson, 2020). En dicha línea se promulgaron en mayor o menor medida el cierre selectivo de actividades para minimizar el contacto social, junto con restricciones a la movilidad de los ciudadanos (Karalis & Raikou, 2020; Stockwell et al., 2021). Dicho efecto se tradujo, a nivel de los distintos sistemas educativos, en el cierre de centros de enseñanza (Parker et al., 2021). Dicha media restrictiva se acompañó de la recomendación por parte de organismos gubernamentales

y supra gubernamentales de la recomendación de adoptar la enseñanza *online* como mecanismo paliativo ante la imposibilidad de realizar enseñanzas F2F (Kumar et al., 2020; Ting et al., 2020; Whitelaw et al., 2020). Dicha migración, no por ser teóricamente recomendable, no deja de estar exenta de retos a distintos niveles, de entre los cuales se pueden destacar los siguientes: las infraestructuras físicas requeridas tanto por el alumnado como por los instructores y los centros educativos para poder realizar enseñanzas *online*, la adecuación de mecanismos inicialmente pensados a ser desarrollados en un entorno *F2F* a un formato *online*, o las habilidades comunicativas en un entorno *online* por parte de los distintos actores implicados (W. Zhang et al., 2020).

Existen diversas consideraciones a destacar en relación a la modalidad de enseñanza *online*: 1) aprendizaje *online* y aprendizaje a distancia no son necesariamente modalidades equivalentes (Moore et al., 2011); 2) el aprendizaje *online* puede ser diseñado en formato síncrono o asíncrono (Clark et al., 2015; de Jong et al., 2013; Hrastinski, 2008; McBrien et al., 2009); 3) el aprendizaje *online* presenta un conjunto de retos en lo relativo al *engagement* del alumnado al experimentar dicha modalidad, de acuerdo a diversos trabajos de investigación (Arkorful & Abaidoo, 2015; Dumford & Miller, 2018; Florence Martin & Bolliger, 2018; Meyer, 2014).

3.1.3 Formación reglada en programas universitarios de ingeniería

Las investigaciones presentadas en este escrito se ha focalizado en el alumnado que cursa estudios reglados de ingeniería en el ámbito de las TIC. Los programas oficiales de ingeniería ya sean de grado o de máster, en tanto que oficiales, abrazan la lógica del Espacio Europeo de Educación Superior (EEES). El EEES nace de la Declaración de Sorbona de 25 de mayo de 1998, sentándose sus bases en la Declaración de Bolonia de 19 de junio de 1999 (Educaweb, 2021b). El seguimiento y evolución del EEES se ha reseñado en ulteriores comunicados: Praga (2001); Bergen (2005); Londres (2007); Lovaina (2009); Budapest y Viena (2010); Bucarest (2012); Ereván (2015) y Paris (2018). El objetivo del EEES es el de armonizar la enseñanza universitaria dentro del contexto europeo para promover tanto la movilidad de las personas entre estados, como la empleabilidad de los ciudadanos europeos (Educaweb, 2021b). Así pues, pueden destacarse las siguientes consideraciones:

- El punto inicial a partir del cual se positiviza el EEES dentro del ordenamiento jurídico estatal español lo constituye la Ley Orgánica 6/2001, de 21 de diciembre, de Universidades. Diferentes documentos legislativos adicionales han venido a completar su despliegue normativo (Real Decreto 1044/2003; Real Decreto 1125/2003; Real Decreto 1171/2003; Orden PRE/572/2006; Ley Orgánica 4/2007; Orden ECI/2514/2007; Real Decreto 1393/2007; Real Decreto 1002/2010; Real Decreto 99/2011; Real Decreto 94/2014; Real Decreto 967/2014; Real Decreto 43/2015; Real Decreto 195/2016). (Educaweb, 2021a)
- El Real Decreto 1393/ 2007, de 29 de octubre, y su posterior modificación de 3 de junio de 2016, establece en su artículo 24 y siguientes los mecanismos al que estarán sujetos las titulaciones universitarias oficiales: 1) Verificación de una titulación por parte del Consejo de Universidades, una vez el centro que quiere impartir unos estudios ha diseñado el plan de estudios, que una vez culminado reconoce a la titulación como oficial (ANECA, 2021b); 2) Acreditación de una titulación, o mecanismo de control a realizar transcurrido un período fijado por ley, consistente en contrastar el plan de estudios verificado en su día por el Consejo de Universidades, y que prorroga y acredita la titulación oficial al culminar dicho proceso; 3) Modificación, o mecanismo que permite implementar cambios en ciertos elementos de una titulación oficial (*numerus clausus*), una vez presentados y ulteriormente validados por parte del organismo competente; 4) Seguimiento, o documentación en la que se plasma la información que viene a reflejar el funcionamiento de una titulación, mecanismo que eventualmente permite el cambio de ciertos de elementos (*numerus*

clausus) del plan de estudios de la titulación oficial. Los procesos de verificación, acreditación y modificación aquí mencionados se llevan a cabo por parte de distintos organismos habilitados por ley a tal efecto, en función de donde radica el centro asociado a la titulación universitaria. Así pues, dicha función la puede llevar a cabo ANECA (Agencia Nacional de Evaluación de la Calidad y Acreditación), AQU (*Agència per a la Qualitat del Sistema Universitari de Catalunya*), AQUIB (*Agència de Qualitat Universitaria de les Illes Balears*), UNIBASQ (Agencia de Calidad del Sistema Universitario Vasco), … (ANECA, 2021a).

- Todas las titulaciones de programas oficiales están sujetas a la normativa del mencionado Real Decreto 1393/ 2007, de 29 de octubre. Cada titulación queda 'fijada' a partir de la memoria de su plan de estudios, estructurada a partir del contenido a nivel de conocimientos, competencias a adquirir y desarrollar, así como de los resultados de aprendizaje a alcanzar por parte del alumnado.
- En La Salle-URL se imparten siete programas oficiales universitarios de ingeniería en el ámbito TIC, a saber: Ingeniería en Electrónica; Ingeniería en Informática; Ingeniería Multimedia; Ingeniería en Organización de las TIC; Ingeniería en Sistemas Audiovisuales; Ingeniería en Sistemas de Comunicación, Ingeniería en Telemática (La Salle Universitat Ramon Llull, 2020). En dichas titulaciones, además de los conocimientos técnicos específicos de ingeniería TIC asociados a cada uno de los distintos grados, se imparten conocimientos básicos del mundo de la empresa y su gestión. La inclusión de contenidos básicos de gestión empresarial dentro de los programas formativos del ámbito de ingeniería constituyen elementos nucleares en la formación integral del futuro egresado (Markes, 2006). Asimismo, cabe destacar la necesidad de incluir dentro de los programas de ingeniería actividades orientadas a la adquisición y desarrollo de *soft skills*, al constituir elementos relevantes de cara a la entrada del futuro egresado en el mundo laboral (Andrews & Higson, 2008; Markes, 2006; Mason et al., 2009). En una de las titulaciones, Ingeniería en Organización de las TIC (OTIC), la formación en el ámbito empresarial constituye una parte esencial del programa de sus contenidos, sin menoscabo de los conocimientos ingenieriles propios de una titulación de ingeniero en el ámbito TIC.

3.2 MECANISMOS PARA POTENCIAR EL ENGAGEMENT DEL ALUMNADO

Consistentemente con el objetivo de esta tesis, se presentan a continuación diversos mecanismos implementados a partir de la propuesta de investigación, orientados a la potenciación del *engagement* del alumnado: 1) implementación de actividades específicas en la primera sesión de clase de una asignatura; 2) implantación de la metodología *Project-Based Learning* (*PBL*), introduciendo mecanismos de evaluación formativa, a la vez que introduciendo actividades de autoevaluación y de evaluación entre pares; 3) obtención de información relativa a la experiencia de usuario del alumnado una vez finalizada la asignatura, con el objetivo de proceder a su (re)diseño y ajuste; 4) Integración del elemento tecnológico *SC* en aulas y laboratorios.

3.2.1 Actividades específicas llevadas a cabo en la primera sesión de clase de una asignatura

En la primera sesión de clase el instructor puede optar por presentar de forma sucinta el programa de una asignatura, o bien llevar a cabo actividades específicamente diseñadas para fomentar el *engagement* del alumnado desde el primer día de clase en que se imparte la asignatura (Bennett, 2004; Iannarelli et al., 2010). La primera sesión de una asignatura tiene una gran importancia en el devenir de una asignatura (Anderson et al., 2011; Bennett, 2004), al establecerse relaciones, ritmos y pautas que impactan en todo el conjunto de sesiones de clases de la asignatura (Kreizinger, 2006). De acuerdo a distintas investigaciones, las actividades y las percepciones del alumnado en la primera sesión de una asignatura tienen efecto, entre otros, en su motivación (Wilson & Wilson, 2007), en el clima de clase (Case et al., 2008), o en el *engagement* (D. Robinson, 2019). Consecuentemente, diversos

experimentos y prácticas se han llevado a cabo con el objeto de generar un impacto positivo orientado a diversidad de aspectos en el alumnado (Bartsch, 2006; Deluse, 2018; Dorn, 1987; Gaffney & Whitaker, 2015; Helmy, 2016; Loschiavo et al., 2002; D. Robinson, 2019).

Dos tipologías de actividades que se pueden realizar durante la primera sesión de clase de una asignatura se presentan en este apartado. En primer lugar, la realización de un estudio empírico mediante preguntas abiertas acerca de las actividades preferidas y las no deseadas ('*likes*' y '*dislikes*') por parte del alumnado, en línea con otras investigaciones (Eskine & Hammer, 2017; Perlman & McCann, 1999). En la misma línea, las percepciones acerca de dichas preferencias se han recabado en otras investigaciones a partir de ponderar y valorar diferentes aseveraciones explícitas (Bassett, 2011; Henslee et al., 2006). Los hallazgos derivados de este tipo de investigación permiten diseñar y mejorar actividades de cara a posteriores 'primeros días de clase' de una asignatura, a la vez que se da una señal al alumnado en el sentido que sus impresiones y valoraciones son de interés para el profesorado, lo que constituye de por sí un elemento positivo de cara al estudiantado. Un segundo tipo de actuación lo constituye el proceder a realizar actividades de primer día de clase orientadas a un objetivo específico, ya sea el de la construcción de expectativas del alumnado (Hermann & Foster, 2008), motivación (McGinley & Jones, 2014; Wilson & Wilson, 2007) o *engagement* (Anderson et al., 2011; Kreizinger, 2006). Una de las herramientas susceptibles de ser empleadas la constituye una entrevista entre alumnado e instructores (en inglés, *Reciprocal Interview Activity*), actividad que permite romper el hielo a la vez que establecer un clima de clase en el que se establece como valor positivo la interactividad entre alumnado e instructor como mecanismo docente, implementado a partir de turnos de preguntas para resolver las dudas que puedan surgir al estudiantado, así como recabar información por parte del instructor (Case et al., 2008; Foster & Hermann, 2011).

3.2.2 *Project-Based Learning* y mecanismos de evaluación

El empleo del aprendizaje basado en proyectos (en inglés, *PBL*), resultará especialmente útil en el contexto de una asignatura del ámbito ingenieril a partir de una doble consideración: 1) la constatación empírica de los efectos positivos en el *engagement* del alumnado; 2) la idoneidad de su empleo en alumnado de ingeniería, al incorporar prácticas y modos de trabajo especialmente útiles para el futuro egresado, aplicando una de las mecánicas empleadas de forma usual en el entorno laboral del ingeniero (Kolmos & De Graaff, 2015; Mills & Treagust, 2003).

Numerosas investigaciones han evidenciado un impacto positivo en el alumnado a nivel de *engagement* derivado del empleo del *PBL* (Craft & Capraro, 2017; Hall & Miro, 2016; Johnson & Delawsky, 2013; Juuti et al., 2021; J. K. Robinson, 2013; J. Zhang et al., 2018). Asimismo, pueden predicarse efectos positivos sobre el *engagement* derivados de la evaluación continua (Holmes, 2018), la implementación de mecanismos de evaluación entre pares (Casey et al., 2011; Weaver & Esposto, 2012) y de la combinación evaluación entre pares y autoevaluación (Kearney & Perkins, 2014).

El aprendizaje basado en proyectos (*PBL*) se ha venido empleando como mecánica de enseñanza en numerosas asignaturas de ingeniería en distintos programas universitarios (Kolmos & De Graaff, 2015; Mills & Treagust, 2003). El empleo de la metodología *PBL* permite de alguna manera entrenar al estudiante de ingeniería mediante parámetros y guías que son las que previsiblemente empleará en numerosas ocasiones una vez se incorpore al mercado laboral, entorno en el cual es especialmente útil dada su mecánica de trabajo (Kolmos & De Graaff, 2015; Mills & Treagust, 2003). Así pues, emplear como método de formación en una asignatura de ingeniería una aproximación mediante PBL permite, por un lado la pura adquisición de conocimientos, a la vez que se adquieren y/o refuerzan competencias clave para el futuro ingeniero derivadas del propio uso de la técnica *PBL* (Kokotsaki et al., 2016). Diversos trabajos de investigación concluyen que a partir del empleo de la metodología *PBL*

se refuerzan competencias tales como el trabajo en equipo, la resolución de problemas o la comunicación (ABET, 2019; Chan et al., 2017; Passow, 2012; Passow & Passow, 2017).

3.2.3 *Smart Classroom*: Tecnología en el aula y en el campus

La tecnología se encuentra omnipresente en casi la totalidad de ámbitos en los que nos encontramos inmersos, actuando ya sea como elemento nuclear, ya como elemento instrumental que permite potenciar y apalancar el desarrollo de ámbitos no centrados a nivel de *core business* en la tecnología. Diversas contribuciones académicas han encontrado una correlación entre el empleo de tecnologías y el *engagement* del alumnado (M. Bond & Bedenlier, 2019; Schindler et al., 2017). Destacar, asimismo, la existencia de posibilidades disruptivas en el ámbito de aprendizaje ligadas a la tecnología *Smart*, de acuerdo a diversos estudios e investigaciones (Cebrián et al., 2020; Hwang, 2014; Zhu et al., 2016).

A raíz de la pandemia derivada del *COVID-19* se recomendó a las instituciones educativas la transición de una enseñanza *F2F* a una modalidad *online*, con el objeto de no interrumpir el proceso de aprendizaje del alumnado (Moorhouse, 2020). Esta sugerencia comportó la adopción de distintas prácticas educativas sustentadas en oportes tecnológicos que han permitido la enseñanza en una modalidad remota (Goldschmidt, 2020; González-Zamar et al., 2020; Kumar et al., 2020; Molino et al., 2020; Riva et al., 2020; Singh et al., 2020; Ting et al., 2020; Whitelaw et al., 2020).

Una de las opciones existentes la constituye la adopción de la tecnología *SC*, que posibilita tanto la transmisión como la interacción en directo entre participantes *on campus* y *off campus* (Shi et al., 2002; Xie et al., 2001), práctica que se tradujo en La Salle-URL en el despliegue al principio del curso académico 2020-2021 de la tecnología *SC* en aulas y laboratorios (ZOOM, 2021). Adicionalmente, conviene destacar que la solución *SC* permite la implementación de actividades y mecanismos que posibilitan la potenciación del aprendizaje en diversos aspectos, tales como la personalización e individualización de la enseñanza del alumnado (Hwang, 2014; Peng et al., 2019; Saini & Goel, 2019), o la compartición y discusión en tiempo real de los contenidos digitales generados por el alumnado con sus instructores y pares (Saini & Goel, 2019; Yau et al., 2003). No obstante, la enseñanza vehiculada mediante *SC* en el caso del alumnado *off campus*, requerirá la adopción de estrategias por parte del instructor para lograr mantener el interés y el *engagement* este alumnado que no está presencialmente en las aulas, al constituir *de facto* una modalidad *online* (Abou-Khalil et al., 2021; F. Martin & Bolliger, 2018). Apuntar**,** asimismo, que la implementación de la tecnología *SC* a nivel de aulas y laboratorios en un primer estadio, permite eventualmente un escalado de la tecnología a un ámbito de campus, dando pie al concepto *Smart Campus* (Huang et al., 2019; Kwet & Prinsloo, 2020).

3.3 EXPERIENCIA DE USUARIO

La experiencia de usuario (*UX*) permite recabar información acerca de un producto o de un servicio, una vez el usuario usado o analizado el producto, o bien ha recibido y completado la experiencia de un servicio (Karapanos et al., 2009; Law et al., 2009; Simonsen, 2017), permitiendo obtener valiosa información relativa a la vivencia experimentada (Law et al., 2009; Soegaard, 2018). La educación universitaria reglada no deja de ser un servicio impartido por un instructor, que recibe el alumnado. Así pues, diversas experiencias educativas se han analizado desde la perspectiva y la lógica de la *UX* (Davis & Wong, 2007; Gamage et al., 2011; Labrador & Villegas, 2014, 2016; Santoso et al., 2016; Villegas et al., 2019), algunas de ellas focalizadas en el ámbito *online* (Davis & Wong, 2007; Santoso et al., 2016).

La Experiencia de Usuario del alumnado una vez este ha concluido su formación en una asignatura puede recogerse mediante la técnica del *Bipolar Laddering* (*BLA*), así como a partir de la valoración de las emociones experimentadas una vez vivida la experiencia. La valoración de las emociones constituye

una información muy relevante desde la perspectiva de *UX* de acuerdo a hallazgos presentados en otras investigaciones (Pekrun, 2006; Pekrun et al., 2007), integrando en esta investigación el modelo de pares de emociones presentado por Schmidt-Atzert (Schmidt-Atzert, 1985).

Bipolar Laddering (*BLA*) es una de las técnicas susceptibles de ser empleadas en la investigación cualitativa. Se basa en una aproximación socrática donde el entrevistado expresa su propia opinión, con un planteamiento inicial de '*tabula rasa*' que pretende evitar condicionantes en sus respuestas con respecto a lo que se le plantea (Pifarré & Tomico, 2007). La mecánica consiste en preguntar al usuario por la descripción de los elementos más positivos a partir de su *UX*, solicitándole asimismo una valoración de cada uno de dichos elementos en una escala de cero a diez. En una siguiente iteración, se solicita al entrevistado que aporte las medidas, que de acuerdo con a su opinión, podrían adoptarse para mejorar su experiencia de usuario. El mismo proceso se realiza con relación a los elementos percibidos como más negativos en la experiencia de usuario. Esta técnica puede administrarse mediante una entrevista personal, dando lugar al formato *BLA*, o bien empleando el formato *pocket BLA*, donde la entrevista personal se sustituye por un formulario escrito a cumplimentar por parte el encuestado. La técnica del *BLA* se ha empleado para recoger opiniones de usuario una vez finalizada la experiencia vivida por este, siendo una práctica también empleada en investigaciones contextualizadas en el ámbito educativo (Fonseca et al., 2016, 2018; Llorca et al., 2019, 2018; Pifarré et al., 2009).

En el contexto de esta investigación se ha recurrido asimismo al empleo de preguntas abiertas (en inglés, *open-ended questions*), con la pretensión de intentar minimizar los condicionantes en las respuestas (Reja et al., 2003). Esta tipología de preguntas se ha empleado en lo relativo a los '*likes*' y '*dislikes*' asociados a las actividades a realizar el primer día de clase, consistentemente con otros trabajos de investigación (Eskine & Hammer, 2017; Perlman & McCann, 1999), y en las percepciones específicas acerca el formato *SC*.

4. SINTESIS DE LA PUBLICACIÓN 1. PERCEPCIONES DEL ALUMNADO DE INGENIERIA A PARTIR DE SU EXPERIENCIA DE USUARIO: *F2F*, *ERT* Y *SC*

Conocer las percepciones del alumnado con respecto a las tres modalidades de clase que han experimentado (*F2F*, *ERT* y *SC*) a consecuencia de la pandemia *COVID-19* permite identificar todo un conjunto de percepciones experimentadas por el alumnado, susceptibles de ser valoradas como positivos o negativos. Una vez identificadas, su eventual potenciación (para las positivas) y corrección (para las negativas) constituirá un mecanismo especialmente útil para el (re)diseño de la asignatura en cuestión, una vez contextualizadas y analizadas con el resto de los inputs de que disponga el coordinador de la asignatura. Así pues, esta práctica constituye un elemento muy valioso para valorar e implementar cambios desde el ámbito la coordinación de la asignatura y es susceptible de potenciar el *engagement* del alumnado.

A continuación, se describen de forma sintética diversos elementos asociados a esta primera contribución académica:

4.1 OBJETIVO

El objetivo de la investigación presentada en este artículo se orienta a conocer las percepciones del alumnado de ingeniería que cursó de forma consecutiva tres modalidades de clase distintas, a saber: *F2F*, *ERT* y *SC*.

4.2 CONTEXTO DEL ESTUDIO

La investigación se llevó a cabo dando voz al alumnado de segundo curso de los siete grados de ingeniería del ámbito TIC impartidos en La Salle-URL. Dicho alumnado experimentó durante el primer semestre en que se incorporó a la universidad el formato de clase presencial (*F2F*). En el segundo semestre, dicho alumnado migró a un formato *online* de emergencia (*ERT*) a consecuencia de las medidas adoptadas en el contexto de la declaración de la pandemia generada por el *COVID-19*. Posteriormente, durante el primer semestre de su segundo curso universitario, pasaron a experimentar un formato *Smart Classroom* (*SC*) a resultas de la implementación estratégica de dicha tecnología en aulas y laboratorios.

4.3 ESTADO DE LA CUESTIÓN

El escrito contextualiza las afectaciones ocasionadas por la pandemia de alcance mundial a partir de la expansión de la *COVID-19*, focalizándose en los efectos y consecuencias sufridos en el ámbito educativo. Se destaca el impacto ocasionado por las restricciones de la movilidad, ideadas para minimizar el contacto social entre seres humanos y así intentar combatir la expansión del contagio, hecho que se tradujo en la mayoría de los casos en un cierre físico de los centros educativos. A efectos prácticos, y centrados en el ámbito universitario, dicha solución comportó la práctica imposibilidad de realizar formación presencial (*F2F*) en los campus. Las circunstancias apuntadas impulsaron en muchos casos a la adopción de modalidades de enseñanza y aprendizaje a partir de un sistema de emergencia (*ERT*), basado en la no presencia física del alumnado en el campus, en muchos casos sustentados a partir de tecnologías que implementaron un formato *online*. Se presenta y se describe en el estudio una segunda iteración del formato *online* a partir de la implementación de la adopción estratégica de la tecnología *SC* en La Salle-URL, desplegada con el objetivo de paliar los déficits que presentó la solución *ERT* inicial.

4.4 METOLOGÍA

A partir del concepto de *User Experience (UX)*, se plantea una investigación que tiene por objetivo identificar los puntos fuertes y los puntos débiles de las tres modalidades de clase experimentadas de forma consecutiva en tres trimestres por parte del alumnado encuestado. Para ello se emplea la técnica del ***B**ipolar **La**ddering* (*BLA*), que permite identificar los elementos antes mencionados una vez el usuario, en este caso el alumnado, ha vivido las experiencias. Dado el volumen del alumnado al que se pretendía llegar (todos los alumnos de las cohortes de los siete grados de ingeniería del ámbito TIC), se optó por emplear la técnica *pocket BLA*, a partir de los mecanismos tecnológicos disponibles. Asimismo, se optó por preguntar al alumnado sobre las valoraciones emocionales percibidas una vez vividas las tres experiencias, lo que permitió generar una información adicional que permite completar las percepciones del alumnado a nivel de *UX*.

4.5 HALLAZGOS Y RESULTADOS

Los hallazgos se presentaron de forma agregada de acuerdo con la lógica del instrumento, listando tanto lo elementos percibidos de forma positiva como negativa, a la vez que se consignó la frecuencia de estos. De entre las tres modalidades, los hallazgos arrojaron una preferencia del alumnado por la formación presencial *F2F*. En lo relativo a la formación impartida mediante la tecnología *SC*, la percepción del alumnado fue positiva, valorándose en gran medida dos aspectos: 1) el ahorro de tiempo derivado del no verse obligados a desplazarse físicamente al campus universitario; 2) la posibilidad de acceder a las grabaciones de las sesiones de clase. Por otra parte, el alumnado destacó tres elementos en los que el formato *SC* presentaba ciertas carencias con respecto al formato *F2F*, de acuerdo con la experiencia que vivieron: 1) el nivel de interacción entre alumnado-instructor; 2) las distracciones experimentadas al cursar sesiones *off campus*, superiores a las que experimentaron al vivir la experiencia educativa *on campus*; 3) un cierto grado de dificultad en lo relativo al trabajo en equipo con sus pares, al compararlo con la lógica de trabajo presencial.

4.6 PUBLICACIÓN 1

Los hallazgos y resultados de esta primera contribución se han publicado en el Special Issue 'Information Systems, E-learning and Knowledge Management' de la revista Sustainability, accesibles mediante la siguiente referencia:

Petchamé, J.; Iriondo, I.; Villegas, E.; Riu, D.; Fonseca, D. Comparing Face-to-Face, Emergency Remote Teaching and Smart Classroom: A Qualitative Exploratory Research Based on Students' Experience during the COVID-19 Pandemic. Sustainability 2021, 13, 6625. https://doi.org/10.3390/su13126625

4.7 CONTRIBUCIÓN DEL AUTOR

El autor de este escrito ha contribuido en los siguientes aspectos del artículo: conceptualización; metodología; análisis formal; investigación; escritura (preparación del borrador inicial); escritura (redacción final y revisión); visualización.

5. SÍNTESIS DE LA PUBLICACIÓN 2. ACTIVIDADES REALIZADAS EN LA PRIMERA SESION DE CLASE ORIENTADAS A FOMENTAR EL *ENGAGEMENT* EN UNA ASIGNATURA

Los elementos significativos de la segunda contribución académica son los siguientes:

5.1 OBJETIVO

El objetivo del estudio es el de obtener hallazgos a partir de dos actividades realizadas durante la primera sesión de clase de una asignatura. Dichas actividades se idearon con el propósito inicial de forjar expectativas del alumnado en relación con la asignatura, a la vez que incrementar el *engagement* y la motivación.

5.2 CONTEXTO DEL ESTUDIO

El estudio se realizó en el contexto de la primera sesión de clase de una asignatura del ámbito de empresa de segundo curso que forma parte de los siete grados de ingeniería del ámbito TIC impartidos en La Salle-URL. En el segundo curso de ingeniería el alumnado se agrupa en las distintas asignaturas a partir del criterio de la especialidad que cursan, a diferencia de lo que sucede en primer curso, donde el alumnado es asignado a un grupo de clase a partir de otros criterios. Cabe destacar que solo en uno de los programas, el grado en ingeniería en organización de las TIC, se encuentra alumnado con una doble vocación ingenieril y empresarial. En los otros seis grados, el alumnado cursa los estudios a partir de una orientación inicial focalizada en uno de los ámbitos tecnológicos nucleares constitutivos del ámbito de ingeniería TIC.

5.3 ESTADO DE LA CUESTIÓN

De acuerdo con previas contribuciones académicas, la realización de actividades específicas durante la primera sesión de clase de una asignatura puede contribuir a incrementar las expectativas, la motivación y el *engagement* del alumnado con relación a la asignatura, influyendo en la totalidad del curso. El *engagement* es un constructo que puede ser definido como 'energía y esfuerzo en acción' (Melissa Bond et al., 2020), y se encuentra relacionado según diversas propuestas teóricas con la motivación. Asimismo, se han encontrado correlaciones entre resultados académicos y los niveles de motivación y de *engagement* del alumnado de acuerdo con los resultados presentados en otras investigaciones.

En el artículo se presenta el marco conceptual asociado al NCA (Nuevo Contexto de Aprendizaje), que postula la adopción de principios pedagógicos que se traducen en la implementación de ámbitos de aprendizaje concretos (ver Figura 1). De entre estos últimos, la investigación asociada a esta contribución encaja en el *welcoming*, y se orienta a la potenciación del *engagement* del alumnado en la asignatura.

5.4 METOLOGÍA

En primer lugar, se realizó un cuestionario *open-ended* con el objetivo de minimizar sesgos derivados de la pregunta. En dicho cuestionario realizado en la primera sesión de clase, se preguntó al alumnado sus preferencias sobre las actividades a realizar (*likes*), así como sobre las actividades que no le gustaba realizar (*dislikes*).

Asimismo, en el contexto de la primera sesión de clase se llevó a cabo una actividad de *Reciprocal Interview*, entre el alumnado y el equipo de instructores de la asignatura. Concluida dicha actividad, el

alumnado dio respuesta a un cuestionario para proceder a una valoración de la *Reciprocal Interview*, así como el impacto de esta en aspectos concretos.

5.5 HALLAZGOS Y RESULTADOS

Esta investigación presenta los hallazgos derivados de dos actividades realizadas en la primera sesión de clase de una asignatura de gestión empresarial. En la primera encuesta *open-ended*, el alumnado manifestó su preferencia por ciertas actividades, arrojando resultados consistentes con hallazgos efectuados por otros autores en estudios realizados previamente. En la parte final de la primera sesión de clase se procedió a realizar una actividad de *Reciprocal Interview*. Dicha actividad se realizó con el objetivo de facilitar una primera toma de contacto entre el alumnado de una especialidad de ingeniería concreta, a la vez que introducir al equipo de profesorado de la asignatura a los estudiantes a partir de las respuestas a las preguntas de diversa índole de estos últimos. La finalidad última de esta actividad fue la de potenciar la motivación y el *engagement* en una asignatura de gestión empresarial. Los resultados de la actividad fueron valorados de forma muy positiva por parte de los participantes en la actividad.

5.6 PUBLICACIÓN 2

Los hallazgos y resultados de esta segunda contribución se han publicado en el Special Issue 'Engaging Students in Sustainable Science Education' de la revista Sustainability, accesibles mediante la siguiente referencia:

Petchamé, J.; Iriondo, I.; Canaleta, X.; Riu, D.; Necchi, S. Engaging ICT Engineering Undergraduates in a Management Subject through First Day of Class Activities: An Empirical Study. Sustainability 2021, 13, 7440. https://doi.org/10.3390/su13137440

5.7 CONTRIBUCIÓN DEL AUTOR

El autor de este escrito ha contribuido en los siguientes aspectos del artículo: conceptualización; metodología; análisis formal; investigación; escritura (preparación del borrador inicial); escritura (redacción final y revisión); visualización; administración del proyecto.

6. SÍNTESIS DE LA PUBLICACIÓN 3. PROPUESTA DE (RE)DISEÑO DE UNA ASIGNATURA DE GESTIÓN A PARTIR DE LAS PERCEPCIONES DEL ALUMNADO EN LA PRIMERA SESIÓN DE CLASE Y DE SU EXPERIENCIA DE USUARIO AL FINALIZAR LA IMPARTICIÓN DE LA ASIGNATURA

En este apartado se presenta de forma sintética el contenido de la tercera contribución:

6.1 OBJETIVO

El objetivo concreto de esta publicación consiste en idear e implementar mecanismos de (re)diseño de asignaturas de gestión empresarial en los programas de ingeniería del ámbito de las TIC con el objeto de potenciarlas y mejorarlas, a partir de los hallazgos derivados de la experiencia de usuario del alumnado una vez este al ha cursado la asignatura.

