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Educational Experience through the Lens of Blended Learning: A Conjoint Analysis of Student and Teacher Preferences

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EDUCATIONAL EXPERIENCE THROUGH THE LENS OF BLENDED LEARNING: A CONJOINT ANALYSIS OF STUDENT AND TEACHER PREFERENCES

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Abstract:

The adoption of blended learning in educational institutions has been driven by the growth of educational technology applications and evolving student learning preferences. While prior research highlights the positive impact of blended learning on student outcomes, its effects on student experience and the effectiveness of specific components (student-teacher, student-student, and student-material interactions) remain unclear. In two conjoint experiments, we assessed student and teacher preferences for diverse course configurations with blended learning elements. We show that the introduction of blended learning has a positive effect on the educational experience of students and teachers, yet the effect is non-linear. We test the heterogeneity of these effects across different course, student, and teacher characteristics. Finally, we provide qualitative insights on student and teacher evaluations of blended learning. Based on our findings, we offer recommendations for implementing blended learning, taking into account student learning preferences and teacher workload.

Keywords: blended learning, education, digitization, conjoint study.

I. INTRODUCTION

The rapid advancement of digital technologies has led educational institutions to undergo a digital transformation, integrating digital elements into their curricula [Leidner and Jarvenpaa, 1995; Nguyen et al., 2021]. Such a digital transformation has been reinforced by a new student generation of digital natives who have grown up immersed in digital technologies [Dondi et al., 2022; Henderson et al., 2015]. The digital transformation in education has led to the emergence and increasing adoption of technology-mediated learning, an environment where students interact with their peers, their teachers, and the learning materials through the use of information technologies [Alavi and Leidner, 2001; Vlachopoulos et al., 2023]. Technology-mediated learning has led to significant changes to (a) the way educational institutions operate, (b) the teaching methods employed by educators, and (c) the ways in which students access and interact with learning materials and instructors [Alavi and Leidner, 2001; Pinho et al., 2020]. Current research has contributed to the understanding of how technology can facilitate and transform the teaching and learning process, with a focus on technological and pedagogical aspects that can improve student experience and performance [Ng'ambi, 2013].

Despite the proliferation of digital technologies in education, the adoption of technology by educational institutions has historically been met with hesitance due to the complexity of the transformation process [Aditya et al., 2021; Fraillon et al., 2014]. Recognizing this need, the European Digital Education Action Plan 2021-2027 was developed to promote the establishment of a digital education ecosystem across the European Union [European Union, 2021]. COVID-19 further accelerated the integration of technology into education [Schleicher, 2020], with recent figures highlighting a broad adoption of digital learning tools [Bryant et al., 2020; Nguyen et al., 2021]. A wide variety of digital learning technologies are introduced, such as virtual learning environments, digital teaching tools, student response systems, and digital assessment tools [Lacka et al., 2021].

Technology plays a crucial role in supporting and transforming education, blending traditional and IT-based learning activities for an enhanced experience [Pucciarelli and Kaplan, 2016; Leidner and Jarvenpaa, 1995; Söllner et al., 2018]. The digital transformation in education has paved the way for the implementation of blended learning approaches, which combine traditional face-to-face instruction with technology-mediated learning to enhance the educational experience [Garrison and Kanuka, 2004; Graham, 2006]. Blended learning methods, such as flipping the classroom or use of digital learning tools in physical teaching, were suggested as the next educational innovation frontier since the early 2000s [Driscoll, 2002]. Previous evidence suggests that the adoption of blended learning in education shifts the focus from a teacher-centered to a learner-centered approach, enhancing students' learning experiences and increasing interactions [Bouilheres et al., 2020; Lacka et al., 2021]. As a result, studies showed an increase in student performance and in student engagement with learning materials, peers, and teachers [Albert and Beatty, 2014; Bouilheres et al., 2020].

Previous research has mainly focused on the effects of incorporating blended learning on student learning and engagement [Bulman and Fairlie, 2016], yet there is limited understanding of what is the impact of specific blended learning components on the overall experience and preferences of students. If blended learning increases learning but students do not adopt it, its potential value cannot be realized. At the same time, there is limited focus on how teachers assess this educational perspective. Some studies suggested that teachers would prefer blended learning due to its potential for increasing student autonomy and enhancing interaction [Bouilheres et al., 2020; Staker and Horn, 2012]. Yet, blended learning may be treated with skepticism due to the increased workload, technical issues, and challenges in maintaining student engagement [Garrison and Vaughan, 2008].

This paper aims at bridging this gap and examine the impact of specific blended learning elements on the overall experience of students and teachers. In collaboration with a major European business school, we conducted two conjoint experiments, where we asked students and teachers to evaluate various configurations of a course (varying in the extent of blended learning integration) in terms of preference, learning motivation, concentration, enjoyment, and expected workload. The research design allowed us to measure the utility derived from different levels of blended learning for students and teachers, to identify an optimal way to integrate blended learning. We show that blended learning has a positive impact on student and teacher outcomes, yet the introduction of multiple elements in tandem may backfire. We leverage qualitative insights on the advantages and disadvantages of using technology in education, to better understand the reasons for the non-linear effects.

This study contributes to education and information systems research in several ways. First, this is the first study studying the introduction of specific blended learning elements in education and compares their relative effectiveness. Second, it complements student experience with insights from teachers, a stakeholder often neglected from most studies in education and technology adoption research (Garone et al., 2022). Finally, it expands the understanding of the blended learning experience of both students and teachers by combining a conjoint experiment with qualitative insights on the value of technology in education. The practical relevance of this paper benefits stakeholders in management education (a) by providing insights into students' and teachers' blended learning preferences and (b) by presenting valuable results for teachers who aim to optimize students' learning experience by restructuring their courses.

II. LITERATURE REVIEW

Technology-mediated and blended learning

Due to the rapid technological advances, educational institutions are going through a process of continuous digital transformation by implementing digital tools [Leidner and Jarvenpaa, 1995; Nguyen et al., 2021]. This trend is facilitated by the increasing internet adoption and proliferation of mobile devices in schools [Belo et al., 2016; Criollo et al., 2021]. Educational institutions have adopted technology-mediated learning (TML), an environment where students interact with their peers, their teachers, and the learning materials by blending traditional face-to-face education with the support of online information technologies and digital tools [Alavi and Leidner, 2001; Bower, 2019]. TML on education has the potential to support the flexibility and accessibility of students, and the personalization of their learning experiences [Henrie et al., 2015; Piccoli et al., 2001] and improve learning outcomes, student engagement, and satisfaction [Sharma et al., 2022; Wu et al., 2010].

Blended learning constitutes a significant subset within the realm of TML. Blended learning methods combine educational activities taking place face-to-face or online, and synchronous or asynchronous [Garrison and Kanuka, 2004; Graham 2006]. Blended learning methods aim at improving students' learning experience by increasing their course interactions [Bouilheres et al., 2020]. Research on integrating technology into education and applying blended learning methods emphasizes the importance of educators' knowledge of technology, pedagogy, and course content [Bizami et al., 2023]. Accordingly, the Technology, Pedagogy, and Content Knowledge (TPACK) framework highlights the interactions between these knowledge domains, arguing that blended learning can be optimized at their intersection, where educators can effectively utilize appropriate technologies and pedagogical techniques to enhance students' learning experiences [Koehler and Mishra, 2006].