6.2 CONTEXTO DEL ESTUDIO

En el contexto de la asignatura 'Sistemas de Información', impartida en el cuarto curso del grado de ingeniería en Organización de las TIC, se pregunta al alumnado por su experiencia de aprendizaje una vez finalizada la impartición de la asignatura. La investigación se focaliza en dos cohortes de alumnado que han cursado la asignatura, una vez esta se remodeló implantándose como elemento nuclear de la asignatura la metodología *Project-Based Learning* (*PBL*). La primera de las cohortes investigada experimentó el formato F2F, mientras que la segunda recibió su formación en un contexto *SC* a raíz de la situación derivada de la pandemia ocasionada por el *COVID-19*.

6.3 ESTADO DE LA CUESTIÓN

En un contexto en que el alumnado que accede a la universidad posee un cierto grado de formación en tecnologías digitales, en La Salle-URL se optó por implementar y desarrollar el denominado NCA (Nuevo contexto de Aprendizaje, en inglés *NLC - New Learning Context* -) con el objetivo de alinear y adecuar de la mejor forma posible el aprendizaje al alumnado.

Se describe sucintamente la problemática derivada de la pandemia ocasionada por la transmisión del *COVID-19* a escala mundial y su impacto en el ámbito educativo, lo que se tradujo en un cierre mayoritario de las instalaciones físicas. Dicho cierre perseguía limitar el contacto personal, con el objetivo de evitar o de al menos minimizar las cadenas de contagio. En dicho contexto, la opción de realizar una migración desde programas formativos presenciales (*F2F*) a enseñanzas *online* constituyó una alternativa empleada por diversas instituciones. La Salle-URL optó por implementar inicialmente una *ERT*, y en una segunda iteración apostó por el despliegue de tecnológico de un formato *SC* en la mayoría de las aulas y los laboratorios del campus.

Desde el punto de vista metodológico, la asignatura 'Sistemas de Información' fue rediseñada de tal forma que durante el curso académico 2019-2020 la metodología *Project-Based Learning* (*PBL*) pasó a constituir la piedra angular sobre la que cimentó el nuevo diseño de la asignatura. La metodología *PBL* resulta especialmente adecuada en el ámbito de enseñanza ingenieril, al tratar de replicar de alguna forma la mecánica de trabajo que empleará el futuro ingeniero una vez este se incorpore al mundo laboral.

6.4 METOLOGÍA

En esta investigación se emplean diversas técnicas que resultan de aplicación en investigaciones de tipo cualitativo, dados los objetivos que se pretenden alcanzar.

En primer lugar, se realizó un cuestionario en la primera sesión de clase, en el que se preguntó al alumnado acerca de sus preferencias sobre las actividades a realizar (*likes*), así como sobre las actividades que no le gustaba realizar (*dislikes*).

En segundo lugar, una vez el alumnado finalizó la asignatura, y siguiendo la lógica asociada a *UX*, se planteó una investigación tendente a identificar los puntos fuertes y los puntos débiles asociados a la asignatura por parte del alumnado. Para ello se empleó la técnica del ***B**ipolar **La**ddering* (*BLA*), que permite identificar los elementos antes mencionados, una vez finalizada la experiencia de aprendizaje por el alumnado. Se optó por emplear la técnica *BLA*, de forma que se entrevistó oralmente a una parte significativa del alumnado para capturar los elementos más destacados de sus percepciones (en inglés, los denominados '*salient items*'). Adicionalmente, se pidió al alumnado que reflejase sus valoraciones emocionales una vez concluida su experiencia de aprendizaje.

Finalmente, se efectuó una pregunta adicional a la cohorte del alumnado que cursó la asignatura en el semestre en el que la impartición se había efectuado mediante el mecanismo *SC*. Se le solicitó de forma explícita su opinión con respecto a la tecnología *SC*, al efecto de asegurar su respuesta con relación a este tema. Recordemos que la técnica *BLA* implica preguntar de modo abierto al alumnado, de forma que podía suceder, como fue el caso, que nadie hiciese referencia a *SC* durante las entrevistas *BLA*.

6.5 HALLAZGOS Y RESULTADOS

Ningún problema específico se mencionó de forma espontánea con respecto a la impartición de la asignatura. La metodología *PBL* resultó muy bien valorada por parte del alumnado de las dos cohortes participantes en la investigación, destacando el perfil profesional de los instructores o bien la propia impartición de la asignatura a partir del aprendizaje a partir del desarrollo de un proyecto. Algunos aspectos concretos (tales como el implementar un único proyecto para todos los grupos de clase, el horario de las clases, …) fueron comentados por parte de algunos de los alumnos entrevistados como elementos susceptibles de ser mejorados. Con relación al empleo de la tecnología *SC*, ningún elemento se destacó de forma espontánea durante la entrevista efectuada mediante el *BLA*, ni de forma positiva ni negativa. En lo que respecta a la pregunta abierta orientada a recabar las percepciones del alumnado en relación a su experiencia con respecto al formato tecnológico *SC*, los hallazgos fueron los siguientes: 1) en relación con los factores que suponían un reto, y por tanto eran susceptibles de mejora, se identificaron tanto la dinámica de clase, como la interacción entre los estudiantes; 2) los elementos más positivos asociados al formato *SC* fueron el ahorro de tiempo derivado de la asistencia a las clases *off campus*, así como el acceso a las grabaciones de las sesiones de clase una vez estas habían finalizado.

6.6 PUBLICACIÓN 3

Los hallazgos y resultados de esta tercera contribución se han publicado en el Special Issue: 'Human-Computer Interaction in Pervasive Computing Environments' de la revista Sensors, accesibles mediante la siguiente referencia:

Petchamé, J.; Iriondo, I.; Villegas, E.; Fonseca, D.; Romero Yesa, S.; Aláez, M. A Qualitative Approach to Help Adjust the Design of Management Subjects in ICT Engineering Undergraduate Programs through User Experience in a Smart Classroom Context. Sensors 2021, 21, 4762. https://doi.org/10.3390/s21144762

6.7 CONTRIBUCIÓN DEL AUTOR

El autor de este escrito ha contribuido en los siguientes aspectos del artículo: conceptualización; metodología; análisis formal; investigación; escritura (preparación del borrador inicial); escritura (redacción final y revisión); visualización.

7. ASPECTOS ÉTICOS DE LA INVESTIGACIÓN

Dos preguntas resultan claves de cara a plasmar los aspectos éticos a considerar en una actividad de investigación: 1) el qué (*what*); 2) el cómo (*how*).

En lo relativo al QUÉ, en el caso de esta tesis las distintas investigaciones realizadas se han orientado todas ellas a preguntar al alumnado que cursa los distintos grados de ingeniería en el ámbito de las TIC en el entorno de La Salle-URL, diversos aspectos susceptibles de impactar en el *engagement* del alumnado, a saber:

- La percepción con respecto a las distintas tecnologías empleadas en clase a raíz de la problemática derivada de la epidemia generada por la expansión del virus *COVID-19*, a saber: *F2F*; *ERT* y *SC*.
- Encuesta de las actividades preferidas ('*likes*') y de las que nos resultan atractivas al alumnado ('*dislikes*') en la primera sesión de clase de una asignatura.
- *Reciprocal Interview Activity*: actividad realizada en la primera sesión de clase donde el profesorado pregunta al alumnado, para posteriormente invertir dicho rol, pasando el alumnado a preguntar al equipo de instructores de la asignatura.
- Preguntar al alumnado desde una perspectiva de experiencia de usuario (*UX*) en lo relativo a las percepciones que ha experimentado, tanto las positivas como las negativas, una vez finalizada la experiencia académica vivida en una asignatura concreta.

En lo que respecta al CÓMO, tal y como ya se ha apuntado, la investigación se ha realizado con alumnado, en definitiva, con personas. Así pues, se han tenido en cuenta los aspectos legales y éticos existentes al respecto, comportando el seguimiento de buenas prácticas asociadas a los mismos:

- Las percepciones relativas a las valoraciones del alumnado con respecto a las distintas soluciones tecnológicas implementadas para impartir clases (*F2F*, *ERT* y *SC*) se han llevado a cabo mediante la técnica *pocket BLA*. Se han realizado de forma anónima, con consentimiento informado y de forma voluntaria.
- Las encuestas relativas a actividades asociadas al primer día de clase se han realizado de forma anónima, con consentimiento informado y de forma voluntaria.
- Las valoraciones relativas a la experiencia de usuario (*UX*) se han realizado mediante la técnica *BLA*. Ha comportado la realización de entrevistas que han sido grabadas, con consentimiento informado y de forma voluntaria.
- Todos los datos recogidos en que las personas eran susceptibles de ser identificadas, una vez tratados, se han anonimizado. Este en el caso de las entrevistas asociadas a la técnica *BLA*.

8. DISCUSIÓN Y CONTRIBUCIÓN

Este trabajo de investigación presenta una propuesta de modelo de (re)diseño de asignaturas con el objetivo último de incrementar el *engagement* del alumnado. En este apartado se contextualizan los elementos y los factores relevantes que han derivado en la génesis de este trabajo de naturaleza cualitativa, a la vez que se presentan toda una serie de hallazgos.

La enseñanza de asignaturas del ámbito de gestión empresarial a alumnado de ingeniería constituye todo un reto para el profesorado que imparte dichas materias, al no ser percibidas por parte del alumnado que cursa dichas titulaciones como tópicos que vayan a ser relevantes en su futuro rol de ingeniero (Petchamé et al., 2020b; Pons, 2016). No obstante, y a tenor de los hallazgos de diferentes estudios, la formación en gestión y empresa, en sus vertientes de contenidos teórico-prácticos y competenciales, resulta determinante de cara a la inserción del futuro ingeniero en el mercado laboral (Chan et al., 2017; Passow & Passow, 2017; M. Robinson et al., 2005). De hecho, una vez el ingeniero se encuentra inmerso en el entorno laboral, este se encuentra dentro de un contexto en el que diversidad de factores de naturaleza empresarial inciden y condicionan su actividad. La posición de ingeniero como elemento integrante de un equipo de personas que forma parte de una iniciativa empresarial se verá, al igual que todas las personas integradas en dicho proyecto de empresa, orientada y condicionada por los elementos que primigeniamente fueron la génesis de la empresa y de sus ulteriores evoluciones. Dado el rol que desarrolla un ingeniero en una organización, ocupe la posición que ocupe, el hecho conocer y entender la lógica empresarial, así como el cultivo y desarrollo de distintas habilidades propias del mundo de la gestión empresarial, se antojan como imprescindibles desde el punto de vista de formación holística del alumnado de un programa de ingeniería una vez se incorpore al mercado laboral.

8.1 UNA PROPUESTA DE MODELO INTEGRAL DE (RE)DISEÑO DE ASIGNATURA

La inclusión de contenidos que van más allá de la formación puramente tecnológico-ingenieril, tales como la formación en ámbito de la gestión empresarial, así como la adquisición de *soft skills*, resultaran claves en la formación integral del alumnado de un programa de ingeniería (Passow & Passow, 2017). A pesar de ello, el *engagement* del estudiante de ingeniería en estas materias dependerá, entre otros, de la percepción y el interés que tenga en dichas asignaturas. Esta tesis se ha orientado a idear, desarrollar y testear mecanismos tendentes a incrementar dicho nivel de *engagement*. Las técnicas implementadas a tal efecto se han basado en recabar información directamente del alumnado en los momentos iniciales y finales de la asignatura con el objecto de realizar un ajuste fino de los contenidos de las asignaturas, siempre de forma consistente con los parámetros y condicionantes fijados a partir de la aprobación oficial de la titulación. No obstante, en el caso de identificar elementos inconsistentes con el programa oficialmente aprobado en la titulación oficial, siempre cabe la posibilidad de proceder, si se considera oportuno, a una adecuación de dichos contenidos mediante un proceso de seguimiento o modificación consistentemente con los procesos reconocidos dentro del marco VSMA.

La valoración por parte del alumnado a partir de su experiencia de usuario, así como sus percepciones acerca de las distintas actividades específicas llevadas a cabo en el contexto de esta investigación, constituyen los elementos centrales de esta tesis de cara al proceso de diseño y ajuste de asignaturas para incrementar el *engagement* del alumnado y los efectos derivados de este.

La Figura 2 muestra de forma sintética la cristalización de los ámbitos de aprendizaje teóricos formulados en el modelo NCA en una propuesta práctica aplicable de forma general a las asignaturas de ingeniería del ámbito TIC, ya sean del ámbito de empresa, ya de ingeniería pura.

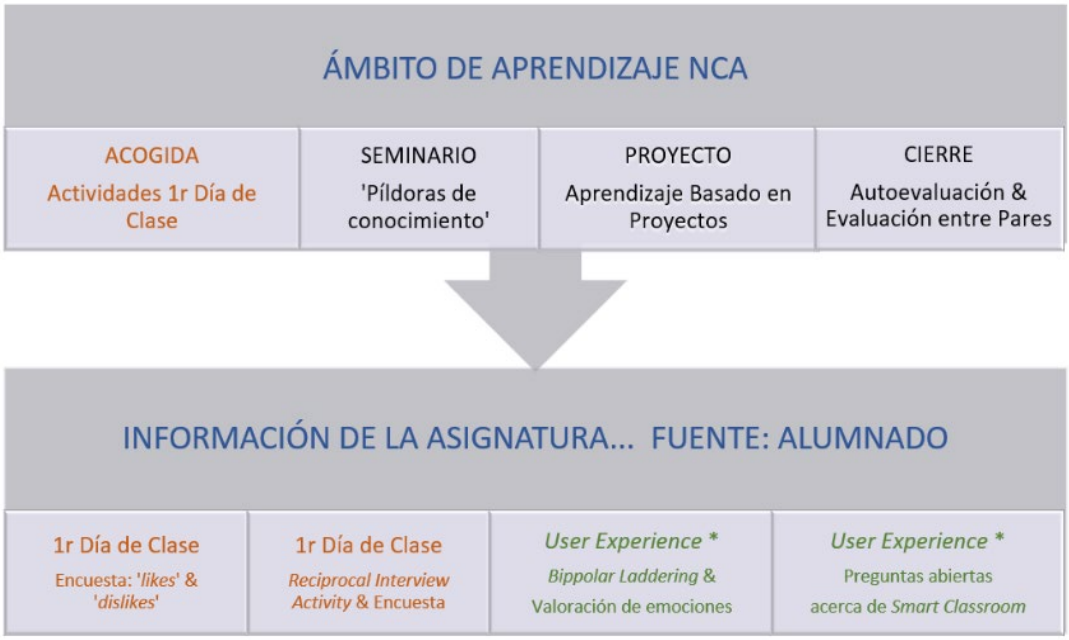

Figura 2. Esquema sintético de la tesis a los efectos de investigación: propuesta de aplicación del entorno de aprendizaje en las asignaturas de ingeniería, derivado del NCA. La experiencia de usuario del alumnado pasa a constituir un elemento nuclear en el diseño y/o ajuste de una asignatura. Dicha información se incardinará dentro del modelo global de diseño de la asignatura presentado en la Figura 3 de este escrito.
* La información relativa a la experiencia de usuario se obtendrá una vez el alumno ha concluido la asignatura.

El esquema presentado en la Figura 2 constituye el elemento teórico nuclear del modelo holístico propuesto en esta tesis, presentado de forma esquemática en la Figura 3. Así, la propuesta presentada en esta tesis captura directamente información del alumnado, en aras de dos objetivos: por un lado, el incremento de su *engagement* a raíz de su misma participación, a la vez que proceder al ajuste y a la mejora continua de la asignatura (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021).

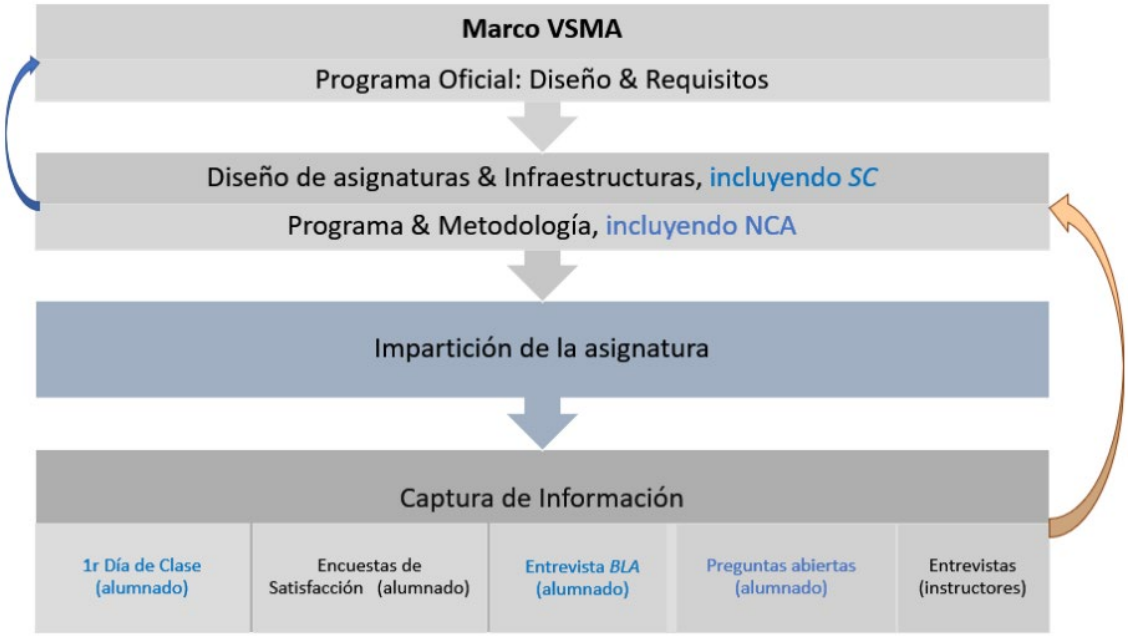

Figura 3. Propuesta de modelo diseñado para potenciar el *engagement* del alumnado, a la vez que ajustando el diseño de los programas formativos de asignatura. Fuente: (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021)

La valoración del alumnado a partir de su experiencia de usuario, tanto a nivel de percepción de las distintas actividades específicas llevadas a cabo, como de las eventuales propuestas de mejora que el alumnado identifica, constituyen los elementos centrales de esta tesis de cara al proceso de (re)diseño y ajuste de asignaturas. A nivel de investigación y desarrollo de los mecanismos potenciadores del *engagement* del alumnado, se ha recurrido a mecanismos cualitativos a partir de encuestas, preguntas abiertas, y técnicas implementadas que son propias del ámbito de *UX*, entre las que se incluye el *BLA* (*Bipolar Laddering*) y una de sus variantes, el *pocket BLA*. Dichas técnicas se han implementado para complementar y enriquecer la visión y percepciones de la asignatura, tanto por parte de la coordinación de la asignatura como de la coordinación del programa de grado de ingeniería, al recabar e incorporar las valoraciones y percepciones del alumnado.

El establecimiento de un mecanismo centrado en oír la voz del alumnado presentado en esta investigación no es excluyente de otros métodos ya implementados actualmente en La Salle-URL que permiten el seguimiento y ajuste de la asignatura durante impartición. Entre estos cabe citar las diferentes reuniones periódicas entre los delegados del alumnado con coordinación y tutoría de la titulación o bien mediante las actividades de primer día de clase del segundo semestre, en el caso de las asignaturas de carácter anual. En relación con el mecanismo de la tutoría, puede destacarse que durante las tutorías individuales y grupales el tutor recoge información relativa a diversas problemáticas, posteriormente reportadas al coordinador de la titulación en las reuniones periódicas que ambos mantienen.

8.2 (RE)DISEÑO DE UNA ASIGNATURA DE INGENIERÍA

Diversos elementos se han tenido presentes de cara al (re)diseño y ajuste de las asignaturas:

- ***PBL* y mecanismos de evaluación**. Una de las lógicas que se han implementado como elemento central en el rediseño de las asignaturas de gestión es la inclusión de la metodología *PBL*, dada su idoneidad al resultar especialmente adecuada como herramienta y práctica de trabajo del futuro ingeniero una vez el alumnado se incorpore el entorno laboral (Mills & Treagust, 2003). Una vez implementado el diseño de la asignatura 'Sistemas de Información' centrado en la metodología *PBL*, se ha prestado especial atención a diversos aspectos: 1) medir aspectos motivacionales del alumnado (Petchamé et al., 2020a); 2) incluir mecanismos de evaluación formativa a partir tanto del *self-* como del *peer-to-peer assessment* (Petchamé et al., 2020b); 3) identificar las actividades a realizar en la primera sesión de clase de la asignatura que puedan contribuir al incremento del *engagement* del alumnado (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021); 4) recabar su percepción de la asignatura, una vez ha concluido su experiencia de aprendizaje (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021).

- **Nuevo Contexto de Aprendizaje (NCA)**. El modelo NCA impregna la estructura de los todos programas de estudio y de las distintas asignaturas que los conforman, en aras de implementar un modelo educativo consistente con lo comentado en el marco conceptual de este documento de tesis. Analizando la propuesta educativa derivada del NCA, el *learning enviroment* '*welcoming*' incorpora todo un conjunto de elementos y prácticas que se llevan a cabo al inicio de una asignatura o módulo de aprendizaje, con el objetivo de incrementar el nivel de *engagement* del alumnado a partir de distintas propuestas. Una primera actividad se realiza justo al iniciarse la primera sesión de clase de una asignatura consiste en una encuesta al alumnado, donde se le pregunta mediante una encuesta *open-ended* tanto de las actividades preferidas a realizar como de las no deseadas en la primera sesión de clase (Petchamé, Iriondo, Canaleta, et al., 2021; Petchamé, Iriondo, Villegas, Fonseca, et al., 2021). Gracias a los hallazgos recabados a partir de dichas encuestas se ha procedido a reajustar en la medida de lo posible las actuaciones en clase a

lo largo del curso, siempre manteniendo la consistencia con el *syllabus* de la asignatura. Así pues, esta actividad ha permitido realizar un ajuste fino en las dos asignaturas en que se ha realizado dicha práctica ('Sistemas de información' y '*Value Chain and Financial Economics*'), a la vez que se han tomado en consideración las aportaciones de los estudiantes para adecuar los programas de ambas asignaturas del próximo curso académico. Los resultados obtenidos son consistentes con otros trabajos de investigación (Eskine & Hammer, 2017; Perlman & McCann, 1999), pudiendo destacarse la petición del alumnado de motivación por parte del profesorado, aspecto reiterado por diversos alumnos en la asignatura de gestión de segundo curso '*Value Chain and Financial Economics*'. Cabe destacar que dicha petición resulta bastante homogénea entre el conjunto del alumnado, incluidos quienes cursan el grado de ingeniería en OTIC, de quienes no intuíamos esta solicitud de motivación previamente al análisis de los datos, dado el enfoque de dichos estudios.

- ***Smart Classroom* (*SC*)**. En el caso de La Salle-URL, los formatos educativos oficialmente aprobados como estudios presenciales pasaron a impartirse en la modalidad *online* a raíz de la pandemia ocasionada por el *COVID-19*, al implantarse un *ERT* como solución excepcional a fin y efecto de completar el proceso formativo del alumnado. Dicha solución se implementó en el segundo semestre del curso académico 2020-2021, y se implementó a partir de escalar a nivel tecnológico las soluciones existentes en los programas formativos de impartidos en formato *online* de la institución. El sistema presencial de los programas de grado se sustentaba en las clases *F2F* y en un *LMS* (*Learning Management System*), este último actuando como un soporte de cara a repositorio de contenidos académicos y de entrega de actividades, que incluyen asimismo las valoraciones y los comentarios de los instructores a los entregables del alumnado. Así pues, la presencialidad en el campus asociada a los programas de grado migró a la adopción de mecanismos de conexión remotos entre instructor y alumnado, manteniendo el *LMS* sus funcionalidades básicas antes mencionadas, a las que se incorporaron elementos adicionales para hacer consistente la enseñanza en la modalidad *online*.

  El curso académico 2020-2021 se inició con el despliegue de una solución *SC* en un gran número de aulas de clase y laboratorios (ZOOM, 2021). Dicha tecnología se adoptó para permitir ofrecer clases presenciales tanto al alumnado que físicamente acudiese a las instalaciones del campus, como al alumnado que de modo remoto se conectase a las sesiones de clase, de forma que este pudiese actuar en directo con todos los participantes corporalmente presentes en las aulas del Campus. Dentro del ámbito de esta tesis se ha realizado un estudio que ha consistido en recabar las opiniones del alumnado una vez este ha experimentado de forma consecutiva en cada uno de los semestres, las modalidades *F2F*, *ERT* y *SC* (Petchamé, Iriondo, Villegas, Riu, et al., 2021), así como recabar información sobre la experiencia de aprendizaje en una asignatura impartida en el formato *SC* (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021).

8.3 ACTIVIDADES DE INVESTIGACIÓN ESPECÍFICAS

Resulta procedente destacar la aportación concreta de cada una de las distintas actividades de investigación, una vez analizado el objetivo de investigación. Hay que apuntar que se ha optado por el empleo de técnicas de naturaleza cualitativa, ya que lo que se pretende obtener son las opiniones del alumnado intentando minimizar cualquier tipo de condicionante. A continuación, se sintetizan las distintas encuestas y actividades efectuadas, incluyendo los objetivos puntuales de cada una de ellas:

- La encuesta de primer día de clase (*likes and dislikes*) al alumnado en línea con trabajos empíricos de otros investigadores (Eskine & Hammer, 2017; Perlman & McCann, 1999), con la cual, a partir de dar voz al alumnado, se ha buscado incrementar el grado de *engagement* del alumnado con la asignatura, mediante posteriores ajustes finos compatibles con el syllabus del programa

(Petchamé, Iriondo, Canaleta, et al., 2021). Los hallazgos de dicha encuesta son susceptibles de ser aplicados en la asignatura, a la vez que constituir motores de cambio en ulteriores ediciones de esta.

- La actividad *Reciprocal Interview* de primer día de clase pretende crear un buen clima de clase entre alumnado e instructores, estableciendo desde el primer día una lógica de interacción a seguir durante toda la impartición de asignatura (Petchamé, Iriondo, Canaleta, et al., 2021). El dar voz al alumnado el primer día de clase permite obtener una información muy valiosa a partir de las preguntas y respuestas generadas, así como la construcción de unas relaciones de cercanía y cooperación entre los distintos actores a partir de la interacción generada por la propia actividad del *Reciprocal Interview.* Todo ello pretende impactar en la mejora del *engagement* del alumnado en la asignatura.
- La percepción del alumnado con respecto a las tres distintas modalidades de clase experimentadas en tres semestres consecutivos: *F2F*, *ERT* y *SC* (Petchamé, Iriondo, Villegas, Riu, et al., 2021). Dichas valoraciones son susceptibles de incidir en la potenciación de los elementos positivos, a la vez que pueden posibilitar la corrección de los déficits que comportan los elementos considerados como negativos por parte del alumnado, siempre que sea factible.
- La experiencia de usuario vivida por el alumno una vez completada la experiencia formativa una vez se ha completado la impartición de la asignatura (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021) tiene como fin último el recabar tanto los aspectos más valorados como los menos valorados por parte del alumnado. El *feedback* que se recoge tiene como objetivo el del (re)diseño y ajuste de la asignatura de cara a próximas ediciones de la asignatura, con el fin último de impactar de forma positiva en el *engagement* del alumnado. Asimismo, dicha información resulta muy útil de cara al diseño de asignaturas *ex novo*.
- El análisis y los hallazgos de naturaleza cualitativa presentados en este documento de tesis se han adecuado a los criterios presentados en diferentes investigaciones de la misma naturaleza (Cypress, 2017; Leung, 2015; Morse, 2015; Morse et al., 2002; Noreña et al., 2012). De acuerdo con Bengtsson (Bengtsson, 2016), una vez decidido el objetivo de investigación, cabe proceder a identificar el conjunto de potenciales individuos que pueden dar respuesta a la cuestión, seleccionar los métodos de recolección de datos, y proceder finalmente a la selección de la metodología de análisis. De cara a incrementar la validez de los resultados, resulta útil proceder a la triangulación de los hallazgos (Bengtsson, 2016) mediante el análisis de datos por parte de diferentes investigadores en las investigaciones realizadas. En lo relativo al tamaño de la muestra, se puede partir de la base de realizar un mínimo de cinco entrevistas en cada una de las investigaciones (Nielsen, 2000). En las investigaciones cualitativas, no resulta tan importante el número de opiniones recabadas como la calidad de las mismas, hecho que permite obtener hallazgos consistentes con un tamaño de muestra relativamente pequeño (Bengtsson, 2016). Así pues, en todas las investigaciones de carácter cualitativo presentadas en el contexto de esta tesis se decidió encuestar al alumnado a partir de un doble criterio: un mínimo de cinco alumnos, a la vez que garantizar recabar la opinión del 25% del universo de estudiantes. Con esta lógica se ha logrado identificar diferentes elementos destacados (en inglés, '*salient items'*) de forma consistente con lo apuntado en (Bengtsson, 2016), lo que ha permitido obtener hallazgos en línea con los objetivos postulados en este documento de tesis.

8.4 ALGUNOS DATOS RELATIVOS A LAS ASIGNATURAS OBJETO DE ESTUDIO

Para contextualizar los hallazgos obtenidos en esta investigación se presentan los resultados de distintas '*Mid-Term Surveys*' generados por el alumnado que ha cursado la asignatura 'Sistemas de

Información' en distintos cursos académicos. Dichas encuestas se vienen realizando sobre todas las distintas asignaturas, siendo rellenadas de forma voluntaria por parte del alumnado y diseñadas a modo de semáforo de cara a detectar posibles disfunciones de la asignatura y del profesorado que la imparte. La Tabla 1 muestra los resultados de la '*Mid-Term Survey*' de la asignatura 'Sistemas de Información' en los últimos cursos académicos. Hacer notar que el rediseño de la asignatura tuvo lugar a partir del curso académico 2019-2020.

Tabla 1. Resultados de la '*Mid-Term Survey*'.