From a pedagogical perspective, blended learning is an approach that combines various educational activities, such as face-to-face and online interactions, with the aim of improving students' learning experiences and outcomes [Staker and Horn, 2012]. The face-to-face activities take place at a physical location and are supervised by an educational professional. They consist mainly of traditional instruction methods (e.g., lecture) but can also be enriched using various technologies (e.g., digital whiteboard). Online activities in blended learning can be accessed through electronic devices [Staker and Horn, 2012], are typically integrated with the offered face-to-face activities and are predominantly asynchronous. From a technological perspective, blended learning is facilitated by the introduction of various technological tools into educational programs. Laurillard [2013] presents a framework that shows different types of learning methods which can be supported using technology. The learning methods framework can be categorized into three main types of interaction: teacher-student, student-student, and student-content [Laurillard, 2013; Thurmond and Wambach, 2004]. Teacher-student interaction involves acquisition (transfer of content via offline or online lectures) and practice (course activities involving students, e.g., student response systems like Mentimeter). Student-student interaction is facilitated through discussion (discussion forums and peer feedback) and collaboration (creation of shared product using, e.g., Miro). Student-content interaction consists of investigation (students researching topics using various sources) and production of a product (e.g., exam, presentation). By incorporating these learning methods, blended learning can create interactive and engaging educational experiences.

Student learning experience

To properly assess the effectiveness of educational interventions, we should consider the learning outcome and the learning experience of students. Learning outcome is the extent to which the student has acquired the intended learning goal; how much the student absorbs the contents of a course [Alavi and Leidner, 2001]. Previous research showed that blended learning can contribute to enhanced academic performance as students participating in blended learning activities achieved higher grades compared to their peers in traditional classroom settings [Garrison and Kanuka, 2004]. Learning experience refers to the perceptions of students regarding the overall learning process, as well as their assessment of the different components of a course. Understand how students assess their learning experience is essential, as neglecting it may lead to higher dropout rates and reduced engagement of students. As the current generation of students grew surrounded by digital technologies such as mobile phones and social media platforms [Prensky, 2001], they are comfortable using technology to access large amounts of information quickly and efficiently. Their familiarity with rapid information streams has shaped their preferences for interactivity [McGuinness & Vlachopoulos, 2019]. Blended learning allows teachers to increase the interaction between students, teachers, and content [Boelens et al., 2018], catering to these student preferences. Overall, introducing blended learning elements into a course positively impacts the learning motivation, concentration, and enjoyment of students [Ndibalema, 2021; Thurmond and Wambach, 2004], leading to better perceived learning outcomes [Gomez et al., 2010]. Consequently, the attractiveness of the learning experience from a student perspective is enhanced. Moreover, incorporating technology in course programs better prepares students for the 21st-century job market [Dondi et al., 2022].

Yet, it is essential to consider potential limitations of blended learning. Previous evidence suggested issues of technological problems, lack of technical support, and poor infrastructure that can impede student learning in blended environments [Tarafdar et al., 2015]. Further, the excessive use of technology in blended learning can lead to technostress, negatively affecting students' mental well-being and learning performance [Al-Fraihat et al., 2020]. Finally, the individual pace and remote nature of some of the blended learning activities may lead to reduced self-discipline and course engagement [Shivetts, 2011] as well as feelings of social isolation [Thurmond and Wambach, 2004].

Therefore, the integration of blended learning is not a one-size-fits-all endeavour. In line with the array of blended learning elements available, it is important to understand which and how many of these elements to integrate to ensure a positive overall experience of students. Accordingly, a limitation of the existing literature is the narrow focus on the presence or absence of a single blended learning element, rather than a configuration of various blended learning elements [Garrison and Kanuka, 2004]. This may not fully capture the complexity of blended learning environments or provide a comprehensive understanding of which specific elements are most effective.

Teacher experience

To appropriately evaluate the value of any educational intervention, it is essential to understand how all involved stakeholders evaluate and approach it. Therefore, understanding teacher preferences in blended learning is equally important since teachers play a crucial role in designing, implementing, and facilitating effective learning experiences. Considering a teacher perspective allows educational institutions to provide appropriate training, resources, and support to help blended learning integration in courses. Finally, it is essential to get teachers engaged and comfortable with blended learning, as that could lead to the development of engaging and personalized learning experiences for the students, which in turn may lead to better learning outcomes.