	2020-21	**2019-20**	2018-19	2017-18	2016-17	2015-16
Matriculados	**17**	**13**	20	7	10	14
Respuestas	**7**	**13**	5	3	3	3
Porcentaje de respuesta	**41,2%**	**100%**	26,3%	42,9%	30,0%	21,4%
Valoración global de la asignatura	**4**	**4**	3,6	3,67	4,7	4,7
Valoración de la organización y la planificación	**4,14**	**3,92**	4	4	4,7	5
Valoración documentación de la asignatura	**4**	**3,85**	3,8	4,67	4,7	4,7
Valoración aplicación práctica	**4,14**	**4,08**	3,4	4	4,7	4,7
Valoración innovación y utilidad asignatura	**4,14**	**4,46**	3,6	3,67	4,0	5,0
Valoración información sobre actividad docente	**4,29**	**3,85**	3,8	4,67	4,7	4,3
Valoración carga de trabajo de la asignatura	**4,14**	**4,38**	3,0	4,0	4,3	4,3
Valoración global instructor 1	**4,29**	**4,38**	3,4	4,33	5,0	5,0
Valoración: como explica el instructor	**5,57**	**4,62**	4	4,67	5,0	5,0
Valoración: dinamismo, participación y motivación	**4,29**	**4,08**	3,4	4,67	5,0	5,0
Valoración: accesibilidad del instructor	**4,57**	**4,15**	3,8	5,0	4,7	5,0
Valoración global instructor 2	**4,43**	**4,46**	-	-	-	-
Valoración: como explica el instructor	**4,43**	**4,54**	-	-	-	-
Valoración: dinamismo, participación y motivación	**4,29**	**4,0**	-	-	-	-
Valoración: accesibilidad del instructor	**4,43**	**4,08**	-	-	-	-

Asignatura del programa de ingeniería en OTIC: '*Sistemas de Información*'

Los resultados que arrojan estas encuestas pueden ser de utilidad a modo alerta, desde el punto de vista del gestor o coordinador académico, para activar acciones correctoras, sí así se requiere una vez analizados otros elementos más allá de los que arroja la propia encuesta. Dos elementos se pueden destacar: 1) los resultados deben analizarse teniendo presente el volumen del alumnado que da respuesta a las encuestas; 2) esta encuesta permite recabar datos solo sobre los puntos preguntados de forma específica al alumnado. Cabe apuntar que la encuesta también incluye la opción de reseñar a pie de encuesta las observaciones que el encuestado considere pertinentes, reflejando históricamente un escaso número de aportaciones en el conjunto de las asignaturas. De lo compendiado en la Tabla 1 cabría destacar que los resultados obtenidos en los cursos académicos 2019-2020 y 2020-2021, cuando la asignatura ya se había rediseñado, son notablemente elevados y con una participación del alumnado significativa (100% y 41,2% respectivamente). En los cursos anteriores, los resultados de las encuestas mostraban unos porcentajes de participación bastante pobres, a pesar de no reflejar malos resultados, reflejando una pobre asistencia a clase. Este último factor, junto a otras consideraciones, fueron las que llevaron a optar por implementar un nuevo diseño de la asignatura. El nuevo diseño, tal y como queda reflejado en la Figura 2 y en la Figura 3, incluyó como etapa inicial el preguntar sobre las actividades preferidas en la primer sesión de clase, así como la realización de entrevistas mediante la técnica del *BLA* para capturar la experiencia de usuario del alumnado una vez finalizado el proceso de aprendizaje, lo que permite un ajuste continuo de la asignatura curso a curso (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021). De las opiniones recabadas a partir del *BLA* realizado al alumnado se podría destacar: 1) una valoración muy positiva de la asignatura; 2) valorar en gran medida el contar con instructores que son profesionales que ocupan

posiciones de alto nivel en el sector de los Sistemas de Información; 3) considerar un acierto el desarrollar la asignatura a partir de un enfoque de proyecto, a partir de la base de un supuesto real; 4) Apreciar el fomento de la participación del alumnado en clase. En lo negativo, puede destacarse el horario de las clases, ya que a juicio del alumnado las clases terminaban demasiado tarde, aspecto este último minimizado por la última cohorte de alumnado, quizás debido al hecho que disponían de la opción de cursar las clases *off line*, gracias a la implementación del formato SC en el Campus.

Los resultados académicos en forma de calificación obtenidos por el alumnado que ha cursado la asignatura 'Sistemas de Información' se muestran en la Tabla 2. De acuerdo con la literatura, los efectos del *engagement* y la motivación van correlacionados con buenos resultados académicos (Linnenbrink & Pintrich, 2002; Wigfield et al., 2015). Los resultados de los años en que se ha optado por impartir la asignatura a partir de la metodología PBL, que ha comportado un trabajo continuado en clase y seguido muy de cerca por parte del profesorado gracias al rol de consultor que ha desempeñado (Petchamé et al., 2020a; Petchamé, Iriondo, Villegas, Fonseca, et al., 2021) se ha plasmado en resultados notables, con unas notas promedio de 8,51 en el curso 2021-2019 y de 6,85 en el curso 2019-2018, superando todo el alumnado la asignatura en convocatoria ordinaria, a diferencia de lo que había sucedido en anteriores cursos académicos.

Tabla 2. Resultados académicos en distintos cursos académicos

	2020-21	**2019-20**	2018-19	2017-18	2016-17
Matriculados	**17**	**13**	20	7	10
NP en convocatoria ordinaria	**0**	**0**	0	1	2
Superan asignatura en convocatoria ordinaria	**17**	**13**	17	6	8
Número alumnos: calificación de 9 o superior	**5**	**2**	5	2	2
Número alumnos: calificación entre 8 y 9	**12**	**2**	9	3	1
Número alumnos: calificación entre 7 y 8	**-**	**4**	3	-	4
Número alumnos: calificación entre 6 y 7	**-**	**2**	1	1	1
Número alumnos: calificación entre 5 y 6	**-**	**3**	-	-	-
Número alumnos suspendidos (ordinaria)	**-**	**-**	2	1	2
Nota media (ordinaria)	**8,51**	**6,85**	7,25	6,71	6
Superan asignatura en convocatoria extraordinaria	**-**	**-**	2	1	1
Nota (extraordinaria)	**-**	**-**	6,0	6,0	4,0

Asignatura del programa de ingeniería en OTIC: '*Sistemas de Información*'

*

Otra de las actividades realizadas en el contexto de esta investigación la constituyó la práctica de un *Reciprocal Interview Activity* en el contexto de la primera sesión de clase de la asignatura del ámbito de gestión empresarial de segundo curso '*Value Chain and Financial Economics*'. La Tabla 3 muestra las valoraciones relativas a dicha actividad de acuerdo a las percepciones del alumnado una vez este ha completado la *Reciprocal Interview Activity* mediante una encuesta (Petchamé, Iriondo, Canaleta, et al., 2021). Dicha actividad se orientó a facilitar la toma de contacto entre el alumnado de las siete distintas titulaciones del ámbito TIC que cursa dicha asignatura, a la vez que introducir a los instructores de la asignatura al grupo a partir de facilitar y estimular el intercambio de preguntas y opiniones en relación con la asignatura del ámbito de *management*. De forma consistente con esta tesis, la focalización en los elementos mencionados se orientó a incrementar el *engagement* del alumnado. Como puede apreciarse en los resultados, el alumnado valoró de forma muy positiva la actividad, obteniendo un resultado igual a o superior a cuatro, sobre un valor máximo de cinco en cada una de las cuatro propuestas relativas a la utilidad de la actividad.

Tabla 3. Resultados obtenidos una vez realizada la *Reciprocal Interview Activity* al alumnado.

Reciprocal Interview Questionnaire	*M*	*Mdn*	*SD*
Comfort with instructor interaction			
C1. 'Talking to the instructor about assignments'	3.93	4	0.70
C2. 'Asking the instructor questions during class sessions'	3.93	4	0.70
C3. 'Talking to the instructor during office hours'	3.71	4	0.91
C4. 'E-mailing the instructor with questions'	3.87	4	1.19
Student comfort with class participation			
S1. 'Participating in group activities during class'	4.20	5	1.01
S2. 'Sharing ideas and opinions during class'	4.00	4	0.76
S3. 'Working group activities outside class hours'	3.67	4	1.23
Evaluation of the activity			
E1. 'Would you recommend other instructors do this activity at the beginning of the term?'	3.80	4	0.86
E2. 'Did this activity seem to be a waste of time?'	1.47	1	0.64
… the activity helped me:			
H1. 'To understand what was expected of them in class'	4.13	4	0.74
H2. 'To work hard to do well in the class'	4.00	4	0.88
H3. 'To become more comfortable participating in class'	4.13	4	0.74
H4. 'To share concerns with the instructor'	4.00	4	1.07

Asignatura: '*Value Chain and Financial Economics*' (Petchamé, Iriondo, Canaleta, et al., 2021).

Un último elemento que destacar de esta investigación lo constituye la percepción del alumnado con relación al despliegue de la tecnología *SC*. Para esta investigación se seleccionó una asignatura de segundo curso del ámbito de la gestión impartida al alumnado de las siete ingenierías. La cohorte de alumnos al que se dirigió la encuesta inició sus clases con el formato *F2F* durante el primer semestre en que accedieron a la universidad, para experimentar de forma sucesiva durante los siguientes dos semestres los formatos *ERT* y *SC* (Petchamé, Iriondo, Villegas, Riu, et al., 2021). Los alumnos fueron encuestados mediante la técnica *pocket BLA*, y valoraron muy positivamente el despliegue tecnológico de la tecnología SC, en comparación con el despliegue *ERT* realizado en el semestre previo para combatir las restricciones gubernamentales derivadas de la pandemia generada por el *COVID-19*. No obstante lo apuntado, el alumnado valoró de forma positiva el despliegue en sí de una solución de emergencia, al posibilitar finalizar el curso 2019-2020. Al valorar las tres opciones experimentadas, el formato *F2F* es el más apreciado. Todo y con ello, la opción *SC* ha sido muy bien valorada, destacando dos elementos de acuerdo con las apreciaciones del alumnado: 1) permitió cursar clases de forma remota a elección del alumnado durante gran parte del curso; 2) la implantación de un mecanismo de grabación de sesiones de clase que ha permitido durante este curso el acceso a las mismas por parte de todo el alumnado durante una ventana temporal concreta. Otro punto altamente valorado ha sido el ahorro tiempos de desplazamiento al campus por parte del alumnado que ha optado por cursar las clases en la modalidad *SC*. En el caso de la asignatura 'Sistemas de Información' se optó por preguntar de forma explícita por la opción *SC* (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021), obteniéndose resultados en la misma línea que los obtenidos vía *pocket BLA* que se han mencionado.

9. CONCLUSIONES, LIMITACIONES Y LÍNEAS DE FUTURO

9.1 CONCLUSIONES

El 'dar voz al alumnado' constituye una práctica que permite recabar información útil a partir de la visión del alumnado, susceptible de ser empleada una vez analizada desde la coordinación académica de una asignatura, ya para corregir eventuales déficits o bien para potenciar aún más los aspectos positivos. El solo hecho de escuchar al alumnado constituye de por sí un factor positivo, al percibir estos que sus opiniones e ideas son escuchadas por parte del profesorado. Así pues, el escuchar al alumnado de una forma sistemática permite reforzar los mecanismos de mejora continua de los programas de las asignaturas, así como eventualmente fomentar el *engagement*.

En esta investigación se ha optado por realizar distintas actividades de investigación focalizadas en el alumnado de distintos grados y cursos de ingenierías del ámbito TIC con la finalidad de recabar sus opiniones, y a partir del análisis de estas, considerar la implementación de mecanismos de reajuste del programa de la asignatura. Los hallazgos y conclusiones apuntadas en las distintas contribuciones académicas publicadas en revistas de investigación se presentan de modo sintético a continuación:

- De la investigación focalizada en las percepciones del alumnado, una vez experimentadas en tres semestres consecutivos tres distintas modalidades de clase, a saber: *F2F*, *ERT* y *SC* (Petchamé, Iriondo, Villegas, Riu, et al., 2021), se pueden extraer diversas conclusiones a partir de las consideraciones expresadas por parte del alumnado: 1) preferencia por la modalidad *F2F* frente a las modalidades *ERT* y *SC*; 2) la modalidad *ERT* es la que resulta peor valorada de las tres alternativas; 3) percepción de las *SC* como una buena opción en el contexto *COVID-19*, caracterizado por restricciones de acceso a los campus universitarios; 4) entre las ventajas asociadas al *SC*, destacan tanto el ahorro de tiempo empleado en los desplazamientos al campus al optar asistir clases *off campus*, como la posibilidad de acceder a las grabaciones efectuadas de las sesiones de clase; 5) entre las desventajas asociadas al *SC*, pueden destacarse la gran facilidad de distracción al asistir a las clases en la modalidad *off campus*, así como las dificultades de interacción del alumnado *off campus*, tanto con los instructores como con el resto de sus compañeros.
- De las investigaciones derivadas de las entrevistas de la primera sesión de clase de una asignatura presentadas en dos investigaciones (Petchamé, Iriondo, Canaleta, et al., 2021; Petchamé, Iriondo, Villegas, Fonseca, et al., 2021), se han recabado las actividades que gustan y las que no gustan al alumnado el primer día de clase de una asignatura. Dichos hallazgos permiten diseñar futuras primeras sesiones de clase una vez valoradas las aportaciones del alumnado.
- La adopción de actividades específicas orientadas a potenciar el *engagement* del alumnado en el primer día de clase de una asignatura, aparte de impactar en el efecto inicialmente deseado, pueden comportar toda una serie de efectos positivos en la impartición de la asignatura (Petchamé, Iriondo, Canaleta, et al., 2021).
- La implantación de técnicas de valoración de la experiencia de usuario (*UX*), una vez ha finalizado la impartición del alumnado, permite valorar la satisfacción del estudiantado con la experiencia de aprendizaje, a la vez que proceder a eventuales reajustes de cara a la próxima edición de la asignatura (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021).

Los hallazgos presentados, una vez analizados de forma agregada, permiten presentar las siguientes conclusiones:

- Las actividades orientadas a dar voz al alumnado, ya sea durante la primera sesión de una asignatura, ya sea al entrevistar al alumnado una vez estos han concluido su experiencia de aprendizaje, han resultado muy positivas a juzgar por los comentarios que manifestados por las personas encuestadas. La adopción de mecanismos de refuerzo o corrección, en línea con lo apuntado por los estudiantes, una vez contrastadas con las valoraciones de los instructores de las asignaturas, contribuyen tanto al ajuste de la asignatura como al *engagement* del alumnado.
- La experiencia de usuario del alumnado una vez ha cursado una asignatura ha permitido proceder al reajuste del programa formativo de la misma, siempre de forma consistente con los parámetros fijados en el proceso de verificación del programa oficial de la titulación universitaria. No obstante, los hallazgos son susceptibles de ser valorados desde la coordinación de programas, tanto para el eventual ajuste de programas de otras asignaturas ya existentes, como para el diseño de nuevas asignaturas.
- El fomento del *engagement* es crítico en asignaturas de gestión empresarial en los programas de ingeniería, dada la percepción inicial de lejanía con los intereses formativos por parte del alumnado de ingeniería. No obstante, el fomento del *engagement* es susceptible de ser impulsado en todas las materias, al generar dicha práctica una dinámica positiva, independientemente del ámbito de una asignatura. Así pues, fomentar del *engagement* en asignaturas percibidas por el alumnado como complejas, a la vez que especialmente relevantes a nivel formativo (en el caso de ingeniería, podría ser el caso de la estadística, las matemáticas o la programación), es previsible que resulte especialmente positivo para el estudiantado.
- La adopción del Nuevo Contexto de Aprendizaje (NCA) constituye un elemento modernizador ideado para alinear y adecuar los métodos y metodologías de enseñanza con la formación, intereses y características del alumnado actual. El desarrollo y consolidación de prácticas específicas dentro del modelo NCA, como son las propuestas concretas presentadas en este escrito, son susceptibles de ser incardinadas dentro de los ámbitos de aprendizaje de *welcoming* y *closure* (Petchamé, Iriondo, Canaleta, et al., 2021; Petchamé, Iriondo, Villegas, Fonseca, et al., 2021) de diferentes asignaturas. Los hallazgos presentados contribuyen al desarrollo práctico del modelo NCA, a la vez que fortalecen y potencian el propio modelo NCA al introducir actividades que contribuyen al *engagement* del alumnado.
- La conceptualización relativa al NCA presentada en (Petchamé, Iriondo, Canaleta, et al., 2021) contribuye al desarrollo teórico del modelo NCA, al presentar formalmente al mundo académico las bases e interrelaciones entre los principios pedagógicos asociados al NCA y los ámbitos de aprendizaje en los que los primeros se cristalizan.
- La apuesta institucional por la introducción de un modelo tecnológico sustentado en un formato *SC* ha sido muy bien acogido por el alumnado, una vez comparado con la solución *ERT* previamente implementada. Así, uno de los estudios realizados ha permitido contrastar los elementos valorados por parte del alumnado en las distintas modalidades experimentadas por el alumnado, a la vez que ha permitido identificar diversos elementos que presentan ciertos déficits a juicio del estudiantado (Petchamé, Iriondo, Villegas, Riu, et al., 2021). El entorno *SC* y el desarrollo de las posibilidades que este ofrece, ha de analizarse desde un punto de vista estratégico por parte de la Institución. La potencialidad que permite dicha solución tecnológica en todo lo relativo a personalización e interacción entre alumnado y profesorado ha de ponerse en valor, siempre teniendo en cuenta los retos reales que supone su implementación.

- La introducción de metodologías activas y alineadas con propuestas asociadas a una lógica constructivista, como puede ser la adopción de la metodología *PBL* (Petchamé et al., 2020a), o bien la adopción de mecanismos de evaluación formativa (Petchamé et al., 2020b), han resultado muy bien valorados por parte del alumnado (Petchamé, Iriondo, Villegas, Fonseca, et al., 2021), a la vez resultan consistentes con la potenciación de la adquisición de los conocimientos y las competencias especialmente relevantes para el futuro ingeniero. Así pues, dichos hallazgos permiten impulsar la réplica y adopción de dichas lógicas en otras asignaturas de las titulaciones de ingeniería, siempre y cuando los condicionantes de las mismas lo permitan.

9.2 LIMITACIONES Y LÍNEAS DE FUTURO

En lo relativo a las limitaciones, hay que apuntar que esta investigación se ha restringido al alumnado de ingeniería del ámbito TIC. Esta opción presenta la ventaja de que las posibles dificultades de índole tecnológico derivadas de la adopción de las soluciones *ERT* y *SC* se han soslayado de alguna forma. Ello ha eliminado un posible factor de rechazo o de dificultad por parte del alumnado, permitiendo focalizar la atención de la investigación en la identificación de las ventajas y desventajas que ofrecen susodichas tecnologías, evitando potenciales sesgos derivados de la adopción de la tecnología en sí por parte del alumnado. Una vez realizada la investigación en un contexto de los estudios de ingeniería, sería oportuno realizar una investigación en línea con lo ya investigado en alumnado no necesariamente proclive de entrada a la adopción de soluciones tecnológicas, como es el caso de los estudiantes de ingeniería en el ámbito TIC. Otra limitación de este estudio es el hecho de que el *engagement* se ha focalizado en oír al alumnado para así adaptar los formatos y contenidos de clase a sus peticiones, siempre que resulten factibles a la vez que consistentes con lo aprobado en los programas oficiales. Se ha de tener en cuenta que no todas las peticiones del alumnado se podrán satisfacer. Lo que de entrada tiene de positivo el escucharle y que este perciba que es escuchado, puede transformarse en negativo desde el punto de vista del *engagement,* en el caso de generar falsas expectativas por parte de los instructores. Así pues, deben generarse con cautela y mucha planificación dichas actividades. El hecho de realizar esta 'escucha' al alumnado mediante la metodología BLA permite minimizar la problemática apuntada, al capturarse la experiencia del alumnado una vez finalizada la impartición de la asignatura.

Una primera línea de futuro de esta investigación se podría orientar a replicar los estudios realizados a nivel de estudios de máster y contrastar si existen o no diferencias entre alumnado de primeros cursos de ingeniería, últimos cursos de ingeniería y alumnado de máster. Otro elemento que se puede desarrollar es el establecimiento de la metodología *PBL* en las asignaturas híbridas de gestión y tecnología que lo permitan, para replicar el modelo aquí postulado. Así pues, un estudio detallado de las asignaturas susceptibles de incorporar el *PBL* como metodología de trabajo y sus ulteriores estudios en línea de lo investigado en este estudio, darían continuidad y arrojaría más luz en al eventual establecimiento de mecanismos de ajuste y desarrollo de asignaturas. Otra línea de investigación a desarrollar podría orientarse a la generalización de distintas actividades de primer de clase en todas las asignaturas de diversos ámbitos, no solo en el de ingeniería, adaptadas de acuerdo con las necesidades y particularidades de cada una de ellas como elemento motivador y generador de *engagement*, a la vez que generador de hallazgos susceptibles de ser adoptados en otras asignaturas. Asimismo, puede plantearse la realización y el estudio de actividades a mitad de curso con la misma orientación. En este sentido, puede apuntarse que en febrero de 2021, y en el contexto de la asignatura de segundo curso de carácter anual '*Value Chain and Financial Economics*', se realizó con carácter experimental una actividad de primer día 'de nuevo semestre' al inicio de la segunda parte del curso, consistente en una nueva *reciprocal interview activity*, con tres objetivos: 1) escuchar las expectativas del alumnado en relación con segundo semestre de la asignatura; 2) explicar el profesorado la utilidad práctica de los conceptos a impartir en el segundo semestre, a partir de las preguntas del alumnado;

3) recibir información de forma coral y distendida de cómo había discurrido el primer semestre de la asignatura. Una línea de futuro alternativa, a la vez que complementaria a los hallazgos presentados en este trabajo de tesis, la constituye investigaciones orientadas a cuantificar el *engagement* del alumnado a partir de alguna de los instrumentos de medida existentes, y así poder analizar eventuales correlaciones con métricas de desempeño del alumnado. Otra posible línea de futuro la puede constituir la adopción de la técnica del *BLA* en las actividades de tutoría, tanto en el caso de las tutorías grupales como en las individuales, al permitir recabar información de una forma sistematizada en ciertos momentos del curso académico (por ejemplo, justo antes o justo después de los 'Puntos de Control'). Dicha técnica no debería ser empleada de forma generalizada en todas y cada una de las sesiones tutorías para no banalizar el mecanismo por parte del alumnado, requiriendo pues un proceso de planificación a partir de un estudio y análisis para determinar el momento idóneo. Una última línea de investigación podría focalizarse en el desarrollo de las potenciales derivadas ocasionadas a partir de la implementación y uso del modelo *SC*, una vez formulada la estrategia de la Institución con respeto a esta tecnología. En el estudio realizado, el modelo *SC* ha sido útil de cara a ofrecer al alumnado mediante un formato *online* una experiencia lo más cercana a la presencialidad en el aula, al permitir interactuar al alumnado que siguió las clases de forma remota una interacción en tiempo real, además de posibilitar el acceso a sesiones de clase grabadas. Una vez desplegada la tecnología en aulas y laboratorios, el reto en forma de línea de investigación es el de aprovechar las posibilidades que la lógica *SC* permite en diversidad de aspectos (individualización del alumnado, interacción y visualización de contenidos, …).

A partir de las distintas contribuciones presentadas en este documento de tesis y una vez se desarrollen las líneas de futuro planteadas, se podrá generar una guía de práctica que proporcione a los instructores un conjunto de actividades orientadas a incrementar el *engagement* del alumnado.

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APÉNDICES. ARTÍCULOS PUBLICADOS

En este apartado se incluyen los artículos asociados a esta memoria de tesis publicados en revistas indexadas en el JCR.

Publicación 1: Petchamé, J.; Iriondo, I.; Villegas, E.; Riu, D.; Fonseca, D. Comparing Face-to-Face, Emergency Remote Teaching and Smart Classroom: A Qualitative Exploratory Research Based on Students' Experience during the COVID-19 Pandemic. Sustainability 2021, 13, 6625. https://doi.org/10.3390/su13126625

Publicación 2.- Petchamé, J.; Iriondo, I.; Canaleta, X.; Riu, D.; Necchi, S. Engaging ICT Engineering Undergraduates in a Management Subject through First Day of Class Activities: An Empirical Study. Sustainability 2021, 13, 7440. https://doi.org/10.3390/su13137440

Publicación 3: Petchamé, J.; Iriondo, I.; Villegas, E.; Fonseca, D.; Romero Yesa, S.; Aláez, M. A Qualitative Approach to Help Adjust the Design of Management Subjects in ICT Engineering Undergraduate Programs through User Experience in a Smart Classroom Context. Sensors 2021, 21, 4762. https://doi.org/10.3390/s21144762

APÉNDICE 1 – PUBLICACIÓN 1

Publicación 1: Petchamé, J.; Iriondo, I.; Villegas, E.; Riu, D.; Fonseca, D. Comparing Face-to-Face, Emergency Remote Teaching and Smart Classroom: A Qualitative Exploratory Research Based on Students' Experience during the COVID-19 Pandemic. Sustainability 2021, 13, 6625. https://doi.org/10.3390/su13126625

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Article

Comparing Face-to-Face, Emergency Remote Teaching and Smart Classroom: A Qualitative Exploratory Research Based on Students' Experience during the COVID-19 Pandemic

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Abstract: The COVID-19 pandemic significantly disrupted traditional face-to-face teaching worldwide and forced education institutions to adopt new, online teaching formats to enable students to continue with their studies. This research focuses on students' perceptions of three teaching different modalities: face-to-face (F2F), Emergency Remote Teaching (ERT) and Smart Classroom (SC), which were implemented in response to the restrictions enforced to combat the spread of COVID-19. A qualitative study based on two user experience techniques, Pocket Bipolar Laddering and Emotional Appraisal, was carried out on a group of second-year ICT engineering university students at La Salle Campus Barcelona. The former technique consists in identifying a maximum of three positive and three negative salient items, while the latter is intended to rate pairs of opposite feelings. In the SC format, saving time on travel to university was considered an advantage of online learning, while disadvantages included less effective instructor–student interaction, distractions when off-campus and teamwork issues. These shortcomings can be addressed by specific online teaching training to develop a more active form of learning and foment student participation. However, both ERT and SC modalities were considered effective solutions to cope with the social and mobility restrictions imposed during the pandemic.

Keywords: COVID-19; Emergency Remote Teaching; engineering education; face-to-face; higher education; ICT; online learning; smart classroom; user experience

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1. Introduction

The outbreak of COVID-19 in December 2019 quickly became a worldwide pandemic in 2020 [1] due to its high transmission and mortality rates. COVID-19 originates from the coronavirus SARS-CoV-2, which causes viral respiratory disease [2]. Hence, in order to cope with the multifaced issues derived from the virus, different measures were adopted by governments and institutions in order to minimize the spread of the disease [3–5]. As public health systems became inundated with patients, human interactions were increasingly restricted [4,6–8]. In 2020, the direct effects of COVID-19 and all the adopted measures that were taken to try to stop the pandemic had a significant impact on worldwide economies [9–11].

In the educational context, institutions implemented different solutions to cope with the effects of the pandemic and to enable students to achieve their learning outcomes. This study presents the salient opinions and feelings of ICT engineering undergraduates who experienced three class modalities at La Salle URL over three consecutive academic semesters: face-to-face (F2F), Emergency Remote Teaching (ERT), and Smart Classroom (SC).

The general aim of this research was to assess three different class modalities according to the undergraduates' perceptions of the 2019–2020 academic year at La Salle URL. It is expected that the results will shed light on F2F, ERT and SC formats and provide insight from a students' perspective to enable course coordinators to make further teaching adjustments to improve learning experiences and outcomes.

The article contributes to the literature by analyzing the user experience of a group of ICT engineering students who attended three class modalities due to the outbreak of the COVID-19 pandemic. Given that all the participants selected for this research were students with strong ICT skills, eventual technological barriers should not have interfered with their perception of these three formats.

2. State of the Art

In the educational sector, different measures were taken, including mobility restrictions, to limit or even forbid physical access to educational premises [12,13]. To cope with the impossibility of face-to-face learning, remote learning was considered as a solution to face the pandemic constraints [14–16]. In addition, the measures taken to curb the pandemic began to have negative effects on students' health in terms of anxiety, depression and stress [17–21]; interpersonal interactions [22]; and a decrease in physical activity while increasing sedentary behaviors [23,24].

To deal with the COVID-19 pandemic, different initiatives were deployed by academic institutions with the objective of maintaining learning frameworks as much as possible [25–27]. In this line, educational institutions adopted different solutions, such as webcasts, open educational resources, flipped instruction using video clips, group learning or online courses [25], learning management systems, instant message platforms, e-mails, webinars or online videos [26].

In this context, most educational institutions decided to apply Emergency Remote Teaching (ERT) [28–30], which involved a temporal shift from face-to-face (F2F) class sessions to remote teaching. This latter modality raises the following points: (1) online education allows competition among universities within a worldwide context [31], as it is considered as a kind of distance education option [32–34] that was already offered by various institutions in pre-pandemic times; (2) online learning has some pros, in terms of flexibility in time or location and the fact that it may be self-paced by the student, among others [35,36]; (3) online learning presents some challenges in terms of assessment [37–39], engagement [40–42] or student participation [43,44]; (4) online learning can be implemented both synchronously or asynchronously, each with its own particular implications [45–47]; (5) online teaching implies certain challenges for the academic staff [48,49]; (6) online teaching has its own idiosyncrasies, requiring adaptions in the practice of teaching [50–53]. On the other hand, online teaching is not conceptually the same as ERT, since the latter is not an initially planned learning strategy [54]. Hence, when shifting to ERT, not all educational institutions started off in the same position which resulted in quite different ERT approaches.

2.1. The Smart Classroom Concept

An SC format is characterized by the introduction of interconnected electronic devices in classrooms, such as cameras, screens, smart-boards or sensors [55–58]. Therefore, it can be said that the SC is an instrumental tool that enables smart education [58,59], which facilitates personalized learning and the possibility of learning anytime and anywhere [58]. A number of studies have been carried out to evaluate the SC format from different perspectives by means of diverse surveys, as shown in different papers, such as [57,60,61]. In the following subsections, the technological tools deployed at La Salle Campus in response to the outbreak of the pandemic are briefly explained from a users' perspective, not from a technical viewpoint.

The SC format is a technological implementation that leverages teaching and learning solutions. Measuring outcomes once a specific class format has been implemented is

considered relevant as it enables course designers to make fine adjustments when required. The concept of performing research focused on students' opinions is also considered appropriate in order to create the whole picture. In that line, some researchers have focused on evaluating students' feedback during the COVID-19 pandemic about a specific topic, such as one measuring the impact of COVID-19 in their lives by means of a questionnaire [62], one about the learning experience of nursing students during the first month of confinement by means of a qualitative study [63], and one about students' perceptions about the forced transition to remote learning [64].

2.2. Technologies Deployed at La Salle URL to Cope with COVID-19

The ICT engineering programs taught at La Salle URL were initially designed in a F2F format. Once attendance restrictions were imposed by government institutions, some changes were implemented to enable teaching activities to continue. An explanation of these changes is given next, distinguishing two different stages: firstly, an ERT approach, and secondly, a more sophisticated technological solution based on an SC model. Implementing an SC solution in the campus facilities was a strategic decision adopted by the institution at a management level. The initial goal of the SC technological solution was to cope with campus closures and the mobility restrictions derived from the COVID-19 pandemic in order to continue teaching students in a way that was as similar as possible to the F2F format in classrooms and laboratories [65].

2.2.1. ERT: 2019–2020 Academic Year, Second Semester

In February 2020, the second semester of the 2020–2021 academic year started, with mobility limitations that restricted student access to La Salle URL Campus. As La Salle URL was already teaching some online programs, ERT could be implemented, taking advantage of the existing resources with the acquisition of additional new equipment. The required elements to implement the ERT are listed as follows:

- Computer, Internet connection, webcam, microphone and speakers. Instructors and students had to have their own equipment. In some cases, La Salle provided the required equipment on request. Furthermore, additional devices, such as drawing tablets, were supplied when required for teaching purposes.
- The corporative Learning Management System incorporated a module named "Online Teaching and Learning Platform" to allow the online interconnections of users.

2.2.2. Smart Classroom: 2020–2021 Academic Year

In September 2020, most classrooms at La Salle URL were equipped with technological devices to make them SCs. This deployment enabled offering class sessions with students inside the classroom (on-campus) or connected remotely to the classroom in a synchronous way (off-campus). The aim of this SC format [65] was to maintain most of the advantages that F2F classes offered [66], despite the COVID-19 pandemic. The complete system installed in most classrooms and laboratories [67] is described as follows:

- Personal Computer (PC): It can be connected to the SMART Board and to the Internet.
- Wi-Fi in all the campus facilities, available in all the classrooms. It enables all authorized users to connect to the Internet by means of their own devices.
- Sound system: The classroom is equipped with a sound system consisting of microphones and speakers to allow interaction between those in the physical classroom and students at home who need a basic audio system.
- Image system: It consists of an equipment based on two cameras and two TVs. One of the cameras automatically follows the movements of the instructor as s/he moves around the classroom. However, at the instructor's request, the camera can directly focus on the board. The other camera shows a general view of the classroom. The two TV can be configured to show different views, such as the mosaic of all students or just the image of a single student attending classes in an off-campus format. In

addition, off-campus students need a device with a camera and a screen to allow proper interaction.

- SMART Board: It is a computer with a huge touch screen that functions as a board. Instructors use this computer to initiate a virtual session where all the authorized participants can connect in order to follow the class session. The screen may display contents from other computers, or just act as a board. The instructor can allow students to write remotely on the board.
- Software and licenses to allow the creation and connection to virtual sessions to undertake class activities online.
- Remote access to different devices (such as specialized computers) located in laboratories at the campus facilities.

3. Methods

The specific research objectives were: (1) to gain insight into the potential for the SC to create new expectations for students once restrictions on COVID-19 are cleared, which could mean rethinking the old F2F format; (2) to obtain greater knowledge about students' perceptions when experiencing the ERT and the SC formats; (3) to detect the possible negative effects of the ERT and SC formats on students from an emotional point of view when compared with the F2F format. This research is an exploratory study of the perceptions of second-year undergraduates who have attended classes in three different technological scenarios in the context of undergraduate engineering studies from a user experience approach [68,69]. A specific technique, Bipolar Laddering (BLA) can be used to collect qualitative data about the user experience of respondents, minimizing the bias of their perceptions as it is based on open-ended questions. Furthermore, to complete information about students' experience, an Emotional Appraisal technique can provide additional data once their experience is completed in a specific class format.

3.1. Participants and Procedure

The surveyed students were enrolled in the course Value Chain and Financial Economics (VC&FE), a compulsory subject that forms part of all the ICT Engineering degrees at La Salle-URL. This research study's open-ended questions were formulated to find out the general perception and the emotions of the students regarding the different class formats deployed in each of the three different scenarios, regardless of the subject itself.

The research took place once the 2020–2021 first semester classes had finished. The surveyed students were chosen because they had started their engineering classes through the F2F modality in September 2019. Later, during their second semester of 2019–2020 academic year, the outbreak of the pandemic affected most aspects of people's lives, and therefore, these students shifted to the ERT format. Finally, during the first semester of the 2020–2021 academic year, they were taught through an enhanced F2F modality, developed to allow attending classes remotely and live, via an SC format. Hence, these second-year students were asked to assess their user experience once they had had class sessions in three different modalities: F2F, ERT and SC.

In the 2020–2021 academic year, the total number of enrolled students in the subject VC&FE was 164, and in terms of gender, there were 128 males (78.05%) and 36 females (21.95%). The survey was carried out synchronously and voluntarily on the last day of class with those students who were present in the classroom and remotely connected at home. It was not necessary to perform a User Profile Test to verify possible differences in the universe to select a suitable sample, since all VC&FE students can be considered homogenous in terms of this research: all students had experienced the three class formats one after the other; all undergraduates were studying an ICT engineering degree; all students had experienced on-campus classes for one semester and all had experienced the SC format when they were physically in the classroom at the beginning of the first semester of the 2020–2021 academic year, and all had attended off-campus classes when more restrictive measures were enforced by the authorities. A total of 43 students started

the survey but only 39 completed it correctly. In any case, as it is a qualitative study, the number of participants is much higher than the minimum established in the literature [70]. In terms of gender, valid questionnaires were answered by 30 males (76.92%) and 9 females (23.08%). The mean age of respondents was 19.7 years old (*SD* = 1.22). Most of these 39 students started their undergraduate studies in 2019–2020 (82.05%), while the rest (17.95%) had started their studies the previous year.

Data were collected by means of a voluntary and anonymous open-ended questionnaire structured through the pocket BLA technique as shown in Figure A1 that students uploaded in the Learning Management System of the university. This option was implemented since this is the platform that students usually use to upload their homework. Students were asked to introduce their answers at the end of the last session of VC&FE in January 2021, and it took them a maximum of fifty minutes to complete the task. Students did not include any personal information in the form, and data were treated once a label to each of the respondents had been assigned (U1, U2, U3, . . .), and the files uploaded by the students were deleted.

3.2. Methodology Applied to Answer the Research Objectives

User experience can be defined as analyzing products or services from the user's perspective once a product of a service has been used [71]. Additionally, other aspects such as emotions can be considered when analyzing user experience [72]. The techniques chosen in the study were based on the opinions of the students reflecting their previous experience in class and the feelings they have had. A qualitative approach to listen to the students' opinions was considered a good option to draw initial conclusions, in line with other research works [73]. The students were surveyed using two techniques: Bipolar Laddering and Emotional Appraisal.

3.2.1. Bipolar Laddering

To assess students' experience, the Bipolar Laddering technique was employed. This instrument is based on a Socratic interview/survey, where the respondents provide their own ideas [74]. Several steps must be taken to perform the BLA [74,75]: (1) users explain all the strong and weak points once the user has completed the experience; (2) users assess (from 0, minimum; to 10, maximum) each one of the identified strong and weak points; (3) users must give their own opinions on how to improve and resolve, according to their thoughts, all the identified points. Then, points are classified and clustered according to the following conditions: (1) positive common elements or positive points cited by at least two users; (2) positive particular elements or positive points cited only by one user; (3) negative common elements or negative points cited by at least two users; (4) negative particular elements or negative items mentioned by one user. The results are shown in different tables displaying the mean associated with each element and the percentage of users who have cited each one of the items.

The Bipolar Laddering technique can be implemented by means of a BLA interview or by using a pocket BLA. This latter option consists of a survey that substitutes the interview carried out when using the BLA interview by an open-ended questionnaire. Both are designed to identify the most salient positive and negative items once the user has experienced a product or a service. The first option is driven by means of an interview, and each interview can take a considerable amount of time, since the interviewer can ask respondents for clarifications. The second option consists of just asking the user to write the most relevant items in a document on completion of the experience. This method provides fewer data per person since respondents are asked to write just a limited number of different elements, but more data when all the answers are aggregated. The latter option is preferred when the goal is to obtain data from many people investing a reasonable amount of time, as was the case of this research. A standard BLA interview activity based on an experience can take around thirty minutes. In the case of this research, it was not just a single experience but three different learning experiences that were to be evaluated, so

the pocket BLA technique was selected. Hence, the pocket BLA consists of identifying a maximum of three positive and three negative items, following all the other instructions explained in the previous paragraph. This system has been applied previously in other educational projects [76–78].

The open-ended questions posed by means of the pocket BLA technique are shown in Appendix A. The process was explained to the students, and they were then asked to identify three positive and three negative elements of each modality based on their perceptions: F2F, ERT and SC. Students were asked to "Identify, according your perceptions, three positive and three negative elements of each one of three class modalities that you have experienced during the last three semesters". Figure 1 presents the components to be completed once the student had identified each element, in other words, a written description of the positive and negative elements, from the three different class modalities. The combined data obtained from each element provide a better understanding of students' perceptions about the item and the feedback from users.

	POCKET BLA	FACE-TO-FACE (in the CLASSROOOM) 1st semester 2019-2020	
		Positive Elements	**Negative Elements**
1st Element	DESCRIPTION		
	WHY? You should justify it.		
	SCORE		
	PROPOSAL to improve the identified element		
2nd Element	DESCRIPTION		
	WHY? You should justify it.		
	SCORE		
	PROPOSAL to improve the identified element		
3rd Element	DESCRIPTION		
	WHY? You should justify it.		
	SCORE		
	PROPOSAL to improve the identified element		

Figure 1. Pocket BLA: Template to be filled out by the participants for each class modality. This figure shows the particular case of the F2F class format.

3.2.2. Emotional Appraisal

Positive emotions seem to have a positive effect on human beings [79,80]. In fact, previous research has focused on emotions and their impact on students' interest, motivation to learn and on their academic achievement [81,82]. Therefore, efforts to analyze the emotions experienced by students in a class format may help to complete the picture about their perceptions.

To capture user's emotions, Emotional Appraisals was used. This questionnaire, in which the user has to rate each pair of opposite feelings shown in Figure 2 by selecting

a percentage that spans between both antonymous pairs of feelings was designed by Schmidt-Atzert [83]. The evaluation of each pair of feelings depends on how close (or far) it is located from each one of the pairs. Assessing all the pairs of feelings on the list enables us to draw a complete map of emotions once the user has experienced a product, service or experience. Hence, it results in the election of a more positive or negative positioning of the pairs of feelings being assessed [77,83,84]. Having surveyed the three different class modalities, an Emotional Appraisal Questionnaire was employed to capture user's feelings about the three class modalities that students had experienced. Within the same form, with the boxes to be completed about the pocket BLA included below, eleven pairs of opposite feelings were given to be assessed by the students as seen in Figure A1, included in Appendix A. Students received the instruction, "Assess the pair of emotions that you have had once experienced each class modality". The antonymous moods to be weighted for each class modality are listed in Figure 2.

Emotional Experience (*)		Class Modality
1	**Confidence / Suspicion**	%
2	**High Quality / Low Quality**	%
3	**Useful / Useless**	%
4	**Interesting / Not Interesting**	%
5	**Known / Unknown**	%
6	**Comfortable / Uncomfortable**	%
7	**Attractive / Not Attractive**	%
8	**Innovative / Conventional**	%
9	**Simple / Complex**	%
10	**Nearby / Distant**	%
11	**Funny / Not Funny**	%

Figure 2. Template to be filled out by the participants for each class modality. It includes all the pairs of opposite feelings of the Emotional Appraisal Questionnaire.

4. Results and Findings

Results from the pocket BLA questionnaire on each of the semesters are shown. All the mentioned positive and negative items are listed, including scores and mention indexes. The students' comments that ranked above 20% in terms of mention index are also included. Furthermore, a comparison of students' emotions per semester is presented from a students' emotional appraisal of each analyzed period.

4.1. Pocket BLA: 2019–2020 First Semester

As previously highlighted, all surveyed students attended ICT engineering courses in the 2019–2020 academic year. During the first semester, classes were taught in an F2F way. Therefore, instructors and students were physically in the classrooms and the laboratories located in the campus facilities. The comments of the students were reworded to be able to capture their ideas in a coherent way, and later, their opinions were grouped.

Table 1 shows the positive and negative items for F2F mentioned by the students. For each common element, the mean score is shown with its variance and the mention index. The mention index is presented as the number of students citing each item, compared to the total number of participants. For each particular element, the score of the item is depicted. Each one of the items was labeled according to a code of maximum length of nine positions: the first two ones, referring to the year; the third and the fourth ones, referring to the semester; the fifth one, referring to positive (P) or negative (N); the sixth one, referring to common (C) or particular (P); the seventh one, referring to element (E); and the remaining ones, which enumerate each one of the elements within the same category.

Table 1. Positive (P) and negative (N) elements both common (C) and particular (P) of the F2F modality (2019–2020 first semester). In bold, the items with a Mention Index higher than 20%.

Item	Description	Average Score	VARP	Mention Index
19s1PCE1	Instructor–student interaction.	**8.85**	1.21	**15/39**
19s1PCE2	More concentration. Fewer distractions.	**8.40**	1.44	**15/39**
19s1PCE3	Teamwork. Promotion of relationship and cooperation.	**8.20**	1.56	**10/39**
19s1PCE4	Classes are better understood.	8.00	0.33	7/39
19s1PCE5	Accesibility (instructor).	9.33	0.89	4/39
19s1PCE6	Resolution of doubts.	8.75	0.69	4/39
19s1PCE7	More entertaining classes.	8.67	0.89	3/39
19s1PCE8	Greater attention. Involvement of instructors and students.	8.50	0.25	2/39
19s1PCE9	More confidence when communicating with the instructor.	10.00	0.00	2/39
19s1PPE1	Good student/classroom ratio.	8.00	-	1/39
19s1NCE1	Waste of time due to travel.	2.67	1.55	13/39
19s1NCE2	Recorded classes are not available.	3.00	0.40	5/39
19s1NCE3	Possibility of contagion. COVID-19 pandemic.	2.00	2.80	5/39
19s1NCE4	Need to get up very early in the morning.	3.00	0.00	3/39
19s1NCE5	All contacts and activities were in person.	2.67	3.55	3/39
19s1NCE6	Classes: low interaction.	3.50	0.25	2/39
19s1NCE7	Too many people in class.	1.50	2.25	2/39
19s1NCE8	Difficulty to see board content in class if too far.	0.50	0.00	2/39
19s1NPE1	Teamwork: sometimes may be difficult.	4.00	-	1/39
19s1NPE2	Long time spent on university campus.	5.00	-	1/39
19s1NPE3	Students not receiving content of the boards.	5.00	-	1/39
19s1NPE4	Distraction from companions, if they are friends.	5.00	-	1/39
19s1NPE5	Shame when speaking in front of classmates.	2.00	-	1/39
19s1NPE6	Not very flexible. Activites related to time and space.	0.00	-	1/39
19s1NPE7	Few exercises solved.	2.00	-	1/39
19s1NPE8	It can be difficult being concentrated in classrooms.	2.00	-	1/39

From the data obtained, the next step was to polarize the elements based on two criteria: (1) positive or negative elements; (2) number of citations of each element, being referred to as "common elements" if cited for more than one student or "particular elements" if the element is just cited by one student. In this type of analysis, the positive and negative common elements are the most representative because they are the most cited.

Depending on the reference rate and its average obtained value, the most relevant elements were identified.

Students' open answers as to how to improve the item 19s1PCE1 (Instructor–Student interaction) were: "keep it as it is", a widely repeated answer; "include more options to contact with the instructor"; or simply no comment. According to analysis of the results of the item 19s1PCE2 (More concentration, Fewer distractions), comments were in the line of: "deploying much more dynamic practices in class"; "giving more dynamic explanations, including more examples", "more silence in class; students sometimes talk in class", "less use of personal computers during the class sessions" or "nothing to do; it depends on the student". Finally, observations about how to improve 19sPCE3 (Teamwork, Promotion of relationship and cooperation) were as follows: "teamworking is easier to perform F2F than contacting online"; "doing more teamwork activities, besides including different students in different teams"; "increasing student-student interactions"; "teamworking in real cases" or "doing some more teamwork activities out of the scheduled class timetable at the university".

Student's comments about how to improve item 19s1NCE1 (waste of time due to travel) were "nothing to do", "allowing the option of doing some classes online" or just including "no comment".

4.2. Pocket BLA. 2019–2020 Second Semester

During the second semester, surveyed students attended classes on the ERT modality. Table 2 shows all the items about ERT commented by the students, including the mention index and the average score of each one of the items.

Table 2. Positive (P) and negative (N) elements, both common (C) and particular (P), of the ERT modality (2019–2020 second semester). In bold are the items with a Mention Index higher than 20%.

Item	Description	Average Score	VARP	Mention Index
19s2PCE1	No time is wasted on campus trips from home.	**7.82**	2.14	**12/39**
19s2PCE2	Emergency Remote Teaching solution.	**7.75**	0.94	**9/39**
19s2PCE3	Comfort of being at home.	7.67	2.88	4/19
19s2PCE4	Resolving doubts remotely.	7.00	3.25	4/39
19s2PCE5	Possibility to review the classes.	9.00	1.00	3/39
19s2PCE6	Accessibility. No time or physical location restrictions.	8.00	0.00	3/39
19s2PPE1	No risk arising from COVID-19.	7.00	-	1/39
19s2PPE2	Viewing class contents.	10.00	-	1/39
19s2PPE3	Exams done remotely.	10.00	-	1/39
19s2NCE1	Very easy to be less attentive or distracted.	**2.45**	1.88	11/39
19s2NCE2	Teaching tools with shortcomings arising from tech.	**2.25**	5.93	10/39
19s2NCE3	Technical problems. Internet connection . . .	0.80	0.16	6/39
19s2NCE4	Less interaction and relationship with instructors.	3.80	0.96	6/39
19s2NCE5	More difficulty following the class.	2.00	1.50	5/39
19s2NCE6	Classes: lower quality compared with F2F classes.	2.67	2.88	3/39

Table 2. *Cont.*

Item	Description	Average Score	VARP	Mention Index
19s2NCE7	Teamwork: quite difficult.	4.50	0.25	2/39
19s2NCE8	Less interaction between students.	1.00	1.00	2/39
19s2NCE9	Less dynamic activities.	3.00	1.00	2/39
19s2NCE10	Stressful exams. Little time to make the resolution.	0.00	0.00	2/39
19s2NCE11	Technical difficulties due to fluid communication.	4.50	0.25	2/39
19s2NPE1	Difficulty resolving doubts.	1.00	-	1/39
19s2NPE2	Most work done individually.	5.00	-	1/39
19s2NPE3	Recorded classes are not available.	2.00	-	1/39
19s2NPE4	Difficulties using the technological tools.	5.00	-	1/39

Comments about how to improve the item 19s2PCE1 (No time is wasted on campus travel from home) were: "keep it as it is", a widely repeated answer; or just including no comment. Observations about item 19s2PCE2 (ERT solution) were: "including methodologies with the goal of increasing the quality of classes"; "trying to minimize problems associated with ERT".

Comments about how to improve the item 19s2NCE1 (Very easy to be less attentive or distracted) were: "doing F2F classes"; "increasing students' attention by means of solving more exercises"; "it is difficult to solve"; "including more breaks"; "majorly depends on the environment of the student at home"; "more dynamic classes" or just including no comment. Observations about item 19s2NCE2 (Teaching tools with shortcomings arising from tech.) were: "more dynamic classes"; "Smart Classrooms"; "using tablets"; "improving online classes" or just including no comment.

4.3. Pocket BLA. 2020–2021 First Semester

Table 3 shows all the items about SC commented by the students. It includes the mention index and the average score of each one of the items.

Table 3. Positive (P) and negative (N) elements both common (C) and particular (P) of the SC modality (2020–2021 first semester). In bold, the items with a Mention Index higher than 20%.

Item	Description	Average Score	VARP	Mention Index
20s1PCE1	Versatility: Attending classes on' or off-campus.	**8.94**	2.05	**18/39**
20s1PCE2	Recording class sessions. It allows reviewing contents.	**9.18**	1.05	**12/39**
20s1PCE3	Very good teaching method.	**8.14**	1.55	**8/39**
20s1PCE4	Blackboard/PC. Very good teaching possibilities.	9.40	0.64	7/39
20s1PCE5	Agile technological system. Better than virtual classes.	8.14	1.55	7/39
20s1PCE6	No time is wasted on campus trips.	8.33	0.88	4/39
20s1PCE7	Classroom cameras: allow a great interaction.	8.75	0.68	4/39
20s1PCE8	It allows good interactivity b/w instructors and students.	8.33	0.22	3/39

Table 3. *Cont.*

Item	Description	Average Score	VARP	Mention Index
20s1NCE1	Students less attentive if they attend classes virtually.	**2.71**	1.63	9/39
20s1NCE2	In the classroom, students learn more and interact better.	**2.25**	1.68	8/39
20s1NCE3	Sometimes writings on the board do not look good.	2.00	4.66	5/39
20s1NCE4	Teamwork: quite difficult.	2.67	2.88	3/39
20s1NCE5	Having to take F2F exams.	1.00	0.66	3/39
20s1NCE6	Class session recordings are deleted too soon.	4.00	1.00	3/39
20s1NCE7	Difficulties in interactions between students (class/remote).	3.00	0.00	3/39
20s1NCE8	Students appear on a screen for a long time.	2.00	0.00	2/39
20s1NCE9	Students do not experience the campus environment.	3.00	0.00	2/39
20s1NCE10	Difficulties in understanding contents/subjects.	3.00	0.00	2/39
20s1NPE1	Sending too many communications via e-mail.	4.00	-	1/39
20s1NPE2	If noise in the classroom, remote learning is difficult.	4.00	-	1/39
20s1NPE3	Improves ERT, but Virtual F2F option is worse than F2F.	5.00	-	1/39
20s1NPE4	Virtual F2F conditioned by technology of each student.	2.00	-	1/39
20s1NPE5	Exams: Little time to make the resolution.	0.00	-	1/39
20s1NPE6	Less interaction between students.	2.00	-	1/39
20s1NPE7	Complications connecting specific link of the class group.	4.00	-	1/39
20s1NPE8	Virtual F2F conditions the way of learning of students.	4.00	-	1/39

Comments on how to improve the item 20s1PCE1 (Versatility: Attending classes 'on-campus' or 'off-campus') were: "students can choose between on-campus and off-campus", a widely repeated answer; "adapting off classroom and on classroom activities in a better way"; "nothing to improve" or just including no comment. Observations about the item 20s1PCE2 (Recording of class sessions, It allows reviewing contents) were: "maintaining recorded classes available for more time" or "nothing to improve". Finally, notes about 20s1PCE3 (Very good teaching method) were: "increasing drawings and writings" and the majority of students did not include any additional comments.

All the positive elements were identified by at least two students. Hence, no single positive particular element was obtained from the questionnaire. Comments about how to improve the item 20s1NCE1 (Students are less attentive if they attend classes virtually) were: "attending F2F on-campus classes"; "increase interactions with off-campus students to enhance their engagement"; "difficult to solve; it is an issue that depends of the student"; "increasing interaction" or just including no comment. Observations about the item 20s1NCE2 (At classroom students learn more knowledge and interact better with the instructor) were: "quite difficult to cope with this issue"; "implement a system to solve stu-

dents' doubts privately"; "doing more questions to be answered (mandatory)"; "attending classes on-campus instead of off-campus" or "increasing even more interaction options".

The findings of the qualitative research obtained by means of the Pocket BLA technique in terms of reliability and validity match the criteria presented in previous studies [85–88]. Reliability was achieved by means of replicating the same methodologies and techniques deployed in other studies to collect students' experiences in an educational context, e.g., [78,89]. The study is considered valid since data collection was carried out in a consistent way with other research works [78,89], the obtained results are consistent with a study that had analyzed different class formats [90], and a great number of respondents (thirty-nine students) form the base elements to analyze our research. Regarding credibility, it should be noted that the analyzed data were provided directly from students' opinions and perceptions experienced in the three class formats one after another for the same period of time, being recognizable as true data by the surveyed students. When analyzing transferability, it can be said that the context in which data were extracted was clearly explained, and the sample of surveyed students was homogeneous with the defined universe, besides collecting data from a great number of respondents. Dependability was achieved since the collection process was clearly explained, while data were analyzed separately by three authors of this paper, previously to synthetizing the results. The transcription of all students' opinions and the comparison of findings with some partial previous results obtained in other studies [90] contribute to the confirmability of the study.

4.4. Students' Emotional Appraisal in the Three Analyzed Semesters

The results of the Emotional Appraisal were subject to a statistical treatment that was carried out using the MATLAB® software, adding [91] to the software package to calculate the Cronbach's alpha test. To check the consistency of the collected dataset, the Cronbach's alpha test [92] was performed. The aggregated dataset had a value of $\alpha = 0.88$, which indicated high consistency since the α was greater than 0.70 [93]. In addition, three additional Cronbach's alpha tests were performed with the data subsets obtained by eliminating each subset of class modality, obtaining the following results: without F2F, $\alpha = 0.91$; without ERT, $\alpha = 0.82$; and finally, without SC, $\alpha = 0.87$. Thus, all the different subsets of data showed consistency.

Table 4 presents the results of students' emotional appraisal in terms of means and standard deviation (SD) of the different class modalities. Respondents assessed eleven pairs of feelings (see Figure 2), according to the procedure mentioned in Section 3.

Table 4. Data from the Emotional Appraisal: F2F, ERT and SC.

Emotional Pair	Pairs of Emotions	F2F Mean (SD)	ERT Mean (SD)	SC Mean (SC)
EP1	Confidence/Suspicion	**0.82 (0.16)**	**0.51 (0.26)**	**0.73 (0.27)**
EP2	High Quality/Low Quality	**0.83 (0.14)**	**0.49 (0.28)**	**0.75 (0.23)**
EP3	Useful/Useless	0.78 (0.23)	0.59 (0.25)	0.76 (0.26)
EP4	Interesting/Boring	**0.69 (0.19)**	**0.47 (0.25)**	**0.60 (0.25)**
EP5	Known/Unknown	**0.79 (0.27)**	**0.47 (0.32)**	**0.60 (0.29)**
EP6	Comfortable/Uncomfortable	**0.68 (0.23)**	**0.58 (0.32)**	**0.71 (0.24)**
EP7	Attractive/Not Attractive	**0.67 (0.20)**	**0.48 (0.30)**	**0.70 (0.29)**
EP8	Innovative/Conventional	**0.37 (0.29)**	**0.67 (0.23)**	0.81 (0.25)
EP9	Simple/Complex	**0.67 (0.26)**	**0.56 (0.24)**	**0.56 (0.22)**
EP10	Nearby/Distant	**0.80 (0.24)**	0.38 (0.29)	**0.56 (0.23)**
EP11	Funny/Not Funny	**0.59 (0.23)**	**0.40 (0.24)**	**0.49 (0.28)**

An ANOVA test was done, which requires a normal distribution of the data. To verify this assumption, a Kolmogorov–Smirnov test was run on each subset of data. Only five of the thirty-three subsets did not show a normal distribution (EP3, F2F; EP3, ERT; EP3, SC; EP8, SC; EP10, ERT), which were not written in bold in Table 4.

Figure 3 shows the different boxplots of each one of the class modalities grouped by each single pair of emotions, displaying also the mean values in green dots.

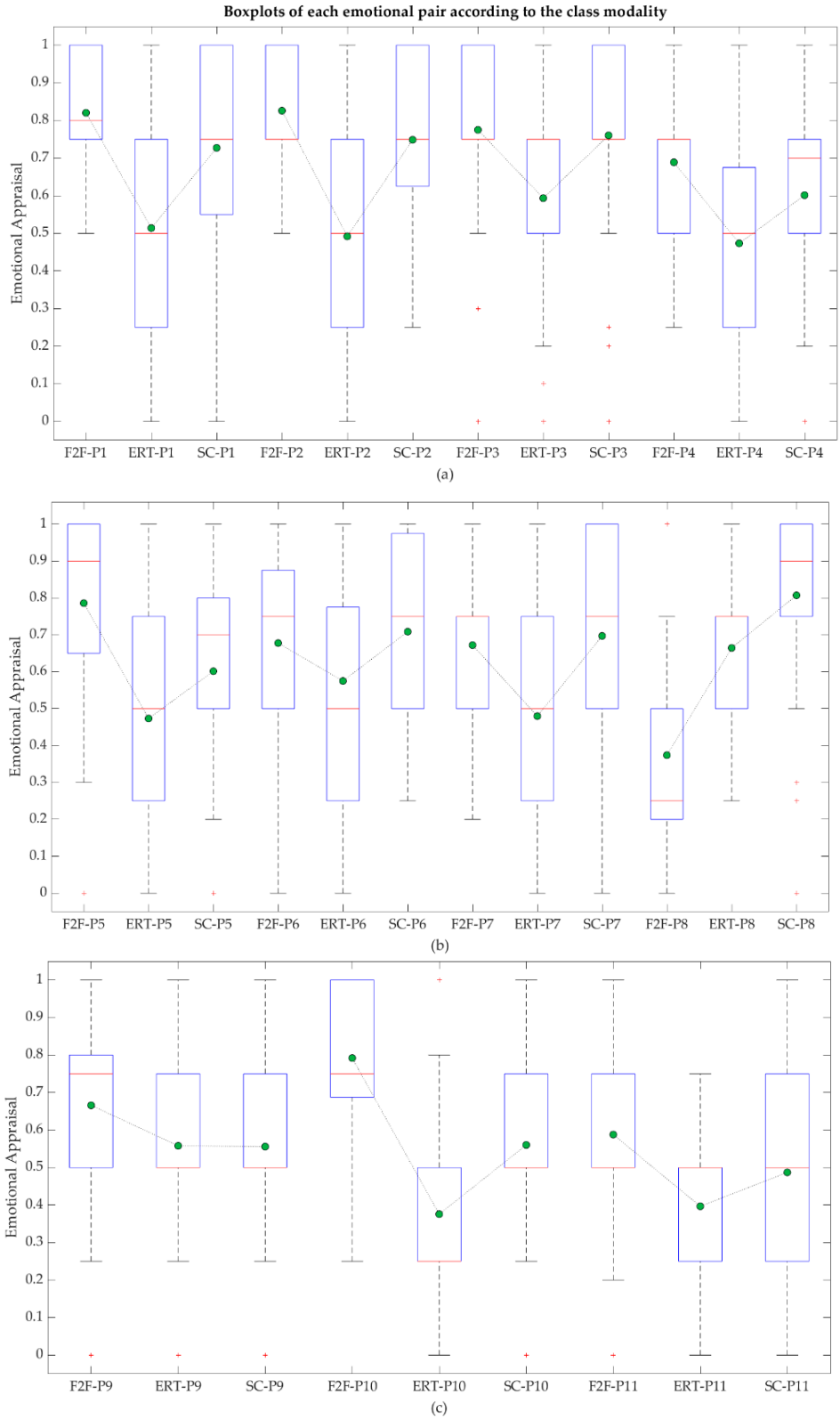

Figure 3. Boxplots: Comparing Emotional Pairs one-to-one in F2F, ERT and SC Class Modalities. The means of each group are marked with green dots. The different subfigures show: (**a**) results from pairs 1 to 4; (**b**) results from pairs 5 to 8; (**c**) results from pairs 9 to 11.

Results of the ANOVA test to analyze reliability are presented in Table 5, showing the degrees of freedom and the values of the F test. All emotion pairs except EP6 and EP9 show significant differences between some of the means of the three class modalities. As can be seen in Table 5, not all the degrees of freedom related to the participants are the same (they range between 85 and 91), since some of them did not score the complete list of the emotional pair for each modality.

Table 5. Degrees of freedom and value of the F test for each of the eleven ANOVA tests.

Emotional Pair	Pairs of Emotions	*F* Test
EP1	Confidence/Suspicion	$F(2,91) = 12.84$, $p < 0.0001$
EP2	High Quality/Low Quality	$F(2,90) = 17.8$, $p < 0.0001$
EP3	Useful/Useless	$F(2,88) = 4.99$, $p = 0.0089$
EP4	Interesting/Boring	$F(2,91) = 6.26$, $p = 0.0028$
EP5	Known/Unknown	$F(2,85) = 7.68$, $p = 0.0009$
EP6	Comfortable/Uncomfortable	$F(2,91) = 2.22$, $p = 0.1143$
EP7	Attractive/Not Attractive	$F(2,91) = 6.24$, $p = 0.0029$
EP8	Innovative/Conventional	$F(2,88) = 21.06$, $p < 0.0001$
EP9	Simple/Complex	$F(2,87) = 1.89$, $p = 0.1570$
EP10	Nearby/Distant	$F(2,87) = 18.85$, $p < 0.0001$
EP11	Funny/Not Funny	$F(2,88) = 3.94$, $p = 0.0230$

On the other hand, Table 6 presents the *p*-values obtained (alpha 0.05) from all the pairwise tests once a multivariate analysis was performed to show the pairwise comparison between the different class modalities. Pairs showing a statistically significant difference of means were written in bold in Table 6.