Blended learning has received mixed reactions from educators in higher education. Proponents of blended learning emphasize its potential for increasing student autonomy, offering diverse learning opportunities, and enhancing interaction between students and instructors [Staker and Horn, 2012]. However, some teachers express their concerns about increased workload, technical issues, and challenges in maintaining student engagement [Garrison and Vaughan, 2008]. Teacher workload emerges as a critical issue in the context of blended learning. The incorporation of digital resources, monitoring of online discussions, and providing timely feedback in virtual spaces can significantly increase the demands on instructors' time and energy. Yet, research suggests that, over time, blended learning can contribute to a more efficient use of teachers' time and a reduction in their workload (Le & Pham, 2021; Picciano, 2009). This efficiency is achieved through the reusability and adaptability of digital resources, streamlined communication channels, and the potential for asynchronous interactions that allow both students and teachers to engage at their own pace (Staker & Horn, 2012). Furthermore, blended learning models can foster increased collaboration and resource sharing among instructors, further reducing individual workload [Graham, 2006]. For blended learning to be implemented successfully, it is crucial to understand what may be bottlenecks in the adoption of blended learning and which elements may contribute largely to the teacher preferences and their overall experience. Such a perspective has been largely neglected in previous studies.

III. STUDY 1: INVESTIGATING STUDENT PREFERENCES

We conducted a rating-based conjoint experiment with students in a major European business school. Conjoint analysis provides valuable insights into user preferences and has a large history in marketing research [Green and Srinivasan, 1990], yet has been recently adopted by educational studies (Sinha et al. 2021). This method involves presenting respondents with various hypothetical scenarios or products, each characterized by a unique combination of attributes [Louviere et al., 2000]. Conjoint analysis is particularly relevant for education as it can determine the relative importance students attach to particular course (or university program) attributes and the utilities they attach to certain levels of these attributes. Respondents rate each product on a predetermined scale, and the resulting data is used to estimate partworth utilities, which represent the contribution of each attribute level to overall preference. By analyzing partworth utilities, researchers determine the relative importance of attributes and understand trade-offs individuals make between them.

In the context of blended learning, the primary focus of this study was on courses. Therefore, we asked students to evaluate multiple configurations of an elective course offered in terms of intention to choose, learning motivation, concentration, and enjoyment. A course can be characterized by the various activities that are offered to the students. We described the courses based on three actionable attributes; activities that involve a teacher (teacher-student interaction), the guided interaction between students (student-student interaction), and the form of assessment (student-content interaction) [Laurillard, 2013]. For each attribute, three levels were introduced. The low level displayed the most traditional form of the attributes and functions as a benchmark (no blended learning). The medium level added one blended learning element, and the high level added two blended learning elements. The chosen attributes and their corresponding levels are presented in Appendix 1.

We used an orthogonal design to reduce the full factorial design of 3*3*3 (27 conditions) to 9 conditions. Orthogonal designs allowed us to select a subset of conditions that ensures each attribute is statistically independent of the others, reducing multicollinearity and allowing for an efficient estimation of part-worth utilities, and at the same time reducing respondent fatigue and maintaining data quality without compromising the study's ability to uncover meaningful insights into preference structures [Louviere et al., 2000].

The study procedure was as follows (Figure 1). First, students were randomly allocated to either a hard skill course on data analytics, or a soft skill course on digital strategy [Laker and Powell 2011]. In a hypothetical scenario, participants were choosing an elective course for their studies during the following semester. They were shown 9 alternative courses, each on a separate page (teaching staff, time schedules, reading material were similar). Every participant saw the same 9 courses (chosen based on the orthogonal design) in a random order. Participants evaluated each course in terms of their learning motivation, concentration, enjoyment, perceived learning outcome, and the likelihood that they would choose that course for the next semester (in 7-point Likert scale). Next, participants were asked to answer two open text questions regarding the advantages and the disadvantages of the use of technology in education.

242 students participated for a chance of winning a gift card. The demographic information of student participants was in line with the student population of the business school. An overview of the descriptive statistics can be found in Table 1.