Table 6. Results from the ANOVA, showing the *p*-value of each pairwise comparison of modalities.

	EP1	EP2	EP3	EP4	EP5	EP6	EP7	EP8	EP9	EP10	EP11
F2F-ERT	**0.000**	**0.000**	**0.020**	**0.002**	**0.001**	0.311	**0.021**	**0.000**	0.217	**0.000**	**0.017**
F2F-SC	0.291	0.382	0.972	0.322	0.053	0.895	0.931	**0.000**	0.192	**0.002**	0.287
ERT-SC	**0.001**	**0.000**	**0.022**	0.074	0.203	0.109	**0.004**	0.067	0.999	**0.011**	0.323

Despite the statistical treatment of the results of the Emotional Appraisal, it should be noted that these results were obtained in the context of an exploratory qualitative analysis. Therefore, this analysis was appropriate in the context of this research, which was designed to collect opinions and feelings of ICT engineering undergraduates once they had experienced three class modalities.

5. Discussion

The results shown in Section 4 were the basis for comparing students' perceptions of the F2F, ERT and SC teaching and learning modalities. The appraisals of these three experiences were carried out jointly when students had finished the third period of classes. This assessment was based on the user experience as explained in Section 3.

5.1. Students' Experience

An analysis of the results from the pocket BLA assessment enables us to find out the strengths and weaknesses of each type of class, according to students' perceptions, as follows:

- Instructor–student interaction was highly valued by students (mean, 8.85; mention index, 38.46%) when attending F2F classes. When experiencing SC classes, some comments are in the same line (mean, 8.33; mention index, 7.69%), whereas others believe that students that are in the classroom interact more than students that are attending off-campus classes (mean, 2.25; mention index, 20.51%). Issues about instructor–student interaction when using the SC had been previously identified in

different works, as shown in [57]. Interaction is assessed in ERT classes with a mean score of 3.8 (mention index, 15.38%). Quite surprisingly, students perceive this issue as less problematic in ERT than in SC perhaps because they are living SC as their reality, and ERT is perceived as something that happened and that is not going to happen again since now SC is available. These opinions support the idea that being physically in the classroom allows better interaction with the instructor. Hence, instructors should put their efforts into trying to minimize this deficit when attending off-campus students in the SC format. Specific training for instructors could help to cope with this issue, increasing instructors' skills to keep interacting with people in the classroom while increasing interaction with off-campus students.

- According to students' perceptions, they reach higher levels of concentration and are less distracted (mean, 8.40; mention index, 38.46%) in F2F classes. In contrast, students perceive that they are less attentive or more distracted when experiencing both ERT (mean, 2.45; mention index, 28.21%) and SC classes (mean, 2.71; mention index, 23.08%). This item is in the same line as that of other authors, as posited in [57,64]. Therefore, students who remain off-campus should be given the tools to increase their engagement. In addition, instructors could introduce new activities with the objective of specifically engaging off-campus students and making them participate in class.
- Regarding teamwork, most students perceived that F2F classes are the best option (mean 8.20; mention index 25.64%). Just one student considered that it was a difficult task when experiencing the F2F modality (score, 4.00). However, the perception of difficulty in performing this activity was higher when doing ERT classes (mean, 4.5; mention index, 5.13%) or SC classes (mean, 2.67; mention index, 7.69%). This result reinforces the idea that teamwork and Project-Based Learning are key skills for engineering students, since both play a key role once they enter the labor market and are both competencies that should be developed and trained in class [94–96].
- When analyzing F2F, students consider that the amount of time needed to commute to the university (mean, 2.67; mention index, 33.33%) as negative. In contrast, commuting is considered a positive item when dealing with ERT classes (mean, 7.82; mention index, 30.77%) or SC classes (mean, 8.33; mention index, 10.26%), since undergraduates can minimize their physical presence at the university. This aspect would lead us to rethink the F2F model and perhaps evolve it towards a blended model, combining on-campus days with off-campus days depending on the kind of teaching activity. On the other hand, minimizing commuting because of the COVID-19 pandemic lockdown may have an impact on student's sedentary behavior and decrease physical activity. These latter outcomes have harmful effects on health, as shown in different studies [23,24].
- Teaching tools have shortcomings that arise when using ERT from the specific technology adopted (mean, 2.25; mention index, 25.64%).
- ERT is perceived as a very good solution to keep on doing classes while social and mobility restrictions remain in place (mean, 7.75; mention index, 23.08%).
- SC classes are perceived as a versatile solution since they enable students to attend classes in person on-campus or off-campus at the students' convenience (mean, 8.94; mention index, 46.15%). In fact, this is one of the main advantages of online classes [35,36].
- Recording class sessions in the SC modality is considered a useful option (mean, 9.18; mention index, 30.77%), since it enables students to review classes ubiquitously. In contrast, formerly, when experiencing F2F, this option of recording did not exist, and once students had experienced the option of reviewing recorded classes, they perceived not having this new technological possibility as a negative (mean, 3.0; mention index, 12.82%).

5.2. Students' Emotional Appraisal

A comparison of students' emotional responses to the three different ways of learning by means of diverse technologies is shown in Figure 4. Each point of the plot represents the mean of the evaluation obtained for each emotion pair in each class modality.

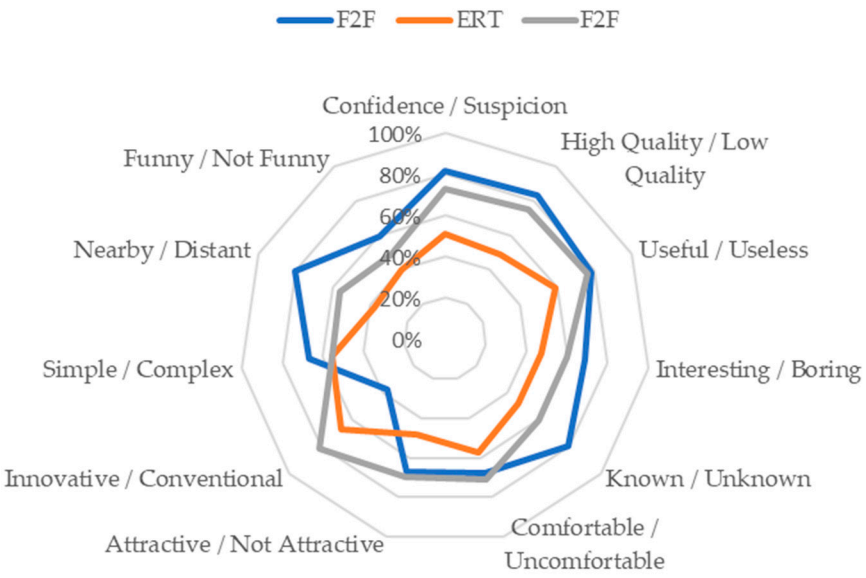

Figure 4. Students' Emotional Appraisal, comparing F2F, ERT and SC.

As can be seen in Table 5, there were statistically significant differences between the modalities for all pairs of emotions except for the pairs Comfortable/Uncomfortable and Simple/Complex. On the other hand, Table 6 highlights all those pairwise combinations that present a significant difference in their means in bold.

Students' preferences can be assessed through a comparison of the means of each emotional pair associated with each class modality. F2F classes appear as the winning option when trading off the different assessed feelings. F2F classes are perceived as the option that offers a higher degree of positive feelings with respect to the other options in terms of being nearby to students, confidence, interesting, being perceived as known and high quality. However, the SC modality is quite close to the F2F modality in most comparisons, such as usefulness, confidence and quality. In fact, the SC format is superior to the other options in terms of the perception of innovation, comfort and attraction. When evaluating their perceptions about the complexity/simplicity of the three formats, the students rated all of them with a similar score, in line with the initial assumption that ICT students were not conditioned by potential technical issues. Finally, based on analysis of ERT classes compared with the other alternatives, it has the lowest perceptions in terms of positive feelings, except in innovation, where it is quite close to SC classes. The perceived low quality of classes, the low interest that this methodology generates on the student while learning and the distance among people involved in the class sessions are three of the major drawbacks of ERT when compared with the other two options. Hence, F2F classes appear to be the option that generates the most positive assessment of students' emotions. However, SC classes are not far behind F2F classes in terms of positive feelings.

An analysis of Table 6 reaffirms some of the previous statements, given that comparisons are statistically significant. First, shifting from F2F to ERT had a negative impact on the majority of the students, as evidenced by the results shown in the row labeled F2F-ERT. Second, shifting from ERT to SC improved several aspects, such as confidence, high quality, usefulness, attractiveness and nearby. Third, when comparing F2F to SC, the greatest differences appeared in the perception of innovation (in favor of SC) and closeness (in favor of F2F), as reinforced by the figures displayed in the row labeled F2F-SC.

Although students considered ERT and SC classes to be worse than F2F classes in terms of feelings, students' comments in the pocket BLA survey emphasized that ERT and SC classes have been a good choice to cope with all mobility restrictions, allowing them to continue learning despite the COVID-19 pandemic.

5.3. Some Additional Observations

The analysis of the results appear to favor the implementation of a blended learning model, mixing on-campus days with off-campus days. This approach could preserve certain advantages of attending classes physically on-campus while reducing some of the issues detected by surveyed students. This solution could be developed to allow off-campus sessions in the case of future mobility restrictions, or when students face a situation in which they cannot attend F2F classes, which could result in a more sustainable model. It should be noted that a change in these characteristics is not a simple or immediate task since it requires the redesign of subjects and degrees. Furthermore, if the adoption of this model is considered, this change should be consistent with the overall strategy of the institution.

Even though the SC model has great potential, students detected certain limitations when they experienced this system. For example, they indicated that the instructor often ended up interacting more with the students in the classroom than those at home, or that it was difficult to follow what was being done in the classroom. Thus, simply emitting class activities is not enough. Activities should be carefully redesigned to facilitate the simultaneous participation and interaction of both on-campus and off-campus students. Henceforth, instructors should be properly trained to take advantage of all the available educational teaching options, besides developing some communication skills.

5.4. Limitations and Directions for Future Studies

The results of this study reflect students' opinions once classes were concluded, although final exams were still not done. However, the aim of this research is centered only on the comparison of teaching and learning when experiencing F2F, ERT and SC classes, as formulated in the survey. The first limitation of this study is the insufficient knowledge base to evaluate the effect of the deployment of different technological education formats to face the situation derived from the COVID-19 pandemic. Another limitation of this research is that the only targeted students of the survey were second-year students. Third- and fourth-year engineering students were not surveyed because they had experienced F2F classes for a longer period of time. An initial design constraint could become a limitation of this research since surveyed students were skilled enough in ICT technology, so technical difficulties in the use of the different teaching and/or learning platform did not arise. Appraising user experience and emotion for students of other academic fields, not necessarily equally skilled in ICT due to their studies and background, could offer different results, both in terms of user experience and emotion feedback. To cope with this latter restriction research including university students of diverse academic fields could be carried out.

Having identified the relevant topics about the different formats in this exploratory research, a future research line might include a quantitative survey of all the students to assess all the different items to obtain information statistically significant information. Another research line is to identify how the different learning methodologies and assessment activities can be adapted to take advantage of the SC class format when there are students on- and off-campus.

6. Conclusions

The COVID-19 pandemic has affected and changed multiple spheres of our lives, including the domain of education. To cope with mobility restrictions, universities have implemented different solutions to continue teaching their students. This research shows the students' response to three different class modalities: F2F, ERT and SC classes. Method-

ologically, user experience and emotions have been selected to measure second-year ICT engineering student's perceptions about classes. According to this research, students perceive F2F classes as better than the other two options in most facets, except in the amount of time that students spend to arrive at the university. From analyzing the SC format, three elements can be highlighted in terms of issues: instructor–student interaction, greater distractions when off-campus and teamwork difficulties. Therefore, more effective training in the development of the appropriate teaching and learning skills within the SC context could help address these shortcomings. These training activities should be aimed mainly at increasing active participation, either through deliverables or specific activities to promote student interaction. Despite the aforementioned issues, the students' assessment of SC classes is quite close to F2F classes, which coincides with other studies [90]. In fact, with the current design, the SC model is quite a good solution despite some drawbacks when compared to F2F. ERT and SC modalities were considered an effective solution to the pandemic in order to cope with restrictions of F2F classes. To conclude, SC is emerging as a solution with huge potential provided educational institutions are able to make the necessary changes at different levels to implement it. Similarly, it is gaining ground as a sustainable solution to cope with the current challenges derived from present educational uncertainties caused by the outbreak of COVID-19.

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Appendix A

This appendix includes the Pocket BLA questionnaire and the Emotional Appraisal that students completed. What is presented is a screenshot of the Excel file with which respondents answered the questionnaire.

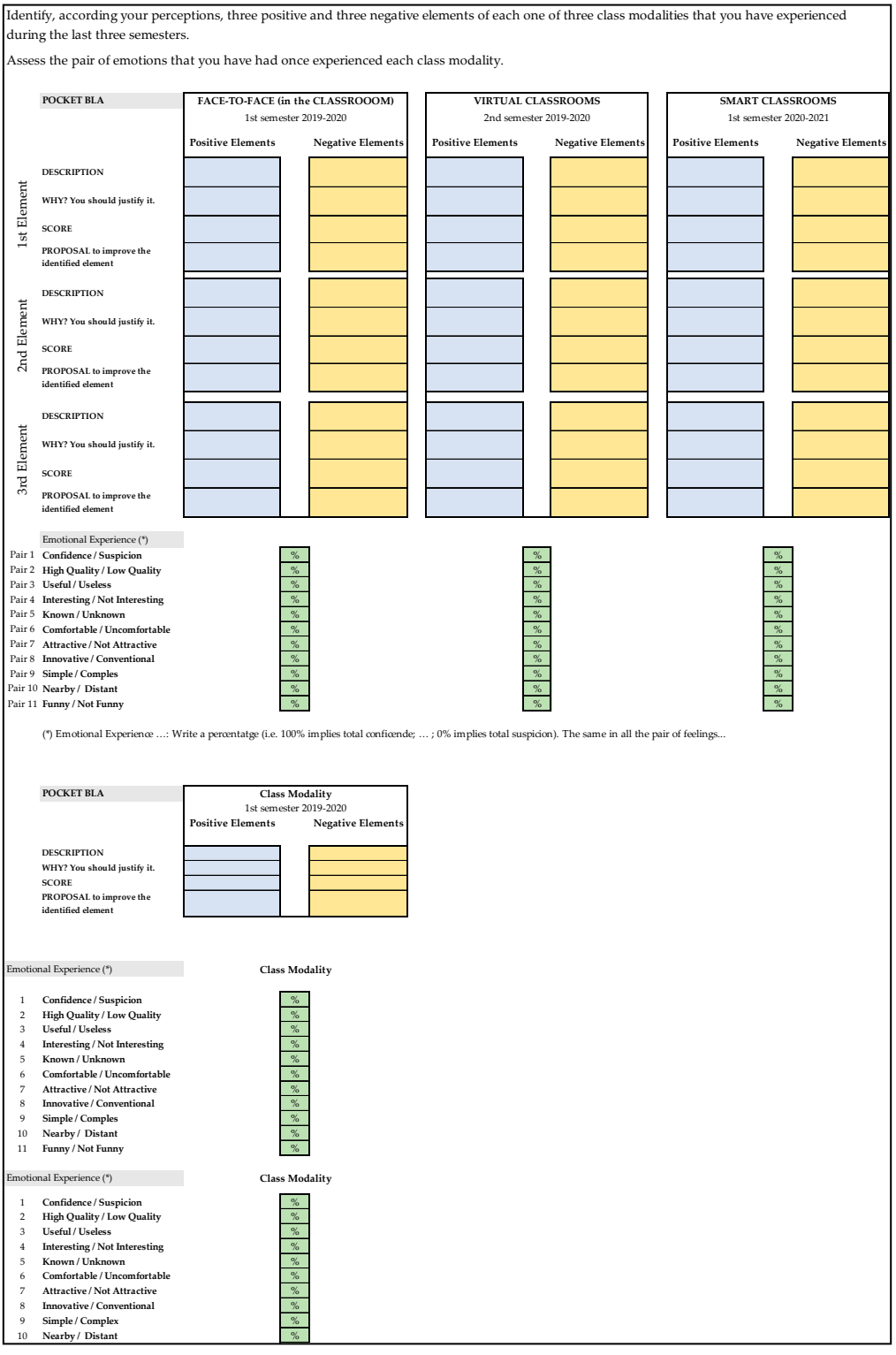

Figure A1. Pocket BLA and Emotional Appraisal Questionnaire.

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APÉNDICE 2 – PUBLICACIÓN 2

Publicación 2.- Petchamé, J.; Iriondo, I.; Canaleta, X.; Riu, D.; Necchi, S. Engaging ICT Engineering Undergraduates in a Management Subject through First Day of Class Activities: An Empirical Study. Sustainability 2021, 13, 7440. https://doi.org/10.3390/su13137440

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Engaging ICT Engineering Undergraduates in a Management Subject through First Day of Class Activities: An Empirical Study

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Abstract: The expectations, attitudes, engagement, and motivation of students are key elements when designing learning activities. Several studies have been implemented and different strategies and activities have been analyzed to improve the aforesaid aspects of learning content. In the context of the New Learning Context (NLC), this paper presents the findings of two first day of class activities aimed at engaging engineering students in a business and management subject from the very first moment: an empirical study conducted by means of a survey answered by engineering students in Information and Communication Technologies (ICT), followed by an interactive activity between students and instructors carried out through a reciprocal interview activity. The survey was performed with the objective of identifying what they 'liked' and 'disliked' on their first day of class of a business subject. The findings are presented and compared with previous studies and have proven to be mostly consistent with previous academic work. Finally, a reciprocal interview activity was chosen to potentially enhance the students' engagement and motivation. According to the feedback received, this activity was positively valued by the students.

Keywords: engagement; engineering students; first day of class; ICT; management; motivation; reciprocal interview activity

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1. Introduction

All first encounters that human beings have with someone or with something generate initial impressions or perceptions that tend to remain in their minds for some time. Just by looking at someone's face, even for less than a second, people make judgments about that person [1–3], although accuracy is not granted [4,5]. In fact, short behavioral observations, from half a minute to five minutes, seem to be enough [6,7]. First impressions about people may be shaped by clothing [8], body language [9], and so on. Shaping first impressions also applies even when thinking about products, such as website aesthetics [10]. Furthermore, first impressions can condition beliefs and behaviors [11]. In terms of education, the first day of class may have a multisided impact on students [12–14].

Several researchers have studied whether students' first impressions have a long-lasting impact on their perceptions of subjects and instructors. Buchert et al. [15] concluded that students formed lasting impressions about academic staff within the period of the first two weeks of class. Laws et al. [16] found that the impressions students had formed during the first week persisted until the end of the semester.

Most ICT engineering syllabi include, in addition to specific engineering knowledge, other topics that provide an all-round formation. In fact, both specific technical knowledge and nontechnical competencies are required [17,18], including teamwork, communication,

problem solving, or leadership skills [19–23]. Along these lines, basic knowledge in business and management was introduced in engineering programs, since these topics are necessary to complete the training of students and improve their employability [24]. However, some engineering students have shown a degree of reluctance when they were first presented with subjects that they perceived to be quite far from their area of personal interest [25,26], for example, business or management subjects taught in ICT engineering programs. Therefore, all the efforts made by instructors in the first session of a subject to enhance engagement and motivation should be carefully planned because of the positive (or negative) impact that they could have on the students [12,13,27,28].

The general aim of this research was to explore two activities carried out on the first day of class of a management subject, in order to increase the students' expectations, engagement, and motivation. Specifically, the first purpose of this this paper is to describe an empirical study on what undergraduate ICT engineering students liked and disliked on the first session of class, contextualized in a management subject. The second objective of this study is to show the students' assessment of a reciprocal interview activity carried out during the second part of the session. Both activities were designed to enhance the appeal of the management subject and allow students to meet their peers and instructors.

The article contributes to the literature by analyzing the outcomes of two different first day of class activities hypothesized to enhance the appeal of a management subject. Given that all the participants in this research were second-year ICT undergraduates, all the findings about the efforts oriented to increase expectations, attitudes, and engagement can shed light in designing good practices to be included in subjects that are not included as core topics according to the perceptions of some students.

2. State of the Art

All the efforts and activities that instructors may implement to increase expectations, attitudes, engagement, and motivation on the first day of class of a subject can be crucial to their success in teaching the entire subject. The relevance of this topic is reinforced by the fact that most books dealing with teaching have a chapter dedicated to the first day of class, e.g., [29–33]. Therefore, the findings of previous research works are synthesized as follows.

2.1. Enhancing Engagement and Motivation the First Day of Class

Motivation to learn is a construct that has been defined by different authors, i.e., [34,35], and can be defined as identifying chosen individual behaviors to reach a specific goal [36]. The motivation to learn has been formalized by means of different theories as shown in [37], the contemporary ones being summarized in [38] as follows: expectancy-value, attribution, social cognitive, goal orientation, and self-determination.

The engagement construct has been conceptualized through different definitions that may include different components [39,40]. Engagement is an observable action, as it can be defined as 'energy and effort in action' [40], and some tips to enhance engagement have been identified in research works [41].

On the one hand, according to several research works, students' motivation is correlated with academic success [42,43] or with an impact on their engagement [44]. In fact, motivation may improve different academic outcomes [45–47]. On the other hand, engagement is related, among other issues, to improved achievement [48,49], decreased dropout rates [50], or to the creation of a positive class climate [51].

The very first day of class can be seen as an exceptional opportunity to implement activities that may help develop students' expectations [12,52,53], attitudes [13,54], engagement [12,55–58], or motivation [13,14], while also determining the learning environment and class atmosphere for the remaining sessions of the subject [59,60]. Although such actions are obviously designed to improve class dynamics, some may have negative effects on students' perceptions.

2.2. Studies about 'What Likes' and 'What Dislikes' to Students the First Day of Class

Several studies have been performed with the aim of identifying both the 'likes' and 'dislikes' that students preferred on their first day of class. The main works and findings include the following.

In an empirical study, Perlman & McCann [53] identified what they labelled as 'works well' and 'peeves' on the first day of class by means of two open-ended questions. They identified and taxonomized seventeen different categories and added the number of occurrences for each one of the normalized options that they identified from a survey of 570 undergraduate students. It should be noted that in some cases an item that 'worked well' for a student could be a 'peeve' for another student. The general trends of students' preferences were the following: general information about the subject (syllabus, overview of the subject, etc.); grading system and information about the instructor (background, teaching style). Among the peeves, homework assignments and beginning the subject content the first day of class were ranked at the top of the list.

Henslee, Burgess & Buskist [61] asked 146 undergraduate students by means of a twenty-nine item survey (twenty-two items to be ranked and seven open-ended questions) about the first day activities, with the aim of identifying student preferences. Results detected that student's favorites were 'information about the class structure' and 'coursework'.

Basset [62] surveyed 249 university students, identifying the following as valued preferences: information about the subject difficulty, professional information about the instructor, structure and content of the classes, procedures followed in class, and also personal information about instructors and peers.

In an empirical study, Eskine & Hamer [63] asked 230 undergraduate students to replicate the aforementioned Perlman & McCann empirical study [53]. The authors asked the identical open-ended questions and classified the answers according the same seventeen categories that were formerly identified in the study performed by Perlman & McCann. In terms of 'likes', the top findings were the same, whereas when talking about 'dislikes', the two top topics were 'poor use of class time' and 'beginning subject content'.

2.3. Activities Carried out the First Day of Class

During the first day of class, a variety of different actions and activities can be performed to achieve different goals [27,55,64]. Iannarelli, Bardsley & Foote [64] highlighted four basic actions that can be performed on the first day of class: explaining subject expectations, where the content of the syllabus plays a key role; learning about students; introducing the instructor; and establishing the right tone.

Some of the actions that have been experienced during the first day of class are listed as follows:

- The most basic activity could be to introduce the academic staff and present the syllabus. Sometimes the instructors start giving contents after the presentation or choose to end the first session of class. Along this line, several activities are described in [65] as examples of 'what not to do' during the first session of class session.
- Creating positive and/or negative 'experiences' on purpose during the first session of class. For instance, Wilson & Wilson [13] showed two different videos explaining the syllabus to different groups of students. In one of the videos, the instructor gave the presentation in a friendly way, whereas in the other one the instructor presented the syllabus while avoiding emotional tone and followed the syllabus presentation by another video that generated a homework assignment to be performed. Another experience, related to a psychology subject, is described in LoSchiavo, Buckingham & Yurak [66], where an instructor showed up at the classroom and after asking the students to fill out some information, he told them to stand up and face the back of the room; later, after some minutes and once the real instructor appeared, they discussed the topic of obedience.
- Introducing topics to create students' interest in the subject. Within this category, icebreakers could be included. Different activities were performed in different fields

to create interest. Different academic experiences can be mentioned as an example, as follows: regarding economics, Helmy [67] played a lottery to assign a country to students in order to discuss their development problems; as for statistics, Bartsch [54] asked their students to generate anonymous questions to be answered during class on the first day, and Bennet [68] also analyzed probability by means of matching students' dates of birth; in the context of physics, Gaffney & Whitaker [69] asked students to answer Fermi's questions, in other words, to quantify questions to which it was quite difficult to obtain the exact solution in terms of their quantification, an experiential learning activity to introduce topics about 'operations management' [70]; using a Readers' Theatre technique [71]; or just whipping [72], a teaching activity to promote students' participation.

- Reciprocal interview activity. As described in different papers [12,73], a reciprocal interview activity consists of following these steps: (1) create groups of students; (2) offer a potential list of questions, as examples, to ask the instructor during the interview phase; (3) each group of students discusses the set of predefined questions that will then be asked to the instructor during the interview activity once the speaker of the group has been selected; (4) carry out the reciprocal interview activity in class, or the instructor asks the different groups what is the same, and finally; (5) students ask the instructor.

According to the academic literature, several objectives may be achieved by means of a reciprocal interview activity, as shown in different research works: building an awareness of students' and the instructor's goals and expectations [12,58,73]; gathering information about peers, the instructor, etc. [55,58]; encouraging class discussions and generating more comfortable interactions students-instructor [12,55,58,73]; creating a lasting effect on students' attitudes [52]; influencing students' motivation by increasing their perception of the interest and usefulness of the subject and also by transmitting attention to them [14] and; establishing a positive climate at class [28].

2.4. NLC at La Salle URL or Leveraging the First Class Session

Due to the new reality and possibilities of the educational sphere (digital natives, new technologies, etc.) the way of teaching may change and evolve [74,75]. In December 2018, La Salle Educational Mission Assembly (AMEL 2018) agreed to design and implement a new educational model in all its educational centers for all the different educational stages, from children's education to universities. This new model was named the 'New Learning Context' (NLC) and is currently being deployed in Spain after two years of design and implementation [76]. This deployment involved 104 centers, including two university colleges, such as La Salle Campus Barcelona (Universitat Ramon Llull) and La Salle Campus Madrid (Universidad Complutense de Madrid).

The NLC model [76,77] is based on five pedagogical principles that constitute a nonvisible substrate of the educational model. These principles are implemented through five learning environments, as shown in Figure 1. In short, the five pedagogical principles are as follows:

- Interiority: The educational model transcends the academic field, considering personal growth as an inseparable part of education.
- Mind (body and movement): This principle tries to convey the idea that learning takes place beyond the classroom. The NLC considers the use of space and its organization as the third educational agent, with students and instructors being the other agents.
- Thought Construction: The NLC should generate cognitive skills and abilities, structures, procedures, and strategies that develop different thinking processes and their use.
- Self-Regulated Behavior: The NLC creates spaces and experiences in which autonomous learning habits are encouraged, where each student learns to self-regulate his/her own pace, intensity, effort, commitment, and time required to reach the learning goals, which can be achieved through different paths.

- Social Dimension of Learning, which is structured on three fundamental levels: (1) the educational spaces, as a pedagogical element which favors social learning; (2) the organizational proposal, which specifies the pedagogical framework of coexistence; (3) the community, as a learning structure.

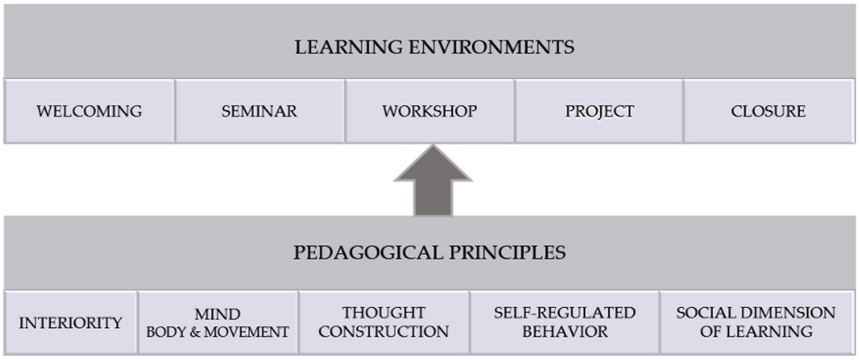

Figure 1. Schema of the New Learning Context (NLC) structure: Five pedagogical principles and five learning environments.

The concept learning environment was widely studied and analyzed from different academic viewpoints, e.g., [78,79]. The learning environment constitutes an essential part of the NLC pedagogical model. In terms of methodology and teaching, the environment can be considered as a separate space with its own educational purpose. The NLC learning environments are as follows:

- Seminar (i.e., focusing on 'knowing'): seminars are organized as teaching areas to allow the student's acquisition of the concepts. In other words, seminars are knowledge areas in which different learning methodologies (such as, lectures, flipped classrooms, peer-to-peer learning, etc.) can be implemented to achieve the learning outcomes.
- Workshop (i.e., focusing on 'knowing how to be'): workshops are pedagogical environments in which the students use their own strengths to construct their own learning process. In the global context of the NLC Methodological Framework, workshops represent the integration of knowledge, allowing students to fully connect with multifaceted elements of their life. Workshops are orientated to build and develop the students' competences which in turn help them develop their own personality.
- Project (i.e., focusing on 'knowing what to do'): this interdisciplinary learning area enables students to learn competences through complex tasks. Those tasks are characterized by their transversal integration of knowledge, being developed in an interdisciplinary way by means of several different sources (scientific, social, historical, artistic, etc.). Projects are usually focused on a specific source, which is then complemented by the other ones, thus creating a learning environment in which students can truly grow, develop, and construct knowledge.
- Welcoming: this is an area of experience that can help students develop healthy study habits by means of different tools. It ranges from internal elements of the human being (such as reflexional, interiority, consciences, motivation) to organizational needs (planning, to-do lists, and objectives, etc.). Not all the welcome activities are mandatorily programmed at the beginning of the session. In fact, some activities may be scheduled just at the beginning of a specific activity or project.
- Closure: this implies the completion of the task. At this point, students assess the work done, make insights for the future, celebrate their achievements, and finish their session. This activity enables students to truly appreciate what they have learnt: conclusions about what they can make, or simply how they can take advantage of these conclusions, as well as being aware of the mistakes they have made and how to learn from them. In the same way as the welcoming sessions, closure sessions are

not necessarily programmed at the end of the day, nor do they always last the same length of time.

During the design period of the NLC, the focus was on substantiating and validating the pedagogical model, while different lines of research were created to assess the impact on the deployment of the model. Along this line, academic research has been performed on several NLC topics (e.g., about redesigning a subject [36], assessment issues [26,80], etc.). Three of the previously aforementioned areas (seminars, workshops, and projects) are well-established elements, which have been widely used and studied in a great amount of academic research. Nevertheless, similar efforts in terms of research have not been made for the other two elements (welcoming and closure, in NLC terminology). Therefore, all the efforts in researching items related to the first day of class will positively affect the effective implementation of the NLC.

3. Methods

The research was focused on obtaining data that helped to adjust both the activities and the content of the first day of class in a management subject taught to ICT engineering undergraduates. In this case, the research objectives related to the first day of class were: (1) to obtain information from the students about which activities they preferred to do, (2) to assess students' reactions to a reciprocal class-interview activity carried out in the first session.

Figure 2 shows a methodology to continue finetuning a subject taught in the context of an official undergraduate program once feedback from the students is collected. The initial design of a subject is clearly marked by the requirements established in the official program of the studies, according to the 'VSMA Framework' [81] (in Spanish, VSMA is the acronym that stands for Ex-Ante Assessment, Monitoring, Modification, and Accreditation). The main inputs of this design of each subject are the definition of content and methodologies along with the needs of academic staff and infrastructures. At this level should also be included the Smart Classroom (SC) [82,83], a technology that offers new teaching and learning possibilities and that was deployed in most of classrooms and laboratories in September 2020 at La Salle URL. Once classes begin, a review and update mechanism must be established. Usually, the main elements to analyze the operation of the subject are the surveys completed by students as well as the opinions of the academic staff. The text written in blue refers to the new elements that the present research work incorporates. On the one hand, the NLC establishes a general framework for the use of new teaching methodologies that the subjects should incorporate. On the other hand, two first-class instruments are proposed to complement the usual mechanisms to refine the subject.

The research related to both activities that were carried out on the first day of class was conducted in the context of the second-year management subject 'Value Chain and Financial Economics'. This is a core subject of all the ICT engineering programs taught at La Salle URL, where seven undergraduate ICT engineering programs are taught: Audiovisual Engineering, Computer Engineering, Electronic Engineering, Engineering in ICT Management, Multimedia Engineering, Telecommunications Systems Engineering, and Telematics Engineering. The activities took place during the first session of class in the first term of the 2020–2021 academic year, and surveys linked to both research activities were handed out to all students that attended the first two-hour class session.

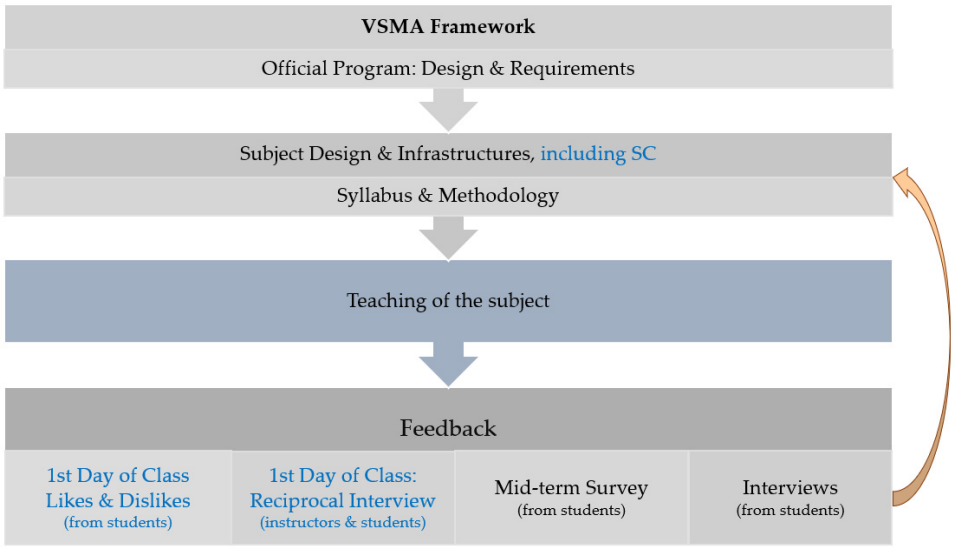

Figure 2. Proposed design and continuous finetuning of a subject in an official undergraduate program once feedback from the students is collected.

3.1. An Empirical Study: First Day of Class, 'What Likes' and 'What Dislikes'

The empirical study to determine the 'likes' and 'dislikes' of ICT engineering students the first day of class was performed during the first session of a second-year management subject. The questionnaire was handed out to the students in class just before a brief presentation of the instructors, after saying 'Hello, good morning' and giving the instructors their first name. At the top of the first page of the survey, data about participants were collected to allow segmentation of the data: 'university degree that you are studying', 'entrance' or access to engineering studies, 'age', and 'gender'. However, no identification in terms of names or any other data that could identify the student was required, resulting in an anonymous form. Each side of the paper contained one of the two open-ended questions: 'Which things would you like an instructor to do on the first day of class of a subject?' on the front side of the paper and 'Which things would you not like an instructor to do on the first day of class of a subject?' on the back side of the paper. Students were invited to answer the questions with a short sentence per idea (ideally, from one to five words, despite not being a specific restriction) to force students first to think and then write a synthesized idea.

Once all the questionnaires had been collected, the answers given by the students were reclassified in homogeneous categories independent of the literal wording of the answers. The methodology that was followed was the same performed by Perlman & McCann [53] and Eskine & Hammer [63]. However, homogenization was not initially restrained to the former taxonomy resulting from the Perlman & McCann's empirical study [53] in order to allow new items to be identified, resulting in the items listed in Table 1. Once the classification was completed, eventual matches in terms of different wording were identified to compare findings, despite keeping some topics disaggregated that were linked to motivation and utility of the subject once the data was analyzed.

Table 1. First day of class (all ICT engineering students): 'likes' & 'dislikes'.

Items [1]	'Likes'		'Dislikes'	
	n	%	n	%
General overview, syllabus, content, & expectations	107	78.10	16	11.68
Describing assessment & grading	75	54.74	12	8.76
Utility & objectives of the subject	44	32.12		
Instructor: introducing background & experience	42	30.66	7	5.11
Icebreaker: doing activities	38	27.74	5	3.65
Getting to know classmates	31	22.63		
Positive attitude of instructor towards students	25	18.25		
Doing a 'nonconventional' class session	22	16.06		
Motivating students	22	16.06		
Beginning subject content	15	10.95	95	69.34
Instructor's advice to pass the subject	15	10.95		
Class takes up full session (2 h)	8	5.84	6	4.38
Explaining instrumental elements (software, etc.)	4	2.92		
Reviewing content (that should be known)	3	2.19		
Doing a test to check initial knowledge	1	0.73	24	17.52
Poor use of class time			20	14.60
Homework assignments			9	6.57
Instructor: poor teaching			8	5.84
Instructor: uncaring, intimidating			7	5.11
Instructor: not being empathetic			6	4.38
Beginning subject content without prior introduction			4	2.92
Instructor: bad attitude			2	1.46
Instructor: not being enthusiastic about the subject			2	1.46

[1] Items have been inferred from findings of two open-ended questions.

3.2. Instructors' and Students' Interactions: A Reciprocal Interview Activity

The reciprocal interview activity was designed to allow the interaction of the whole class with the instructors and vice versa. The mechanics of the reciprocal interview were described briefly in Section 2.3 of this paper. Groups of four students were created and the activity was carried out. One of the instructors sat at the instructor's table writing all the answers given by the different groups of students to the questions raised by the instructors (fifteen minutes were left to prepare the interview, while the interview lasted around fifteen minutes). The final stage of the activity was the instructors answering the different questions asked by the students (eight minutes were left to prepare the interview, while the interview activity lasted twenty minutes).

Once the reciprocal interview was completed, a survey to assess the activity was handed out to all the students to be answered individually to assess students' perceptions of the activity. Again, data about participants were collected to segment the data, in fact the same that was collected in the previous survey: 'university degree that you are studying', 'entrance', 'age', and 'gender'. Yet again, no identification in terms of names was required, resulting in an anonymous form. The survey was structured in four blocs: (1) comfort with approaching the instructor (four items); (2) student comfort with class participation (three items); (3) evaluation of the activity, a reciprocal interview (two items); and (4) ' . . . the activity helped me:' (four items). A space under the tittle 'Any comments?' was left to include students' commentaries. The content handed out to the students was an evolution of the questions surveyed in the Hermann & Foster questionnaire [12].

4. Findings and Results

This section presents the findings obtained once students carried out two activities specifically designed to improve their expectations, engagement, and motivation.

4.1. First Day of Class, 'Likes' and 'Dislikes'

The main findings of the first survey were obtained from the answers to two open-ended questions. Students were asked what they liked and what they disliked, in terms of the class content of the first day and the activities to be carried out during the first session of the subject 'Value Chain and Financial Economics'.

The number of students enrolled in the subject was 164, of which 7 did not participate in any class activity throughout the course. The survey was completed by 137 of them (M = 19.42 years old, SD = 1.32), who answered the open-ended questions. In terms of gender, there were 33 females (24.09%; M = 19.09 years old, SD = 1.08) and 104 males (75.91%, M = 19.52 years old, SD = 1.38). Once the data were collected, responses were normalized without trying to match all of them with the previous taxonomy presented in [53], in order to avoid being conditioned by previous findings. Once the collected data had been classified and reworded, resulting in the items listed in Table 1, the contents were compared with the aforementioned research and then further reworded in a second stage to be able to compare findings. Table 1 shows what students 'liked' and 'disliked' in terms of actions and percentages on the first day of class for the surveyed students. The students' answers shown in Table 1 were standardized to allow adding students' assessments under the identical concepts.

Table 2 shows the actions taken and the percentages of 'likes' and 'dislikes' expressed by the ICT Management engineering students on the first day of class. In all seven engineering programs, the same core subjects are taught in the first academic year. In second year, students take different subjects according to their specific engineering degree program. The distinctiveness of the ICT Management engineering program is that the weight that management subjects have in terms of ECTS (acronym that stands for European Credit Transfer and Accumulation Systems) is much bigger in comparison with the other six ICT engineering programs. The total number of ICT Management engineering students that answered the survey was 15 (M = 18.93 years old, SD = 0.45), with 3 females (20.00%, M = 19 years old, SD = 0) and 12 males (80.00%; M = 18.83 years old; SD = 0.57).

Table 2. First day of class (ICT Management engineering students): 'likes' & 'dislikes'.

Items [1]	'Likes'		'Dislikes'	
	n	%	n	%
General overview, syllabus, content, & expectations	13	86.67		
Describing assessment & grading	10	66.67		
Instructor: introducing background & experience	8	53.33	1	6.67
Getting to know classmates	6	40.00		
Icebreaker: doing activities	5	33.33		
Motivating students	4	26.67		
Utility & objectives of the subject	3	20.00		
Instructor's advice to pass the subject	2	13.33		
Good instructor's attitude towards students	1	6.67		
Doing a 'nonconventional' class session	1	6.67		
Beginning subject content	1	6.67	9	60.00
Reviewing previously acquired content	1	6.67		
Doing a test to check initial knowledge			4	26.67
Poor use of class time			1	6.67
Instructor: uncaring, intimidating			1	6.67
Instructor: bad attitude			1	6.67

[1] Items have been inferred from findings of two open-ended questions.

Table 3 shows the actions and percentages of all ICT engineering students in terms of 'likes' and 'dislikes' on the first day of class, excluding ICT Management engineering students. The total number of students matching this criterion was 122 (M = 19.48 years old, SD = 1.39), with 30 females (24.59%; M = 19.10 years old, SD = 1.14) and 92 males (75.41%; M = 19.60 years old, SD = 1.44).

A Chi-squared analysis compared listed and unlisted frequencies of the ICT Management engineering students to all the other ICT engineering students. No significant differences emerged in the list of 'likes' and 'dislikes' except for the one of the 'likes' items. Chi-squared analysis identified that a greater percentage of the ICT Management engineering students (53.3%) listed 'Instructor: introducing background & experience' as a 'like' than all the other ICT engineering students (27.9%), resulting in an $X^2(1, n = 137) = 4.807$, $p = 0.04$.

Table 3. First day of class (all ICT engineering students, excluding ICT Management engineering students): 'likes' & 'dislikes'.

Items [1]	'Likes'		'Dislikes'	
	n	%	n	%
General overview, syllabus, content, & expectations	94	77.06	16	13.11
Describing assessment & grading	65	53.28	12	9.84
Utility & objectives of the subject	41	33.61		
Instructor: introducing background & experience	34	27.87	6	4.92
Icebreaker: doing activities	33	27.05	5	4.10
Getting to know classmates	25	20.49		
Positive attitude of instructor towards students	24	19.67		
Doing a 'nonconventional' class session	21	17.21		
Motivating students	18	14.75		
Beginning subject content	14	11.48	86	70.49
Instructor's advice to pass the subject	13	10.66		
Class takes up full session (2 h)	8	6.56	6	4.92
Explaining instrumental elements (software, etc.)	4	3.28		
Reviewing content (that should be known)	2	1.64		
Doing a test to check initial knowledge	1	0.82	20	16.39
Poor use of class time			19	15.57
Homework assignments			9	7.38
Instructor: poor teaching			8	6.56
Instructor: uncaring, intimidating			6	4.92
Instructor: not being empathetic			6	4.92
Beginning subject content without introduction			4	3.28
Instructor: not being enthusiastic about the subject			2	1.64
Instructor: bad attitude			1	0.82

[1] Items have been inferred from findings of two open-ended questions.

This qualitative research was planned according to the guidelines presented in previous works [84–89]. As presented in [84], the steps followed were: (1) define the objectives of the research; (2) identify potential respondents; and (3) decide on the methods for collecting

the data and the analysis methodology.. The tool chosen to collect students' preferences about activities to be done during the first day of class followed the same methodology used in [53,63], while questions about the activity were collected and analyzed in line with the study of [12]. The data from the first day of class were collected from students by means of an open-ended questionnaire, a tool that enables students to answer while minimizing possible biases [90]. It should be noted that the sample of surveyed respondents was homogeneous since all of them were students of a second year ICT engineering undergraduate program who took a management subject. Once data about the first day of class were collected from students by means of open-ended questionnaire, the items were analyzed separately by three different researchers to increase the validity of the obtained findings [84].

4.2. Reciprocal Interview Activity

The reciprocal interview activity took place at the final part of the class session once a synthetic presentation of the syllabus was given. A summary of the main results obtained from the interviews when activity was completed is presented in this subsection.

After completing the reciprocal interview activity, a second survey was performed to evaluate the students' assessment of the interview activity. It was the last activity before finishing the first-class session of the mandatory management subject 'Value Chain and Financial Economics' in all ICT engineering programs. Information was extracted from a survey in which students' statements were rated by means of a 5-point Likert scale (ranging from 1—*not at all*—to 5—*a very great extent*—). The results, in terms of mean, median, and standard deviation, are presented in Table 4.

The total number of students that filled the survey with valid results was 131 (M = 19.33 years, SD = 1.56), and six forms were discarded because data were not completed. In terms of gender, the form was answered by 30 females (22.90%; M = 19.10 years, SD = 1.10) and 101 males (77.10%; M = 19.30 years, SD = 1.56).

To assess reliability, the internal consistency of the different sections of the questionnaire was measured by means of the Cronbach's alpha [91,92]. 'Comfort with instructor interaction' had a Cronbach's alpha of 0.72, and removing sequentially each one of the items of the section, the measures were 0.64, 0.74, 0.57 and 0.68, respectively. Further, removing C2 increased the analyzed value, moving from 0.72 to 0.74. Therefore, there was no need to remove any of the items since the whole former section obtained a value greater than 0.7 [92]. 'Student comfort with class participation' had a Cronbach's alpha of 0.69, and removing sequentially the items results were 0.47, 0.62 and 0.76, respectively. Again, by removing an item, S3, the value increased. As in the other case, the result of the second section was nearly 0.7, so consistency was achieved. All the other items, despite been grouped in different sections, were linked to individual concepts. The questionnaire had content validity according to the view of the researchers since it covered the different aspects to be measured once compared with other studies, e.g., [12].

Answers to the questions asked by instructors were compiled carefully. Two instructors asked questions, while another instructor noted down students' responses in front of the whole class. In the same way, students' questions were answered by instructors. All the opinions and statements given by students were analyzed in depth by the instructors once the session was completed. For illustrative purposes, some of the answers to the questions asked by the instructors were about the grading system, continuous assessment activities, key dates, instructors' experience, instructor motivation to teach the subject, and utility of the subject, among others. In addition, some of the students' answers to the instructors' questions were about their expectations for the subject, what they thought they were to be taught, their previous knowledge in management and business, etc.

Table 4. First day of class (ICT engineering students). Reciprocal interview: Data and statistics.

Reciprocal Interview Questionnaire	*M*	*Mdn*	*SD*
Comfort with instructor interaction			
C1. 'Talking to the instructor about assignments'	3.93	4	0.70
C2. 'Asking the instructor questions during class sessions'	3.93	4	0.70
C3. 'Talking to the instructor during office hours'	3.71	4	0.91
C4. 'Emailing the instructor with questions'	3.87	4	1.19
Student comfort with class participation			
S1. 'Participating in group activities during class'	4.20	5	1.01
S2. 'Sharing ideas and opinions during class'	4.00	4	0.76
S3. 'Working group activities outside class hours'	3.67	4	1.23
Evaluation of the activity			
E1. 'Would you recommend other instructors do this activity at the beginning of the term?'	3.80	4	0.86
E2. 'Did this activity seem to be a waste of time?'	1.47	1	0.64
. . . the activity helped me:			
H1. 'To understand what was expected in class'	4.13	4	0.74
H2. 'To work hard to do well in the class'	4.00	4	0.88
H3. 'To become more comfortable participating in class'	4.13	4	0.74
H4. 'To share concerns with the instructor'	4.00	4	1.07

5. Discussion

This section presents the analysis of the results shown in Section 4 regarding two activities that were carried out on the first day of class of a management subject taught in seven engineering programs.

5.1. What Students 'Like' and What They 'Dislike'

The first part of this research deals with ICT engineering students' opinions on what they prefer to do on the first day of class. The collected data were classified and quantified in terms of percentage of mentioning. All the items sourced from the answers of the whole pack of ICT engineering students are shown in Table 1. Hence, on the top of the 'likes' rank appears, 'General overview, syllabus, content, and expectations', followed by 'Describing assessment & grading', as shown in Table 5. Equally, when thinking about 'dislikes', 'Beginning subject content' is the most common dislike, as shown in Table 6. In addition, both tables include data segmented consistently with Section 4.1.

Table 5. Top ranked 'Likes' clustered by engineering programs.

	AICTep [1]	ICTMep [2]	ICTeMep [3]
General overview, syllabus, content, & expectations	78.10%	86.67%	77.06%
Describing assessment & grading	54.74%	66.67%	53.28%
Utility & objectives of the subject	32.12%	20.00%	33.61%
Instructor: introducing background & experience	30.66%	53.33%	27.87%
Icebreaker: doing activities	27.74%	33.33%	27.05%
Getting to know classmates	22.63%	40.00%	20.49%
Good instructor's attitude towards students	18.25%	6.67%	19.67%
Doing a 'nonconventional' class session	16.06%	6.67%	17.21%
Motivating students	16.06%	26.67%	14.75%

[1] AICTep (All ICT engineering programs); [2] ICTMep (ICT Management engineering program); [3] ICTeMep (ICT excluding Management engineering program).

Table 6. Top ranked 'Dislikes' clustered by engineering programs.

	AICTep [1]	ICTMep [2]	ICTeMep [3]
Beginning subject content	69.34%	60.00%	70.49%
Doing a test to check initial knowledge	17.52%	26.67%	16.39%
Poor use of class time	14.60%	6.67%	15.57%
General overview, syllabus, content, & expectations	11.68%	-	13.11%
Describing assessment & grading	8.76%	-	9.84%

[1] AICTep (All ICT engineering programs); [2] ICTMep (ICT Management engineering program); [3] ICTeMep (ICT excluding Management engineering program).

As in the previously mentioned research works [53,63], the most common 'dislike' is 'Beginning subject content', as seen in Table 6. 'Doing a test to check initial knowledge' was considered an unpopular activity, according to students' perceptions.

Most of the results found in the research (first column of Tables 5 and 6) are consistent with other previous studies [53,63]. Most of the answers to the ranked items are the same, despite changing the numeric value in terms of percentages associated with citing each one of the items by the students. However, some findings included in Table 5 that differ from the aforementioned previous research studies should be highlighted, as follows: (1) 'Utility and objectives of the subject' are highly ranked (32.12%) on the list compared to previous studies, as they were not found in [63] and only reached 7% in [53]. The fact that this element was in the third position and that it did not appear as a 'Dislike' reveals that it was an action highly appreciated by students, and therefore its inclusion in it on the first day of class could be useful to increase the intrinsic motivation of the students. Intrinsic motivation deals with behaving or doing something in a specific way because the individual (i.e., the student) believes that it is inherently pleasant or interesting [93]. (2) 'Motivating students' was selected by 22 students (16.06%) as a positive action to be done by instructors while this item did not appear in previous referenced research works [53,63].

Analyzing the segmented data subsets, some ideas can be highlighted about the previously mentioned items: (1) 'Utility & objectives of the subject' was cited more often by ICT engineering students (33.61%) than by ICT Management engineering students (20%). This difference could be explained by the fact that undergraduates that are enrolled in the latter program are likely to know more about business topics than students that have chosen a purely ICT engineering program. (2) Quite surprisingly, 'Asking for motivation from the instructor' was cited by more ICT Management students (26.67%) than ICT engineering students (14.75%).

5.2. Analizing the Students' Evaluation of the Reciprocal Interview Activity

Data obtained from the reciprocal interview activity were collected from a second survey articulated to assess pronouncements by means of a Likert scale [94], specifically a 5-point Likert scale. Results of the form were grouped in four categories, two related to students' comfort (with approaching the instructor and with class participation), one evaluating the reciprocal interview activity, and the last one evaluating four statements related to potential benefits of the first day activity that the student actually performed.

All the items related to the label 'comfort with instructor interaction' received a high score value. Within this tag, the statement that received a lower mean value (3.71) was 'talking with the instructor during office hours'. All the other items received values quite close to four. In fact, students asked a lot of questions about the continuous assessment of the subject. When analyzing the elements associated with 'student comfort with class participation', two of the statements were also highly assessed. Again, the item with lower values (and again with the higher variance) was the one related with an action to be done outside class hours, in other words, 'working with their peers outside class hours'. Both low values may suggest that students are initially more oriented to perform their learning activities within class hours. Further research should be done in these specific items to shed light on both statements.

The third section of the form was focused on the assessment of the reciprocal interview activity. Two sentences were provided to check how students assessed the activity, one in positive while the other one is formulated in negative. Both results were consistent, giving good feedback about the activity. Here again, further research to compare the results generated by different first day activities should be carried out. In the framework of the NLC [76,77], a list of available activities to be done in the specific context of engineering and management subjects during the welcoming should be made. This list can be completed after an analysis of the evaluation and effectivity of the potential activities by means of student surveys. It seems that the reciprocal interview activity, according to the results obtained in the survey, worked very well considering the students' opinions, in line with other research works [12].

The last section of the questionnaire was designed to check what specific issues had emerged from the reciprocal interview activity. Understanding expectations, sharing concerns with instructors, and becoming comfortable with their participation in class were very well valuated (all equal to or greater than four).

5.3. Practical Implications of the Findings

Once the main findings of the research are presented, different practical implications emerge. The mere fact that students realize that their opinions are heard and considered increases their engagement [41]. Hence, both activities performed on the first day of class that give voice to the students can enhance their engagement. In addition, the information collected through the answers of both activities is very valuable feedback for the instructors. Moreover, in the case of implementing some students' opinions, engagement can increase since they perceive that their ideas have been valued and applied [41]. Another option that may enhance engagement is to promote the use of new technologies by students [95], and once again, asking students about how they perceive their experience using technology [82] may be crucial. Finally, promoting peer-to-peer interaction also may increase

engagement [96]. In fact, most of these actions took place in the context of this research through both activities that were carried out the first day of class.

5.4. Limitations, Restrictions and Future Research Directions

A first limitation of both studies, the empirical survey and the assessment questionnaire about the reciprocal interview activity, was that surveyed students were restricted to those taking a second-year ICT engineering subject. Consequently, even though students from seven different ICT specialties were asked, which facilitates the comparison of student's perceptions across all the diverse ICT engineering programs, the sample was limited to second-year students. However, and to cope with this limitation, replicating this research work in other subjects has already been already scheduled. A second limitation related to the first day of class activity was that only one option was chosen, a reciprocal interview. Some of the other activities listed in this paper could be implemented in other subjects and in different academic courses to verify and compare results between the different first day activities. A third limitation was that students were invited to answer the survey with short sentences. This option was chosen to force students to first think and then write synthesized ideas. However, this option could lead to limiting the depth of their opinions. In fact, we are going to repeat these activities in the next academic year in different subjects, and we are planning to set a new limit (around twenty words).

Future research works should aim at properly developing the 'New Learning Concept' that is currently being implemented at La Salle URL [76,77]. Firstly, it would be wise to replicate the study of the 'likes and dislikes' of the first day of class in different subjects. Hence, third and fourth-year ICT engineering students should be surveyed in the context of subjects taken for all ICT engineering students to check if findings are similar in terms of items and its percentages. The study should be carried out in the context of engineering subjects and in the framework of business subjects. Secondly, and along the same line, preferences about 'what likes and what dislikes' could be done in the context of ICT master students to analyze eventual differences in students' preferences that may exist between undergraduate and master programs. Finally, besides the reciprocal interview, some other first day activities could be implemented to check its potential success in a technological context.

6. Conclusions

The main contribution of the empirical studies presented in this paper was to shed light about the preferred actions to be done on the first day of class in the specific framework of ICT engineering programs through collecting students' opinions. In fact, asking students preferences and carrying out an activity that promotes their participation is a powerful way to establish the tone of a subject, which impacts engagement and motivation. Findings were quite consistent with previous research in terms of the list of preferences, despite some differences in ranking and percentages. An item related to requiring 'motivating students' by instructors appears recurrently as one of the students' requests. Further, once a specific first day activity was implemented, by means of a reciprocal interview between students and instructors, students' perception about the activity were surveyed. According to the results of the survey based on those interviews, the activity was very positively assessed by students. These findings, results and experiences are very valuable in the framework of the NLC, specifically in the Welcoming stage, because the outcomes obtained from this research will help to develop in a tangible way the new learning strategy that is being implemented at this moment.

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APÉNDICE 3 – PUBLICACIÓN 3

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A Qualitative Approach to Help Adjust the Design of Management Subjects in ICT Engineering Undergraduate Programs through User Experience in a Smart Classroom Context

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Abstract: Qualitative research activities, including first-day of class surveys and user experience interviews on completion of a subject were carried out to obtain students' feedback in order to improve the design of the subject 'Information Systems' as a part of a general initiative to enhance ICT (Information and Communication Technologies) engineering programs. Due to the COVID-19 (corona virus disease 2019) pandemic, La Salle URL adopted an Emergency Remote Teaching tactical solution in the second semester of the 2019–2020 academic year, just before implementing a strategic learning approach based on a new Smart Classroom (SC) system deployed in the campus facilities. The latter solution was developed to ensure that both on-campus and off-campus students could effectively follow the course syllabus through the use of new technological devices introduced in classrooms and laboratories, reducing the inherent difficulties of online learning. The results of our findings show: (1) No major concerns about the subject were identified by students; (2) Interaction and class dynamics were the main issues identified by students, while saving time on commuting when learning from home and access to recorded class sessions were the aspects that students considered the most advantageous about the SC.

Keywords: COVID-19; emergency remote teaching; engineering education; first day of class; higher education; ICT; information systems; smart classroom; user experience

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1. Introduction

Knowledge in a specific field, the state of the art of technology, as well as learning techniques evolve year after year, so continuous adjustments to undergraduate programs are required. In 2020 the COVID-19 (corona virus disease 2019) pandemic added another piece to the puzzle, a threat that would become an opportunity to transform education [1], which involved a switch from face-to-face (F2F) to remote teaching [2], students' performance [3] or the redefinition of the role of the instructors [4,5]. When focusing on ICT (Information and Communication Technologies) engineering programs, as in most engineering programs, a multidisciplinary approach is recommended [6,7]. In this research we propose the incorporation of undergraduates' user experience to help refine subjects based on their perceptions about the salient items that they observed on completion of their learning experience. A specific element to analyze was the experience that students had had once used the Smart Classroom (SC) technology in the context of the subject. SC consists of a technological solution adopted by La Salle URL (Universitat Ramon Llull) to

cope with the COVID-19 pandemic [8] that according to a previous research study was positively valued by students [9]. The subject 'Information Systems', taught exclusively on the ICT Management Engineering program, one of the seven ICT engineering programs of the Institution, was chosen as a pilot experience subject for this work since it combines technological and management topics.

The final goal of this work was to enhance the pre-existing teaching model of business subjects in ICT engineering programs through the incorporation of students' feedback. Firstly, a description of the whole model is provided, then the techniques used to collect information are presented from a dual-fold perspective. Secondly, the evidence obtained from students' perceptions is analyzed to combine their feedback with the other mechanisms previously implemented in the continuous redesign and adjustment of the subject 'Information Systems'. Thirdly, information about students' experience when using a SC was collected in order to adjust and improve its usage in future academic years. Data was collected by means of a Socratic technique and open-ended questions, resulting in a qualitative approach to evaluate both the subject and the use of the SC. Fourth-year ICT engineering students are highly skilled in technologies, so issues and concerns specifically linked to the use of a new technological approach such SC should not appear, as confirmed in the results of this research.

The novelty of this research was the incorporation of engineering students' opinions to refine the design of management subjects through two feedback activities, one on the first day of class and another on completion of the subject to collect their salient opinions on the subject. Although some previous studies had focused on collecting information about student's opinions of SC by a quantitative approach [10,11], we chose a qualitative approach that allowed us to collect more spontaneous feedback responses.

2. Research Background

Most ICT engineering undergraduate programs include topics that, according to the initial perception of students, may appear quite remote from their areas of interest. However, cross-competencies and business and management knowledge are increasingly sought-after in the labor market [12] so specific knowledge in engineering and management is a fundamental part of many engineering programs. Consequently, topics related to business, basic management, soft skills, and other generic competences are included in some subjects, or even conceptualized as a subject itself. Along this line, a similar approach is applied in most disciplines and contexts [13,14]. Therefore, we believe that more effort is needed to make management subjects as interesting and engaging as possible for engineering students in order to increase their interest in those topics.

The majority of recent undergraduates are 'digital natives', according to the terminology coined by Prensky [15]. Today, undergraduate students live in a world where the use of the Internet and other ICTs is widespread, despite the fact that not all of them have the same level of competence in this area [16–18]. Then, it is likely that this generation can learn in a different way, compared with their predecessors [19,20]. However, generations born before the 'digital natives' can become highly skilled in ICT by means of the proper training and experience [21]. Consequently, neither are all 'digital natives' highly skilled in ICT, nor are all those from older generations lacking in ICT knowledge. Therefore, in all cases, people that are experts in ICT can take full advantage of the potential that these technologies provide, e.g., [22]. In the specific field of education, digital technology can leverage student experience in different facets [23], making digital technology a key element in higher education [24].