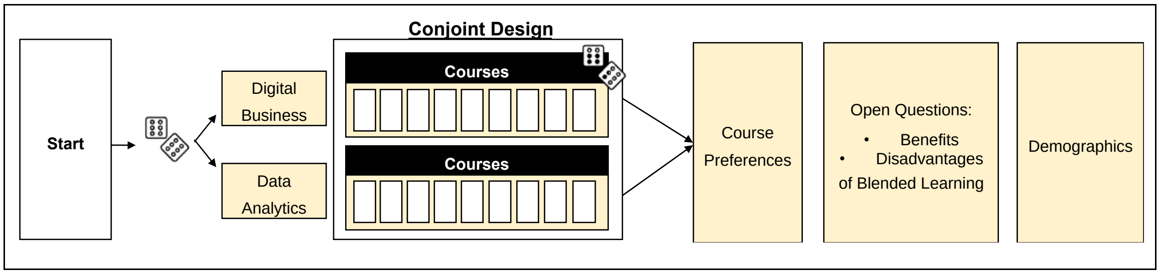


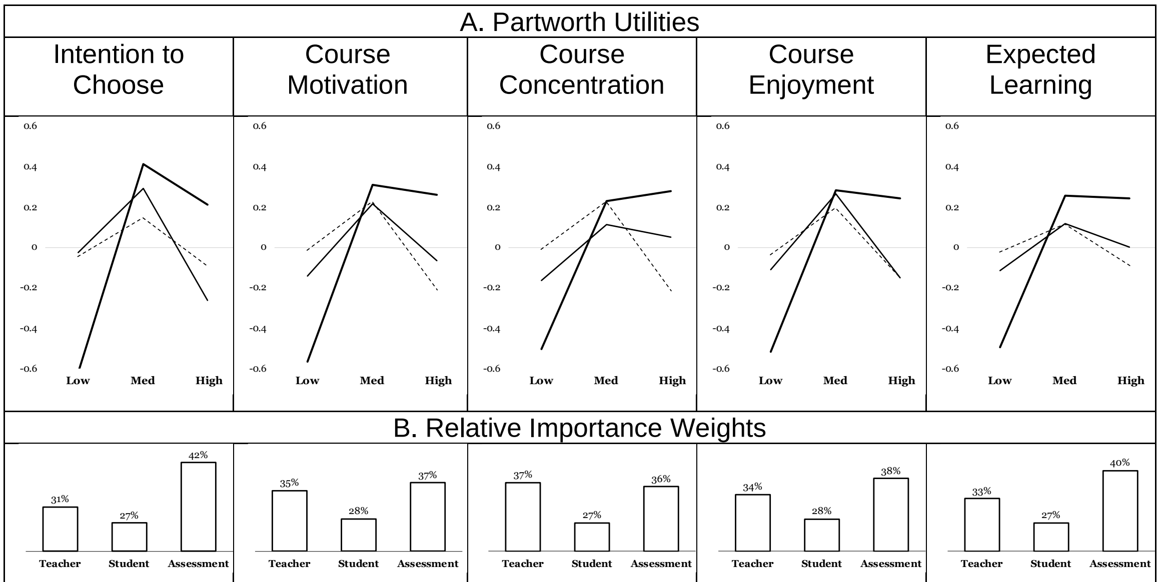
Figure 1: Study Procedure

We first conducted a conjoint analysis to calculate the partworth utilities for each level of each attribute and the attributes' relative importance. Partworths are measuring the utility a level of each respective attribute provides to an individual's overall evaluation of utility (overall value). The utility estimates are interpreted within each attribute: the level with the highest utility estimate yields the highest value for the participants included in the sample, all other things being equal. The relative importance measures how important each attribute is when assessing a course and allows for the identification of the weight of each attribute. We first focus on the likelihood of students to choose the course. We find that the medium levels have been awarded the highest relative utility estimates within each attribute (student-teacher, student-student, and student-content interactions). Interestingly, the introduction of multiple elements of blended learning reduces the value the course offers to students. Such a non-linear effect of blended learning suggests that too many components have the potential to backfire, and students may defer from such courses. Further we find that the choice of a course with blended learning elements is largely driven by the student assessment (42.1%). Similarly, blended learning increases the expected motivation, concentration, enjoyment and expected learning of students, yet the high levels of all course attributes (where multiple blended learning elements are introduced) result in suboptimal evaluations. Student assessment drives the assessment of course motivation, enjoyment, and expected learning, whereas student teacher interactions drive the course concentration. The overview of partworth utilities and relative importance weights can be found in Figure 2.

Table 1: Descriptive Statistics Study 1 and Study 2

	Study 1: Students				Study 2: Teachers			
	Student Level (N=242)				Teacher Level (N=29)			
Variable	Mean	SD	Min	Max	Mean	SD	Min	Max
Age	21.79	2.11	18	25	3.68	0.96	1	6
Female	0.49	0.50	0	1	0.35	0.50	0	1
Education level (MSc)	0.53	0.50	0	1	n/a	n/a	n/a	n/a
Soft Course Preference	4.76	1.68	1	7	5.44	1.47	1	7
Hard Course Preference	4.86	1.53	1	7	6.00	1.44	1	7
	Course Level (N=2178)				Course Level (N=261)			
Course motivation	4.51	1.63	1	7	4.61	1.63	1	7