2.1. Context of the Study

According to this reality, in the 2018–2019 academic year La Salle URL adopted the 'New Learning Context' (NLC) to enhance student learning [25,26]. The main reasons for implementing this new approach were: (1) most new entrants as undergraduates are used to working with technology tools and in digital environments; (2) the available

ICT technologies can improve different aspects of learning; (3) the modern approaches of learning and teaching help acquire skills and knowledge more effectively. For this purpose, the NLC establishes a pedagogical framework to achieve specific outcomes by means of active learning through different learning areas (welcoming, seminar, workshop, project, and closure). Although the NLC is out of the scope in this paper, it is a key point to understanding why La Salle URL engineering programs are undergoing an extensive redesign process. In this context the deployment of a replicable design methodology for different subjects would be interesting.

The research presented in this paper was carried out in the context of a fourth-year subject that includes engineering and management topics, with the aim of developing a model to be replicated in different third- and fourth-year management subjects. All the previously mentioned ideas were considered in the redesign of the subject 'Information Systems'. A Project Based Learning (PBL) methodology was adopted [27], following the constructivist logic while working in a collaborative learning context. Besides, traditional classes were transformed into short sessions in the form of a 'pill classes' specifically designed to promote students' participation, as explained in [28]. What is more, this redesign was implemented to reinforce students' active learning [29,30], along the line of the NLC. It should be highlighted that a learning environment which applies PBL enables students to work a similar way as many engineers do in most of the cases when they enter the labor market [31,32]. On the other hand, competences such as teamwork, written and verbal communication skills, critical thinking, and so on, are highly valued in the labor market, resulting in increasing students' employability according different studies, e.g., [12]. So, different tasks and activities where included in the new design of the subject to teach and develop these competences, such as the introduction of Self- and Peer to Peer assessment activities [33].

2.2. Technologies Deployed at La Salle URL to Cope with the COVID-19

In 2020 the nature of the COVID-19 pandemic seriously affected many aspects of people's lives, particularly with regard to social interactions and public health [34], besides putting at risk most worldwide economies [35]. As a consequence of the quick and easy propagation of the virus, governments took measures to minimize its effects on health (limiting and restricting mobility, isolating ill people, . . .) [36–38]. Consequently, in the specific area of education measures were introduced to prevent the virus from spreading [39]. However, the effects of the disease on people, besides other consequences derived from some of restrictions adopted, have had a harmful effect on people's health, provoking feeling of anxiety and stress [40–42]. Focusing on education, most educational institutions restricted and limited the physical access to their educational facilities because of governmental decisions adopted to constrain most of the activities that involved direct social interactions of any type. As a result, online learning was thought to be a viable solution to cope with the pandemic constraints [43,44]. The immediate reaction of educational institutions was to implement emergency remote teaching (ERT) solutions. These new formats consisted of temporarily switching from F2F class sessions to remote teaching [45], which became a challenge for most of the agents involved in the change [46–48]. The competences and attitudes of the teaching staff were two key points when they were forced to change from F2F to ERT, specifically: (1) their competences in ICT, including digital literacy and teaching skills in an online environment; (2) their attitudes, such as perceived threat, their ability to develop new skills or a positive approach to challenge [5]. Regarding the students, they switched to remote learning which allowed them to maintain their educational training despite mobility restrictions. However, different challenges arose when attending classes off campus, such as distractions or less effective student-instructor and student-student interactions [9]. In addition, different research works have reported issues in other areas, such as their wellbeing [49], learning capabilities or engagement levels [50].

The pedagogical system of La Salle URL evolved from an ERT solution implemented at the beginning of the second semester of 2019–2020 academic year to a SC deployment before

the start of the 2020–2021 academic year [9]. In other words, it implied moving from a tactical solution (ERT) to cope with the COVID-19 pandemic, to a strategical approach based on the SC format. This latter strategy consisted of a large investment in technology with the aim of leveraging students' experience in the case that the undergraduates had to stay at home. To do that, classrooms and laboratories were equipped with different hardware devices, such as a sound system, an image system and a 'Smart-Board'. In addition, a software solution to allow a proper interaction with different electronic devices completed the solution. The SC format was introduced to enable off-campus students to follow classes in real time to make the learning experience as similar as possible to attending classes physically in the classrooms and laboratories at the campus facilities. In fact, the ERT solution was effectively implemented thanks to two elements: (1) the existing infrastructure in the campus facilities to provide services to a few existing online programs, infrastructures that were simply adapted and scaled to meet the new requirements; (2) the instructors and the engineering students were able to easily shift to remote teaching and learning because of their background and abilities to adapt quickly to the new tools. It should be said that although students had been taught on a F2F basis until the outbreak, all of them were already familiar with a Learning Management System (LMS). In the preexisting context (F2F), LMS was used to consult the syllabuses, contents and class materials of subjects, grades, uploading homework or just accessing to information of their interest.

The 2020–2021 academic year constituted a second stage, since strategically La Salle-URL decided to focus on a new approach which was much more consistent with the initial F2F modality even considering the COVID-19 pandemic threats [9]. Hence, a new model based on SC as shown schematically in Figure 1 was implemented which aimed to maintain the advantages of F2F learning [51]. The SC format was thought to be resilient enough to cope with commuting restrictions that could affect students and instructors, characterized by incorporating hardware devices inside more than sixty classrooms and laboratories [52], allowing different possibilities as explained in a case study [8]. SC is a concept characterized by the introduction of electronic devices at classrooms, such as cameras, televisions, smart-boards, or sensors [53–56]. SC has a huge potential due to its technological nature. Then, it can be said that SC is an instrumental tool to allow smart education [55,57], that may allow personalized learning and the possibility of learning anytime and anywhere [55]. Besides, SC can be a very convenient instrument when using project or problem-based learning techniques [58]. As pointed out in [53,54,59], SC makes possible a blended model mixing F2F on-campus and off-campus classes.

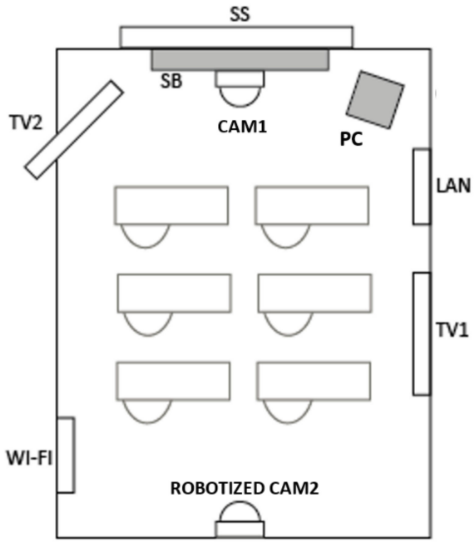

Figure 1. Technological devices deployed in a standard 'Smart Classroom': Sound system (SS); Smart-Board (SB); Camera 1 (CAM1); Robotized Camera 2 (CAM2); Television 1 (TV1); Television 2 (TV2); Local Area Network (LAN); Wi-Fi; Personal Computer (PC).

From the user perspective of the student and as shown in Figure 2, the system can be described as compounded by different parts, as follows:

- Sound system: Microphones and speakers. Both devices allow the sound interaction between people that are physically in the classroom (on-campus) and those at home (off-campus). To have a complete interaction, those at home must use a device that includes their own sound system.
- Image system: Two cameras (one of the cameras is a robotized camera that can follow the instructor while moving in the classroom class), plus other camera that shows a full view of the classroom. Through the Smart-Board, the instructor decides which view is shown to students attending classes off campus. Two TV sets complete the hardware devices to provide images. Once again, to allow complete interaction, people at home must use a device with their own audiovisual system.
- Smart-Board: In fact, it is a computer with a huge screen that acts as a blackboard (or whiteboard) or as a projector. The screen is a touchable board that allows drawing on its screen, by means of just writing directly on the screen or by writing from the different devices connected to the class session (under permission of the instructor).
- Software to allow a virtual connection between the classroom Smart-Board and all the other systems located on- or off-campus.

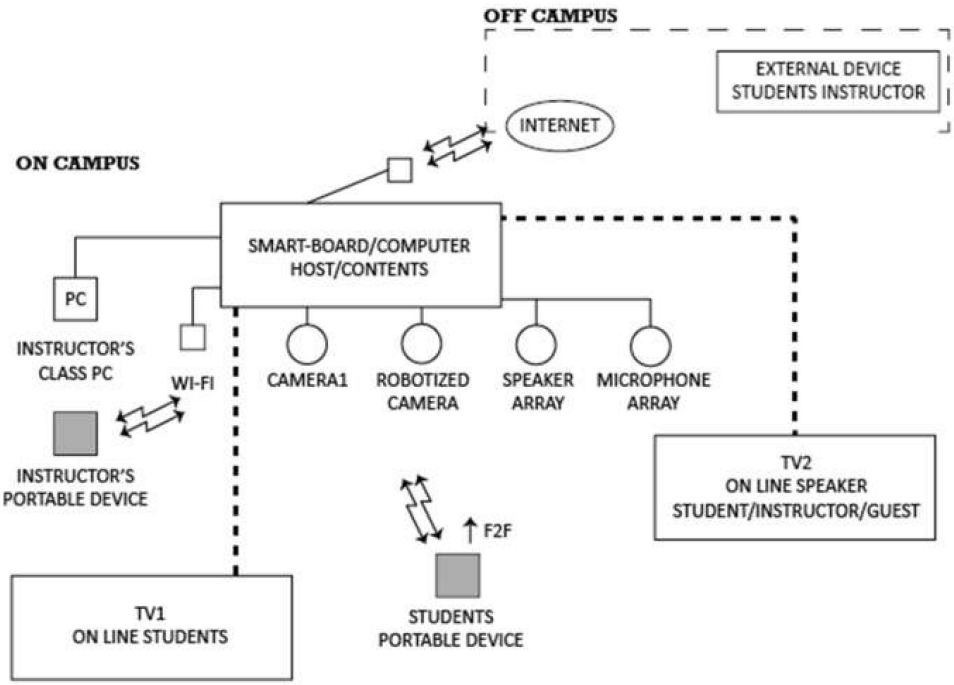

Figure 2. User interaction with the technology deployed in a 'Smart Classroom'.

In addition, some supplementary changes were made to allow remote access to several devices located physically in the campus facilities, such as laboratories. This latter casuistic is not described in this paper, since 'Information Systems' does not require access to any additional devices, except the ones already described. Finally, to complete a whole picture of how looks a typical 'Smart Classroom' at La Salle URL, two actual photographs are shown in Figures 3 and 4.

Figure 3. 'Smart Classroom': 'Smart-Board', Sound system, Camera1 and TV1.

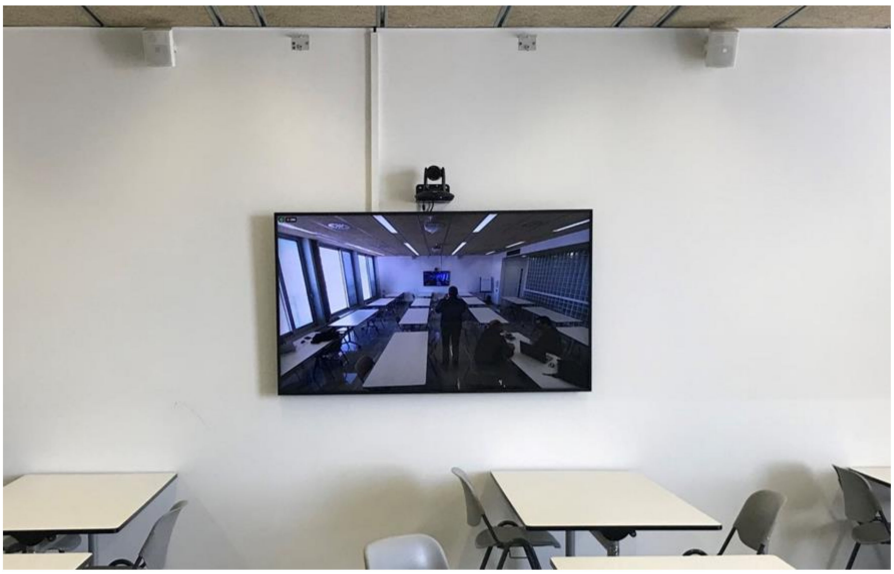

Figure 4. 'Smart Classroom': Sound system, Robotized Camera2 and TV2.

It should be highlighted that the initial goal of the SC format was to offer an on-campus experience despite being off-campus thanks to an online solution which could effectively overcome the main issues that traditional online formats have. In other words, the aim was to make the off-campus experience as similar as possible to the on-campus experience. To accomplish this objective, some features of the specific SC deployment are briefly explained in the next lines. The robotized camera tracks the instructor, trying to give a feeling of a greater interaction with the instructor with students who are at home. The other camera is thought to offer a general vision of the classroom to off-campus students. One of the TV devices shows all the off-campus students, thought to integrate off-campus and on-campus students in the class sessions. The other TV device shows the off-campus student that is interacting live with all the other people following the class session. The 'Smart-Board' enables instructors to show presentations, videos, or files on its screen. Besides, it can act as a white or black board. On a regular basis, the instructor shows and writes contents on the screen of the board. Students may show or write content on the board under instructor permission. Additionally, the system allows recording class sessions. As a result of the policy of the Institution, recorded classes are available to all students for a limited period. This option enables students to review the class content in case they wish to go over anything when studying contents. Hence, all this technology enables that students

to attend classes off-campus. Besides, this technology has proved to be useful when the instructor has been unable to physically come to campus as it has enabled them to teach class sessions from their own home if needed [8].

2.3. Teaching 'Information Systems' at La Salle URL in the Context of 'Smart Classrooms'

In the 2019–2020 academic year, a fall-semester fourth-year ICT engineering subject named 'Information Systems' was redesigned. This subject, as all the subjects given in the seven official ICT engineering programs, is taught on-campus in a F2F modality. In fact, most programs at La Salle URL are officially recognized as F2F instruction modalities. In the very first academic year of the new design, the subject was taught on a F2F format with all students attending classes physically in the classrooms.

In September 2020 classes started in a context characterized as commuting restrictions were lifted due to the positive evolution of the pandemic. This situation affected students, instructors, and other people that worked in the Institution. To cope with this situation the subject shifted to a new teaching and learning format based on SC, since this new strategy had been adopted at La Salle URL.

Classes were conducted by two highly skilled instructors, both working in management positions in the Information Systems area, besides teaching part-time classes at a master's degree level. Instructors taught classes on-campus throughout the fall semester. From the very first day students had two options available: attending on-campus classes, inside the classroom; or attending online off-campus classes once students were remotely connected to the class sessions. The subject was organized in 14 weekly sessions of 150 min, including a final project presentation. Classes were split into two parts: the first one, with short explanations given by the instructor, designed to stimulate students' participation by trying to encourage questions from students, or through questions asked directly by instructors to the students; and a second part designed to work under the PBL logic. Then, during the second part of each class session students worked in groups of three or four, while the instructors acted as consultants [28]. The PBL activity started from the analysis of a real case in which the deployment of an information system initially failed. Next, the students had to discover the reason why it had failed and then propose a feasible solution. This task was developed over twelve sessions. In session 10, all groups gave a mock presentation to their classmates and to one of the instructors with their preliminary findings in order to obtain feedback and refine their final conclusions. Finally, each group presented their final results and conclusions in the last class session, giving an oral presentation in front of all the students and a judging panel that included three instructors. The instructors assessed the students' individual performance in the presentation as well as in the question and answer session. In addition, the final grade included a self-evaluation and a peer-to-peer weighting [33]. In the case that students were attending off-campus classes, a software application enabled them to join the class in real time [8]. This platform also enabled the creation of virtual groups where students and instructors could interact.

SC allow leveraging teaching and learning class activities [53,56,58,60]. However, since this technological solution was deployed just a few days before starting the 2020–2021 academic year, not all the potential features derived from the SC were exploited to take advantage of the new possibilities offered by the new format. The approach of the subject in this new context, in line with the objective of La Salle-URL in the 2020–2021 academic year, was simply to make the learning experience for off-campus students as similar as possible as that of the on-campus students.

2.4. Integrating Students' Feedback in a Model to Adjust the Design of a Subject

This study was focused on enhancing the design of a model based on the continuous adjustment of a subject once each cohort of students had completed the subject, as shown in Figure 5. This diagram includes different elements: the pre-existing elements are colored in black, while the new ones presented in this research work are colored in blue. In short, the different stages of the proposed model are: (1) To seek from the National Accreditation

Board validation of a new official program that includes all the curriculum design, according to its framework for the validation (ex-ante accreditation), monitoring, modification and ex-post accreditation of recognized degree programs (known by its Spanish acronym VSMA) [61]; (2) If the proposal is accepted by the National Accreditation Board, the new program is implemented through different subjects according to the different methodologies, deploying new infrastructures in the campus facilities, if required; (3) To teach the different subjects of the program; (4) To receive and analyze feedback from instructors and students to allow the fine-tuning of each one of the subjects, while keeping the mandatory core elements officially approved. Hence, a user experience assessment on 2019–2020 and 2020–2021 students was carried out to adjust and refine the design of the subject once the collected data had been processed. This model was implemented with the aim of being potentially replicable in other third- and fourth-year management subjects imparted in the seven ICT engineering programs at La Salle URL. This continuous adjustment was initially planned to be carried out on an annual basis once students had completed all their class activities, including assessments. In order to complete the whole picture, if the changes to be made in the subject as a result of the analysis of possible improvements (brown arrow in Figure 5) are not consistent with the official degree program, these changes should go through a process of modification (M) or monitoring (S), according to the VSMA framework (blue arrow in Figure 5).

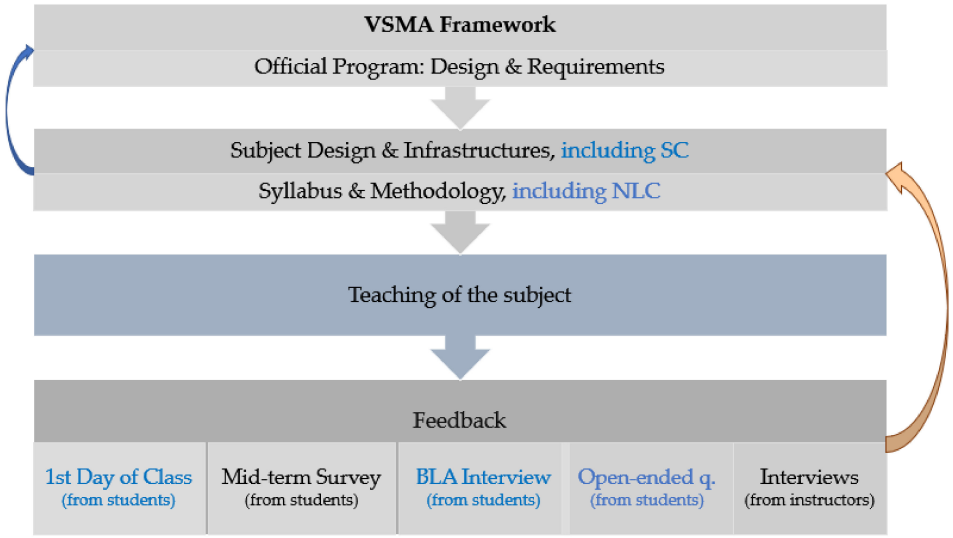

Figure 5. Continuous adjustment of the subject once feedback from the students is collected.

In addition, SC was introduced into the model since it became a new way of teaching and learning in the Institution, providing new interesting possibilities from a didactic point of view.

Different techniques collect students' feedback, through either open-ended or closed-ended questionnaires [62]. The first day of class is a crucial day that may have an impact on several elements, such as building students' expectations [63], attitudes [64], engagement [65] or motivation [66,67]. In fact, most teaching books have a chapter about the first day of class [68,69]. Some surveys have been performed by researchers to detect students' preferred activities on the first day of class [70–74]. When instructors identify what the students' preferred activities are, instructors can incorporate them into the subject, once aligned with the goals of the subject.

On the other hand, students' feedback can be collected on completion of a subject. User Experience (UX) is a topic that has been defined by highlighting different elements and perspectives, as reflected by Laws et al. [75]. According to ISO (the International Organization for Standardization), user experience can be defined as the 'person's perceptions and responses resulting from the use and/or anticipated use of a product, system

or service' [76]. As explained in Tullis and Albert [77], some options must be chosen depending on the research, as done: in terms of study goals, formative experience; in terms of user goals, satisfaction; and in terms of choosing the right metrics, self-reported metrics. Then, assessing user experience with a proper technique may be a suitable way to obtain students' feedback about classes. Laddering Theory has to deal with one-to-one in-depth interviews to obtain users' evaluations of products or services, in order to identify the most important attributes [78,79]. Bipolar Laddering (BLA) is a tool designed to extract value from user experience by means of Socratic survey, once the user has completed the experience related with a product or a service [80]. BLA can be described as a process that requires different steps [80,81], as follows: Firstly, using a Socrates' Tabula Rasa (i.e., without previous conditionings), users spontaneously identify the strong and weak points of the experience according to their perceptions and they justify their selection; secondly, users assess each one of the identified elements (out of 10; being 0 no satisfaction, extending to 10, the maximum level of satisfaction); finally, users are asked to give their suggestions about how to improve each one of all the items that they have mentioned.

3. Methods

As formerly mentioned, the aim of this research was to obtain data to adjust the redesign of a subject while analyzing issues derived from the implementation of SC. Our final research objectives were: (1) To obtain information from the students' viewpoint about the redesign of a subject started in 2019–2020, 'Information Systems'; (2) To propose a replicable methodology, as shown in Figure 5, to readjust subjects including a user experience approach to obtain qualitative feedback from students; (3) To detect positive and negative effects derived from the use of a SC format from the undergraduates' viewpoint.

To perform this qualitative research, a user experience approach was chosen to get students' feedback. Two techniques, Bipolar Laddering (BLA) and Emotional Appraisal have been used in this research due to the linkages that exist between them [82,83]. BLA interviews, a specific question about utility and two questions about SC are based on open-ended formats which minimize possible biases [62]. On the other hand, data about preferred activities to be done the very first day of class could provide very valuable information about eventual students' concerns related to SC, besides adjusting the final design of the subject. Finally, two specific questions about SC were included in this research to provide feedback about this topic. Hence, some different instruments were used to capture data needed to analyze users' perceptions about the subject and the SC.

3.1. Participants and Procedure

This research includes undergraduate students from two different cohorts enrolled in the subject 'Information Systems' in two consecutive academic years, thirteen in 2019–2020 and eighteen in 2020–2021 academic year. The only difference that existed between both cohorts was the implementation of SC, as previously explained. Additional details about participants that responded the questionnaires and interviews are shown when presenting results, as not all the research techniques were carried out in both cohorts. The second cohort experienced the on-campus and off-campus SC. In order to obtain feedback about the subject by means of a user experience appraisal, the student must have finished the whole experience. So, the initial schedule was to perform the students' interviews in February 2020. However, since the pandemic was declared at that moment, we preferred to postpone the surveys to avoid potential biases derived from the critical situation (see Section 3.3).

A User Profile Test to check potential differences in each one of the two cohorts to establish criteria to select a proper sample for each specific cohort was not required to be done, since all students of 'Information Systems' can be considered homogeneous: (1) All the 2019–2020 students attended class in the classroom at the campus physically, while all the 2020–2021 undergraduates experienced a SC class format, attending some of them on-campus and off-campus classes due to some commuting restrictions during that semester; (2) all undergraduates were studying an ICT engineering degree. Therefore, asking students

to voluntarily complete a questionnaire implied no issues in terms homogenously concerns about the resulting sample, once reached a minimum number of respondents.

This qualitative research has been planned according the guidelines and criteria presented in previous studies [84–89]. So, as presented in [84], having selected the aim of the research, the next steps were to identify potential respondents, decide the methods to collect data, and finally select the analysis methodology. Techniques to measure user experience have been deployed in other studies to collect students' experiences in an educational context, e.g., [90–92]. The analyzed data was directly collected from students by means of questionnaires and interviews. The context from where data were extracted has been clearly explained, students of a fourth-year ICT engineering undergraduate program while attending the subject 'Information Systems', being the sample of surveyed students homogeneous when compared with the total number of enrolled students. Once data has been collected, the items have been analyzed separately by three different researchers who finally came to a consensus, a way of triangulation to increase the validity of the results [84]. When presenting results in this research, all students' opinions were transcribed literally.

3.2. An Empirical Study: First Day of Class, What 'Likes' and 'Dislikes'

An empirical study was performed the first day of class with all the 2020–2021 students that were on-campus at the classroom. Once the very first session of class started, the subject coordinator, who was already known by all the students, welcomed all the students briefly. Next, he introduced the instructor that was going to give the initial class, just mentioning his name, and announced that an introductory activity was going to be performed. After that, an anonymous survey was handed out to all the students that were in the classroom, asking them to complete the form on a voluntary basis. The survey included data about 'age' and 'gender', besides two open questions, each one to be answered on one side of the paper. In the first side of the sheet of paper the open-ended question was 'What things would you like an instructor to do on the first day of class of this subject?', while in the other side of the paper the question was 'What things that an instructor does on the first day of class of this subject do you dislike?' Students were requested to answer the questions with a short sentence, if possible, just writing a few numbers of words (five or less). Once researchers collected the forms, answers were reworded to uniformize students' responses. Three researchers did the job on an individual basis. The next step consisted of reaching agreement on the results, once compared, and discussed. Thanks to the latter task, items were analyzed and finally aggregated to show percentages of occurrence.

3.3. User Experience

Different techniques have been used to collect students' user experience. In this research we have gathered data from a user experience viewpoint from two different students' cohorts: 2019–2020 and 2020–2021. All the interviewed students signed a form allowing the use of the collected data for research purposes, besides authorizing the recording of their opinions of the BLA interview, the open-ended questions, and the Emotional Appraisal. A total number of ten respondents gave their opinion about experiencing 'Information Systems', five of each cohort, albeit 32.3% of the total enrolled students. The number of people to be interviewed to get accurate results is five according to Nielsen [93]. However, this number should be increased at times depending on the degree of homogeneity of the universe and representative issues of the chosen sample [94]. It should be noted that in this research the surveyed sample is homogenous with the whole universe of students. The BLA technique used in this research is based on interviewing respondents in an open-ended basis, without limiting the number of answers of the interviewed people. This latter design decision has a great impact on the findings, since even with relative small samples, such as ten samples most of the salient items can be obtained, as posited in [95]. As found in [96] this latter finding is consistent with previous research works [97–100].

- Collecting results from the 2019–2020 cohort was done in December 2020 to five of the 13 enrolled students (38.5%). The mean age of the sample was 21.06 years with

a variance of 0.64, three males (60%) and two females (40%). Students received two e-mails asking for their collaboration to do a survey about the Information Systems subject. All the interview activities were performed by a very skilled instructor in the use of the UX techniques who had not had any kind of relationship with the subject, to avoid any possible biases.

- Collecting results from the 2020–2021 cohort was performed in January 2021 to five of the eighteen enrolled students (27.8%). In terms of age, the mean of the sample was 22.2 years with a variance of 5.76, all men. In the last class session, the teacher told the students that they would receive an email once their grades had been published and they were invited to a voluntary meeting to give their opinion on the subject. The interviewer was the same instructor that surveyed the first cohort.

3.3.1. Bipolar Laddering

During each semester, all engineering undergraduates at La Salle URL are asked to give their opinion about all the subjects in which are enrolled by means of what is named a 'Satisfaction Questionnaire'. This survey is completed online, and students rank different statements. Besides, the questionnaire includes a blank space at the bottom of the form where students can add observations about whatever they want. The results obtained are useful 'to raise a flag' in case that some non-detected issues are affecting students. Most of comments deal with additional information about some of the previously ranked statements. So, this technique can be useful to detect some general issues, while providing results by means of statistical tools.

In contrast, data obtained by means of the BLA technique cannot be treated statistically, since respondents give their own opinion about a specific item, not necessary a coincident one. Nevertheless, possible biases derived from the redaction of the question are minimized, and genuine perceptions about a particular topic of interest can be collected. Hence, BLA can be a very useful technique to obtain students' perceptions of a subject from their user experience as learners and then use this information to improve it.

Methodologically, in order to show findings and once all the students' ideas had been analyzed, a rewording process is carried out to write a clear statement linked to each idea. This task was done by three of the authors of this research, who wrote the final statements. Once done that, each one of the statements is grouped according one of the next criteria, as follows: (1) Positive common elements, or positive items mentioned by at least two users; (2) Positive particular elements, or positive items mentioned by just one user; (3) Negative common elements, or negative items mentioned by at least two users; (4) Negative particular elements, or negative items mentioned by just one user. This technique has been used to assess different user experiences in diverse fields e.g., [92,101], including teaching experiences [90,102–104].

3.3.2. Open-Ended Questions

Open-ended questions offer the advantage of getting spontaneous answers from the surveyed people, besides minimizing the bias resulting from the closed-ended questions [62]. Hence, to research on three specific issues of interest, three open-ended questions were asked to the students: a first one about the perceived usefulness of the subject to all the students and two additional questions about the SC format that were only asked to the respondents of the 2020–2021 cohort, since they were the only ones that had experienced the SC format. The open-ended questions were as follows:

- Question 1. Do you think that 'Information System' has been a useful subject in the context of the ICT Management Engineering program?
- Question 2. What is your opinion about the 'Smart Classroom' system deployed at La Salle URL to cope with the COVID?
- Question 3. Once you have experienced the 'Smart Classroom' classes ... Do you think that you learn the same by experiencing the classes on- and off-campus?

3.3.3. Students' Emotional Appraisal

Emotions may have a great effect on human beings, as posited in different works [105,106]. When focusing on educational science different studies have analyzed the impact of emotions on students' motivation and interest or academic achievement [107,108], since emotions play an important role in learning [109]. Henceforth, getting data about students' emotions once they have experienced the whole learning process of a specific subject may provide relevant information to the instructors to adjust the teaching process in the next future.

Appraising emotions once a product or service has been experienced by the user may provide very valuable feedback. Schmidt-Atzert [110], implemented a questionnaire based on different opposite pairs of feelings to be assessed by the user. The appraisal process consists in selecting one of the five points-scale that extents between both pairs of emotional states (100%, associated to the positive feeling; 75%; 50%; 25% and 0%, associated to the negative feeling), which are shown in Section 4.4. Once the user finishes this process, the outcome offers a whole picture in which different pairs of related positive and negative emotions are showed [91,110,111].

4. Findings and Results

Once the different goals to achieve in this research have been previously defined, the results are presented in this section. Four different instruments were used to obtain information related with this research. All students that physically attended class were asked to complete voluntarily an anonymous survey about the preferred and the undesired activities to be done on the first day of class. To complete the other three instruments, an e-mail was sent to all students on the completion of their experience, inviting them to participate in a survey. Once five positive answers of each cohort were received, the interviews were done.

4.1. An Empirical Study: First Day of Class, What 'Likes' and 'Dislikes'

The total number of respondents that completed the survey were 13 out of 18 enrolled students in the subject in the academic year 2020–2021. The mean age of the respondents was 23.08 years with a variance of 3.90, being 69% males and 31% females.

Results were captured from a survey done by means of two open-ended questions and are shown in Table 1. Students answered on what they liked and what they disliked, in terms of activities and tasks to be done the first day of class of the subject 'Information Systems'.

Table 1. First Day of Class, 'Information Systems': What 'likes' & what 'dislikes' to students.

Activities	'Likes'		'Dislikes'	
	n	%	n	%
General overview, syllabus, content & expectations	12	92.31		
Exams, continuous assessment & grading	11	84.62		
Utility & objectives of the subject	6	46.15		
Instructor: presenting & explaining background	6	46.15		
Icebreaker: doing activities	4	30.77		
Good professor's attitude towards students	4	30.77		
Motivating students	4	30.77		
Getting to know classmates	3	23.08		
Doing a not conventional class	2	15.38		
Advices to pass the subject	1	7.69		
Don't exhaust the full class time	1	7.69		
Beginning subject content			10	76.92
Instructor: Poor teaching			3	23.08
Instructor: Bad attitude			3	23.08
Poor use of class time			2	15.38
Homework assignments			2	15.38

Findings are consistent with previous empirical findings such as [70,73,74] in terms of the items (activities) ranked on the top positions of 'likes' and 'dislikes'. However, percentages vary, and some elements such as 'Motivating students' and stressing the 'Utility and objectives of the subject' can be highlighted in our results. On the other hand, no activities or issues related with SC or about the COVID-19 pandemic were reflected in the students' answers.

4.2. Bipolar Laddering (BLA)

A BLA interview was done to both students' cohorts, 2019–2020 and 2020–2021. Results are shown in terms of positive and negative perceptions. Besides, both data sets are grouped depending on whether they are mentioned by two or more students or just being cited by a single student.

- BLA: 2019–2020 academic year results

Table 2 shows four positive elements cited by two students or more. The table includes a succinct description of each statement and its assessing out of 10. It also includes the average score of each item, and the percentage of students that have mentioned the statement, under the label 'mention index'. Items have been ranked and presented in the table according to their average score. The only statement that has been mentioned by all the students ('Instructors work in the Information System field') achieved the maximum average score (9.60). All items have a very low variance (0.24 or less), except the item about PBL (variance 1.25).

Table 2. 'Information Systems'. 2019–2020 academic year. Positive common elements highlighted by the students (referenced as U1 to U5) who provided feedback.

Item	Description	Average Score	VARP [1]	Mention Index	U1	U2	U3	U4	U5
19PCE1	Instructors work in the I. S. field	9.60	0.24	100%	10	10	9	10	9
19PCE2	An approach to labor market	9.33	0.22	60%	10	9	-	-	9
19PCE3	PBL/Study Case. Hands on	8.50	1.25	80%	8	-	9	7	10
19PCE4	Teamwork	8.00	0.00	40%	8	8	-	-	-

[1] VARP stands for Variance for the Population.

Different suggestions were made to improve each one of the four elements. Item 19PCE1 (both instructors working in the Information System field) was considered "quite difficult to improve" in a greater extent consistently with students' assessment. Item 19PCE2 (the subject is real approach to the labor market) could be improved by means of "including more insights, specifically linked to topics related with the market entrance", or as mentioned by two students by "working on real cases". Item 19PCE3 (using PBL) could be improved "if each group works in different cases" as said by two students, by "developing a real project" or by giving "less theory and more practice". Finally, item 19PCE4 (teamwork) could be enhanced according students by "establishing a competition between groups" or by "mixing students, to increase students' interaction".

Table 3 includes the eight positive elements mentioned only by one of the respondents. The elements identified by the students in this category were ranked with values from 7 to 10.

Table 4 contains the only two negative elements that have been mentioned by at least two students. Despite been considered negative, both items have been scored with values quite close to 5 (in fact, 4 and 5 in each one of the elements).

Table 3. 'Information Systems'. 2019–2020 academic year. Positive particular elements highlighted by the students who provided feedback.

Item	Description	Score	User
19PPE1	Supervising & orientating students	10	U2
19PPE2	Interaction among students & instructors	9	U2
19PPE5	Instructors: labor orientation to students	9	U3
19PPE4	Well-balanced subject: work/ECTS	9	U4
19PPE5	Proposing solutions in an Infor. System context	8.5	U2
19PPE6	Describing I.S. impact on companies	8	U2
19PPE7	Two instructors, two complementary visions	8	U3
19PPE8	A final project to assess the subject	7	U3

Table 4. 'Information Systems'. 2019–2020 academic year. Negative common elements highlighted by the students (referenced as U1 to U5) who provided feedback.

Item	Description	Average Score	VARP	Mention Index	U1	U2	U3	U4	U5
19NCE1	Timetable: non-suitable	4	0.50	80%	5	4	3	-	4
19NCE2	All group deploying the same project	5	0.00	40%	5	-	-	4	5

Students' comments about how to improve the item 19NCE1 (a non-suitable timetable) were: "finishing classes earlier in the evening" or "doing different class sessions of an hour and a half each per week". On the other hand, the element 19NCE2 (all groups working in the same project) two students coincided in their appreciation by saying that it could be improved by means of "doing different projects each group".

Table 5 contains four negative elements, each of them mentioned by a single student. It can be highlighted that an element (19NPE1, 'an excess of traditional classes'), despite been considered negative, was assessed with a score of 6. Item 19NPE4 was reported by a student who did a great job during the course, but failed in the final presentation, as he recognized in the BLA interview.

Table 5. 'Information Systems'. 2019–2020 academic year. Negative particular elements highlighted by the students who provided feedback.

Item	Description	Score	User
19NPE1	Too many 'traditional classes'	6	U5
19NPE2	Non-dynamic classes, because of students' attitudes	4	U3
19NPE3	Contents: too general	4	U4
19NPE4	Subject assessment: final presentation, too much weight	3	U3

- BLA: 2020–2021 academic year results

Table 6 shows the positive common elements identified by the students of the 2020–2021 academic year, while Table 7 shows the positive elements mentioned only by one of them. The positive common results are quite coincident with those showed in Table 2.

Students' comments about how to improve the item 20PCE1 (both instructors working in the Information System field) were: "it is quite difficult to improve", "giving some class sessions with both instructors teaching at class altogether", or "inviting more instructors to teach some specific sessions". When thinking about how to improve the item 20PCE2 (the subject has a great content), students suggested that "it is difficult to improve" or that it could be done by "including more homework about Customer Relationship Management (CRM) and Enterprise Resource Planning (ERP), while minimizing content about

e-commerce, since students already learned this topic in other subjects". Suggestions about how to improve the item 20PCE3 (using PBL) are in line with "doing more short assessing activities", as said by three students. Item 20PCE4 (teamwork) could be improved by "working F2F instead of online" or by "keeping a better track of each one of the students to avoid free-riding". When talking about the element 20PCE5 (interactive classes) students propose "reducing class lecture time while increasing instructor-student interactions" or "reducing theoretical explanations".

Table 6. 'Information Systems'. 2020–2021 academic year. Positive common elements highlighted by the students (referenced as U6 to U10) who provided feedback.

Item	Description	Average Score	VARP	Mention Index	U6	U7	U8	U9	U10
20PCE1	Instructors work in the I. S. field	9.50	0.20	100%	10	9	9	9.5	10
20PCE2	Subject: Great content	9.00	1.00	40%	-	-	10	8	-
20PCE3	PBL. Assessment System	8.67	1.56	60%	-	7	10	-	8
20PCE4	Teamwork	8.00	0.00	40%	8	-	-	-	8
20PCE5	Interactive classes	7.67	0.89	60%	7	7	-	9	-

Table 7. 'Information Systems'. 2020–2021 academic year. Positive particular elements highlighted by the students who provided feedback.

Item	Description	Score	User
20PPE1	A very useful subject	10.0	U7
20PPE2	Instructors: Great teaching skills	10.0	U8
20PPE3	Two instructors, two complementary visions	8.0	U8
20PPE4	Few students per class group	8.5	U9
20PPE5	Students: developing communication skills	7.0	U10
20PPE6	Final Project: open; allowing possibilities	7.0	U10

There was only one negative common element mentioned by the students, as shown in Table 8. Students' comments about how to improve the item 20NCE1 (Final Project centered in CRM) were: "doing a more complex project" or "focusing on CRM and ERT even more".

Table 8. 'Information Systems'. 2020–2021 academic year. Negative common elements highlighted by the students (referenced as U6 to U10) who provided feedback.

Item	Description	Average Score	VARP	Mention Index	U6	U7	U8	U9	U10
20NCE1	Final Project: centered in CRM	3.5	0.25	40%	4	-	-	3	-

Table 9 shows the negative particular items mentioned by only one interviewed student.

Table 9. 'Information Systems'. 2020–2021 academic year. Negative particular elements highlighted by the students who provided feedback.

Item	Description	Score	User
20NPE1	Two instructors	4	U6
20NPE2	More real cases should be presented	4	U7
20NPE3	Few assessment activities	4	U9
20NPE4	Too many 'traditional classes'	3	U10
20NPE5	Timetable: Non-suitable timetable	1	U10

4.3. Open-Ended Questions

Respondents of the 2019–2020 cohort only answered question 1, because they did not experience SC, while the 2020–2021's answered all the three questions. Students' answers to the three open-ended questions are presented, as follows:

- Question 1. Do you think that 'Information Systems' has been a useful subject in the context of the ICT Management Engineering program?

All the students answered in line with the idea that this subject had been very useful: "Very useful. This subject enabled me to understand applied concepts, besides comprehending some tasks that I am supposed to do"; "Very useful. Very important and interesting. In the long term, I would like to manage similar projects. It is very important that this subject is taught by real information systems professionals"; "I have learnt a lot. Theory plus a real application of concepts. One of my best subjects in my engineering studies. Oriented to the labor market. Very interesting for ICT engineering students. Indispensable"; "It is really useful. Even better if some more practical elements were included"; "I t is good to know how things are done in the labor world. An interesting subject, despite it is not indispensable"; "Very useful for an ICT Management Engineering student. I believe I shall study a master program in this line"; "Very useful. It is the most motivating subject of this semester"; "Very useful. We have learnt how different departments work in the real world. This subject should be included in all seven ICT engineering programs at La Salle"; "Very useful for ICT Management Engineering students. I have learnt a lot. Very useful when thinking about accessing to the labor market. A transversal knowledge about companies and businesses is given"; "I do not know if I shall use the content learned in this subject. However, it is a very useful and applicable subject. A very good subject. It gives a whole picture about companies. Highly experienced instructors. A very motivating subject".

- Question 2. What is your opinion about the 'Smart Classroom' system deployed at La Salle URL to cope with the COVID?

Student's answers were: "Very interesting and nicely implemented. It enables us to following classes from home. I have attended a lot of classes in a F2F format, and students that were attending online, could easily interact. Very easy format to use, F2F and online"; "I prefer the F2F format. When you are attending online classes, it is much more difficult to interact and to pay attention. Despite all the commented issues, I have learnt all the explained concepts by the instructors. F2F classes are funnier that online classes"; "Something is lost when attending classes from home. Everybody is comfortable in his own home, but everything is done through a screen. It is more difficult to connect with the other students. However, it has some positive elements: you are comfortably in their home and no commuting time is spent to go to the campus facilities. Instructors can be asked easily. I think that online learning is not an issue in this subject. In subjects where a laboratory is required, this format implies some issues"; "Interacting by means of a screen is a quite cold feeling. Being on-campus in the classroom improves students' experience compared with online formats. Students ask and interact more when they are in the classroom. At home there are a lot of distractions"; "When thinking about different online option, 'Smart classroom' is the best option. However, being in the classroom is better. Some weaknesses of the online format: it is quite difficult to concentrate; you are not in a close contact with the other students, influencing personal mood and attitude. I think that watching a screen during all day is not good, and I feel that on me".

- Question 3. Once you have experienced the 'Smart Classroom' classes ... Do you think that you learn the same by experiencing the classes on- and off-campus?

Students answered this question highlighting different ideas: "When you are at home, sometimes you are reluctant to ask questions because in some cases you are not sure if the topic to be asked has been already explained (because of possible distractions at home). When you are attending classes in the classroom you are more engaged in the class dynamics"; "attending classes in the campus facilities allow a better adaptation from

instructors to each student, since it is easier for the instructor to perceive how the student reacts to class contents. Being in the classroom allows more interaction than online format. Being in the classroom adds more value to what the instructor is explain to the students. Clearly better being in a classroom than experiencing the online format in this subject. I would have enjoyed more this subject in a fully F2F format in the classroom. When learning other subjects, perhaps there is not such a different when doing classes in a classroom or in an online format"; "I have followed all classes online. I have learnt a lot because I have had instructor's' notes in advance. I was able to follow all the explanations without problems in this subject"; "It is easier been concentrated in the F2F format than in the online format. When classes are performed in traditional format there is no problem; when classes are based on discussions and interactions, it is not the same. When we are all in the classroom, motivation is higher and interaction is increased"; "In the online format the learning process is worse, it is slower than in the F2F format. Some positive elements of the online format are: notes and written documents are available in advance; recorded classes are available; you do not need to be fully concentrated to write what is said by instructors or students since class sessions are recorded. However, these advantages have the effect of decreasing the concentration level of the student".

4.4. Emotional Appraisal

Emotional Appraisal questionnaires were done to compare results with different students' cohorts, 2019–2020 and 2020–2021. Table 10 lists the different pairs of antonymous feelings assessed, including the total average of all the pairs of feelings, 76.36% for the academic year 2019–2020 and 85.91% for the 2020–2021 academic year.

Table 10. List of pairs of opposite feelings assessed in the Emotional Appraisal Questionnaire.

Pairs	Emotions	Average 19–20	Average 20–21
PE1	Confidence/Suspicion	85%	90%
PE2	High Quality/Low Quality	90%	95%
PE3	Useful/Useless	85%	95%
PE4	Interesting/Boring	90%	90%
PE5	Known/Unknown	60%	75%
PE6	Comfortable/Uncomfortable	65%	85%
PE7	Attractive/Not Attractive	85%	85%
PE8	Innovative/Conventional	80%	95%
PE9	Simple/Complex	70%	65%
PE10	Nearby/Distant	70%	85%
PE11	Funny/Not Funny	60%	85%

Figure 6 shows all the different pairs of feelings, by means of boxplots, and compares 2019–2020 and 2020–2021 results.

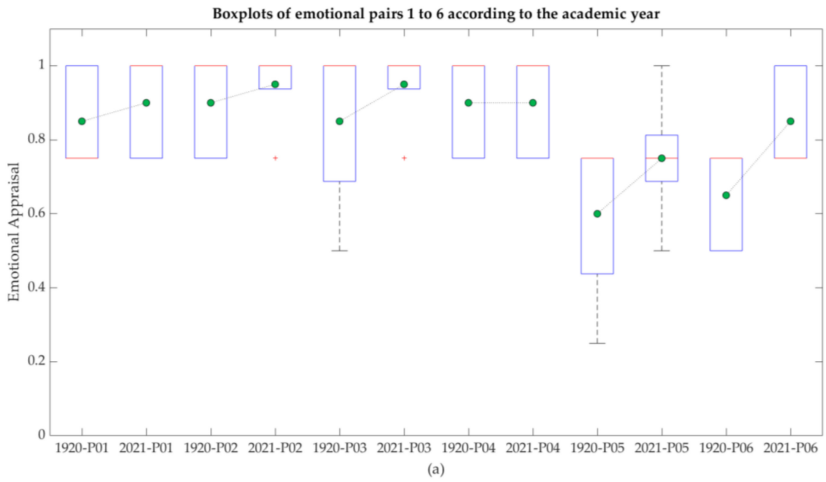

Figure 6. *Cont.*

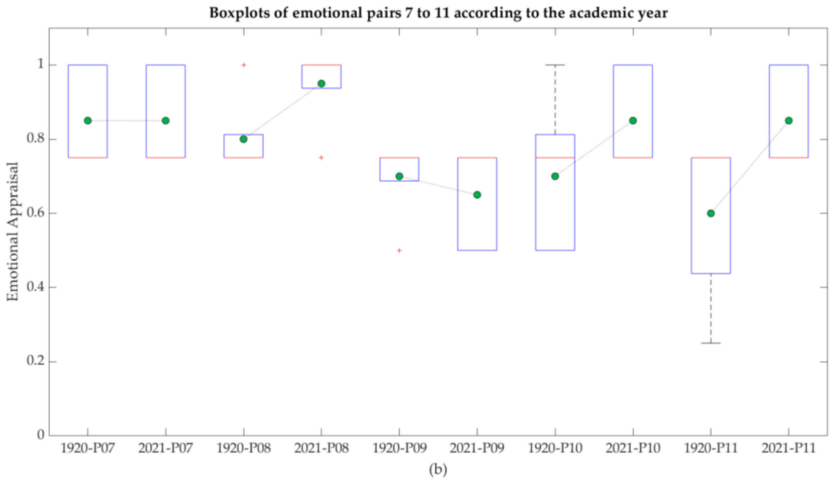

Figure 6. Boxplots: Comparison of 2019–2020 and 2020–2021 Emotional Pairs. The means of each group are marked with green dots. The numbering of the pairs of emotions corresponds to that shown in Table 10. The different subfigures show: (**a**) results from pairs 1 to 6; (**b**) results from pairs 7 to 11.

5. Discussion

This study analyzes students' insights by means of different techniques from a two-fold perspective. On the one hand, the results obtained from the surveys and the interview activities should allow the fine adjustment of the redesign of this fall-semester fourth-year subject imparted in the context of an ICT Management Engineering program. On the other hand, gathered data should give information about students' perceptions on the students' learning experiences when interacting with SC with the objective of identifying positive outcomes while detecting elements that could need an adjustment. Table 11 shows a synthesis of all the items listed in Section 4, rewording and synthesizing students' perceptions about the subject.

Table 11. 'Information Systems': Summarizing and synthesizing students' perceptions.

Element	Pos./Neg.	Items
Instructors work in the Information System field	Pos.	19PCE1; 20PCE1
Instructors: Two complementary visions	Pos.	19PPE7; 20PPE3
Instructors: Supervising & orienting students	Pos.	19PPE1
Subject: Great content & labor oriented	Pos.	19PCE2;19PPE4; 19PPE5; 19PPE6; 20PCE2; 20PPE1
Class methodology: PBL approach	Pos.	19PCE3; 19PPE8; 20PCE3; 20PPE6
Class methodology: Interactive classes	Pos.	19PPE2; 20PCE5
Competences: Teamwork	Pos.	19PCE4; 20PCE4
Competences: Soft skills	Pos.	20PPE2; 20PPE5
Few students per class	Pos.	20PPE4
Timetable: Non-suitable	Neg.	19NCE1; 20NPE5
Final Project: Same project; assessment . . .	Neg.	19NCE2; 20NCE1; 20NPE2; 20NPE3
Too many traditional classes	Neg.	19NPE1; 20NPE4
Non-dynamic classes	Neg.	19NPE2
Contents: Too general	Neg.	19NPE3

5.1. Fine-Tuning of the Subject

The first day of class survey gave information consistent with previous academic works, e.g., [70,73,74]. Students' priorities were concerned with receiving information about the syllabus, class content, the utility of the subject and information about assessment, while beginning subject content. Getting to know their classmates was not highly ranked

in terms of frequency and could be explained since they were fourth-year students, and most of them were of the same cohort and knew each other from a long time ago. Just one student proposed not to exhaust the class time, a result that in other empirical surveys is higher [70,73,74].

Results from BLA are quite consistent when comparing data from 2019–2020 and 2020–2021 academic years (see Table 11). Students greatly appreciate the subject's content, the assessment system and the instructors' performance. PBL is highly valued as a way of working, in line with [30–32]. Besides, an element closely related with the PBL logic, such as teamwork, is also mentioned as a positive element. Timetable appears as one of the weak points of the subject, mainly for students that attended on-campus classes in the 2019–2020 academic year, since classes finished quite late in the evening and they had not the option of attending off-campus classes, as 2020–2021 students had. This element is quite difficult to cope with and it is the price to pay in case of selecting instructors that work in the industrial environment as their main activity, in fact one of the most assessed items by undergraduates. The element that is considered an issue by students is the fact that all students are working on the same project. In fact, the initial approach was that working on the same project could provide different solutions to the same problem, stimulating critical thinking, one of the competences to develop. Further options about the final project should be analyzed.

The answers to the first question about the usefulness of the subject were all very positive, since all the students posited that this subject was very useful. Besides, most of the students perceived that the approach of the instructors to the labor market was highly valuable. In fact, one of the students was thinking about in starting a master's degree oriented in the same topic.

Results about the emotional appraisal can be considered as highly positive, since even though students faced mobility restrictions, at the end of the day they have been able to follow on-campus or off-campus classes on demand. Hence, once experienced the advantages and drawbacks of both formats, 2019–2020 students have had the possibility to select an option to attend on-campus or off-campus, according students' preferences. Results displayed in Figure 6 showed higher levels of positive feelings in almost all the pairs of assessed feelings in 2020–2021 when compared with 2019–2020 results.

5.2. Feedback about 'Smart Classrooms'

As already explained, all the instruments discussed in this paper deal with getting information through open-ended students' responses. So, there are no constraints on the students' answers, a fact that implies getting statements that reflect freely students' opinions, without conditioning their viewpoint. Nevertheless, a potential drawback of these approaches is that in cases where the surveyed people provide no useful information about the topics of interest for the research, no data can be collected about that topic. Here both the mastery and the experience of the interviewer have been key elements to obtain results of interest, when conducting the interviews in a professional manner which avoid influencing students' opinions. Nevertheless, to ensure collecting feedback about the SC format, two open-ended questions specifically oriented to get students' perceptions about SC were introduced at the end of each one of the interviews.

The empirical survey about 'First day of class', instrumentalized by means of two open-ended questions, offered neither opinions nor questions from students on SC or COVID-19 issues. Hence, no spontaneous concerns raised from students about SC during the first day's session. In addition, and just before the start of the classes, several online sessions were held, attended by all the students of each of the seven ICT engineering programs with the different program coordinators. The aim of these sessions was to inform about the academic year, specifically including topics about COVID-19, the different protocols to follow at the university and the use of the SC.

Regarding the 2019–2020 BLA results, no references appeared about SC because it had not been implemented yet or about the COVID-19 issues, since the pandemic did not

exist at that moment and students could finish their academic year attending classes in the campus facilities. However, these results were useful to validate that the subject had been properly designed and that there were no major issues. Since subject did not experienced major changes but the SC, it was 2020–2021 students were going to express their opinion about the subject in the same line (no major issues), allowing to get information about SC minimizing possible bias. An in deep analysis of the obtained results show that while the 2019–2020 students that attended on-line classes majorly complained the about class timetable (80%), just one of the 2020–2021 students (20%) of the 2020–2021 cohort identified timetable as a negative element. This new student's perception could arise from one of the advantages that SC offers: the possibility of attending off-campus campus under students' request, as highlighted in other studies [23]. On the other hand, quite surprisingly, when examining the 2020–2021 BLA survey there are not explicitly references the SC format nor to COVID-19 issues. An explanation of this latter result, once analyzed the two open-ended questions explicitly referred to SC, could be that students were quite satisfied when experiencing off-campus classes though the SC format. Hence, no spontaneous issues about SC raised from the BLA interview, in line with the results obtained by means of the 'First day of class' activity performed during the first day's session.

The explicit question about SC adequacy to cope with the restrictions imposed because of the COVID-19 pandemic gave valuable information about the SC format. In fact, most students preferred to attend on-campus classes, because it is more enjoyable than the online format, especially when dealing with laboratories or offering a better students' experience. Nevertheless, one of the students that have attended most of classes in an online format believed that SC was a very option, making no differences according his perception, attending on-campus or online off-campus classes. However, several students remarked that the SC off-campus format required more efforts to keep on concentrated, while interaction was not as fluid as attending classes on-campus classrooms. Despite some inherent issues of the SC online off-campus format, students consider that this latter option was a very good option, a finding in line with [9]. When talking about specific advantages of experiencing off-campus SC classes, two students said that attending SC off-campus classes allowed remaining comfortably at home, while not spending commuting time by one student.

The third open-ended question asked directly if learning outcomes were the same when attending on-campus or off-campus classes. Some students highlighted several elements that had a negative impact on their learning process when experiencing the SC off-campus classes: An issue highly related to interaction, since that when being off-campus students felt more reluctant to ask questions; lack of concentration; being less motivated; and having less students' engagement. A student stressed the idea that on-campus classes allow a better adaption of instructor to the students, since there were higher levels of verbal and nonverbal communication elements when compared with attending SC off-campus classes, remarking that this issue depended a lot on the nature of each one of the subjects. Another student, that was attending all classes in the SC off-campus online format, said that he had learned a lot because he had had previously available all the written materials in advance. The fact of having written materials in advance, besides the option of having available recorded classes, were considered positive elements to enhance learning according to the viewpoint of a student.

Results about emotions are presented in Figure 6, while Figure 7 allows a visual comparison of both cohorts. In general, there were no great differences between both cohorts. Unexpectedly, classes are perceived as less distant and more enjoyable in 2020–2021 than in the 2019–2020 academic year. Perhaps this result could be explained by the immediately previous experience that student had in the previous semester based on an emergency remote teaching solution, clearly poorer at all levels than the SC solution. However, this latter assumption cannot explain why 2020–2021 have been superior in most of items to 2019–2020 results, when students attended classes in a F2F format. A further research should be done in this casuistic. Not surprisingly, perceptions about comfortability

are higher in 2020–2021 than in 2019–2020 academic year since students had the possibility of choosing attending classes off-campus or on-campus under their own request.

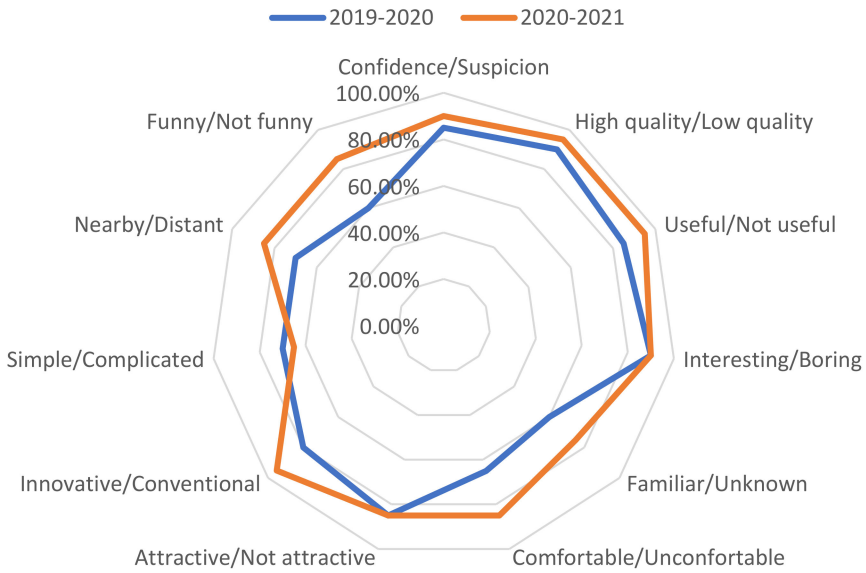

Figure 7. Plot of all pairs of feelings: Comparing 2019–2020 and 2020–2021 results.

5.3. Implications and Initial Findings of the Research

The subject was positively rated by students according to the data collected by means of the BLA interviews. Instructors, who are professionals that develop management roles in the Information Systems field, were highly valued by students. In the same line, the contents of the subject were highly appreciated, the same as the assessment logic based on Project Based Learning. One of the main issues according to the 2019–2020 students' perceptions was the timetable, since the class sessions finish quite late. However, 2020–2021 students reflected no concerns about timetable but for one student. This result may be a direct consequence of the implementation of SC, since attending on-campus or off-campus was an option that students could decide for themselves. The open-ended question about how useful the subject was, confirmed that all students, besides being highly satisfied with the teaching and the content, believed that this subject was likely to be very useful for them in the next future.

5.4. Limitations of the Study and Future Research Directions

In this study, a qualitative approach was employed through getting students' opinions by means of different techniques: A survey during the first day of class; a BLA interview, once students completed their experience on subject completion; three open-ended questions about specific topics when required, and an emotional appraisal questionnaire. All the aforementioned instruments were selected trying to avoid biases, with the aim of trying to keep students' answers as open as possible. Besides, this research was focused on users' perceptions as users once two students' cohorts completed 'Information Systems' while the last cohort has experienced the SC format. When considering the SC format, one of the self-imposed constraints was to perform the research to students that had experienced on-campus classes at the campus facilities, which initially excluded first-year students. So, fourth-year students were the best candidates to survey, since they were the ones that had experienced on-campus classes for a longer time. When analyzing all the different available options, the subject 'Information Systems' was selected, a fourth-year ICT Management engineering subject that was redesigned in the 2019–2020 academic year, a redesign that was highly valued by students as shown in the 2019–2020 BLA survey. Hence, when choosing 'Information Systems', issues derived from the subject itself were not likely to appear in the 2020–2021 BLA survey, as in fact it happened. One of the limitations of the

study was the number of enrolled students, eighteen, a potential issue that was solved by using a BLA interview without limiting the number of responses as a research instrument since this technique provides salient items from few interviews [95]. Further researches should be done to check SC perceptions in first- second- and third-year undergraduate engineering students once experienced management subjects.

6. Conclusions

The final goal of this work was to provide a potentially replicable model to implement redesigns of third- and fourth-year management subjects. A first stage was to implement in the design of the subject appealing and suitable methodologies to learn engineering, such as PBL, according to findings of other research works [30,31]. The second stage was to include students' feedback to refine the design of the subject. Evidences about students' perceptions were collected with the objective of adding additional mechanisms (see Figure 5) to allow the continuous redesign of the subject 'Information Systems'. Additionally, information about students' experience when using a SC was gathered to allow adjusting and improving its usage in the next academic years.

On the one hand, our results show that students of the two different cohorts are highly satisfied with the design of the subject 'Information Systems' according to their user experience appraisal as shown in the interviews from 2019–2020 and 2020–2021 cohorts. On the other hand, 2020–2021 students shed light about the SC format once they had experienced this format, in line with previous findings [9]. In fact, spontaneously they had no comments or complaints about following classes from home via SC. So, pre-planned specific open-ended questions asked after the BLA interview were crucial to get information about the SC format. Most of those students attended classes in the university facilities when possible, in an on-campus SC format. On-campus classes appear to have advantages over the SC off-campus format according to students' perceptions, such as establishing more and better-quality interaction with instructors and other students, or about the class dynamics. Hence, students and instructors should put their efforts into developing new skills to minimize the mentioned limitations that the SC off-campus format has when compared with on-campus classes. However, students valued very positively different aspects that the SC introduced, such as: (1) Being able to follow off-campus classes by means of SC seems to be a very good option to cope with commuting restrictions derived from government limitations in the context of the COVID-19 pandemic or when, as a result of unexpected situation, it is impossible to be on the floor of the classroom; (2) Reviewing class sessions since it allows accessing at a specific class session on student's convenience to watch and review some content that has not been understood by the student.

The obtained findings reflected that despite being on-campus classes the preferred option by students, the SC format in its off-campus format was highly valued as a good and versatile technological solution when facing commuting restrictions, besides offering some specific advantages, such as attending classes remotely or reviewing the specific content of a previously taught class session.

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Informed Consent Statement: Informed consent was obtained and signed from all students involved in the study, except in the 'First Day of Class' survey, where data was collected by means of an anonymous form to be completed on a voluntary basis, once handed in and collected during the first day's session.

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