Course concentration	4.61	1.61	1	7	n/a	n/a	n/a	n/a
Course workload	n/a	n/a	n/a	n/a	4.55	1.61	1	7
Course enjoyment	4.43	1.62	1	7	3.20	1.62	1	7
Course learning	5.06	1.38	1	7	4.60	1.38	1	7
Course choice	4.26	1.76	1	7	3.54	1.76	1	7

We further employed a panel data analysis at a course level allowing us to account for any unobserved individual-specific effects that may vary across participants and offering increased modelling flexibility. The results of both random effects and fixed effects models qualitatively resemble the insights from the conjoint analysis, where the integration of blended learning element is beneficial for all educational outcomes, yet a high number of elements is not necessarily appreciated by students (Table 2). The results are robust when we control for the order in which each course appeared for each participant. Further, we found no interaction effects between the attributes of the courses, suggesting the independence of the different attributes. We found no difference across the course types, or demographic characteristics of students. Finally, to efficiently account for the error correlation across the multiple models of the different educational outcomes and get more accurate and efficient parameter estimates, we employed a seemingly unrelated regressions (SUR) model. The results are robust[1].



NOTES: ---- Teacher Student ▬ Assessment; Teacher: teacher-student interaction / Student: student-student interaction / Assessment: student-content interaction / Utilities are scaled to sum to 0 within each attribute. Hence, we do not test whether the mean utilities are significantly different from 0.

Figure 2: Conjoint Analysis Study 1

Table 2: Panel Data Analysis (Study 1)

DV:	Intention to Choose	Concentration	Enjoyment	Expected Learning	Motivation
Teacher $_{MED}$	0.190** (0.078)	0.234*** (0.070)	0.233*** (0.071)	0.136** (0.058)	0.241*** (0.069)
Teacher $_{HIGH}$	-0.052 (0.078)	-0.208*** (0.070)	-0.114 (0.071)	-0.063 (0.058)	-0.196*** (0.069)
Student $_{MED}$	0.321*** (0.078)	0.278*** (0.070)	0.376*** (0.071)	0.229*** (0.058)	0.355*** (0.069)
Student $_{HIGH}$	-0.237*** (0.078)	0.215*** (0.070)	-0.043 (0.071)	0.113* (0.058)	0.074 (0.069)
Assessment $_{MED}$	1.030*** (0.078)	0.731*** (0.070)	0.796*** (0.071)	0.726*** (0.058)	0.871*** (0.069)

[1] Results are not reported due to length restrictions. They can become available upon request.

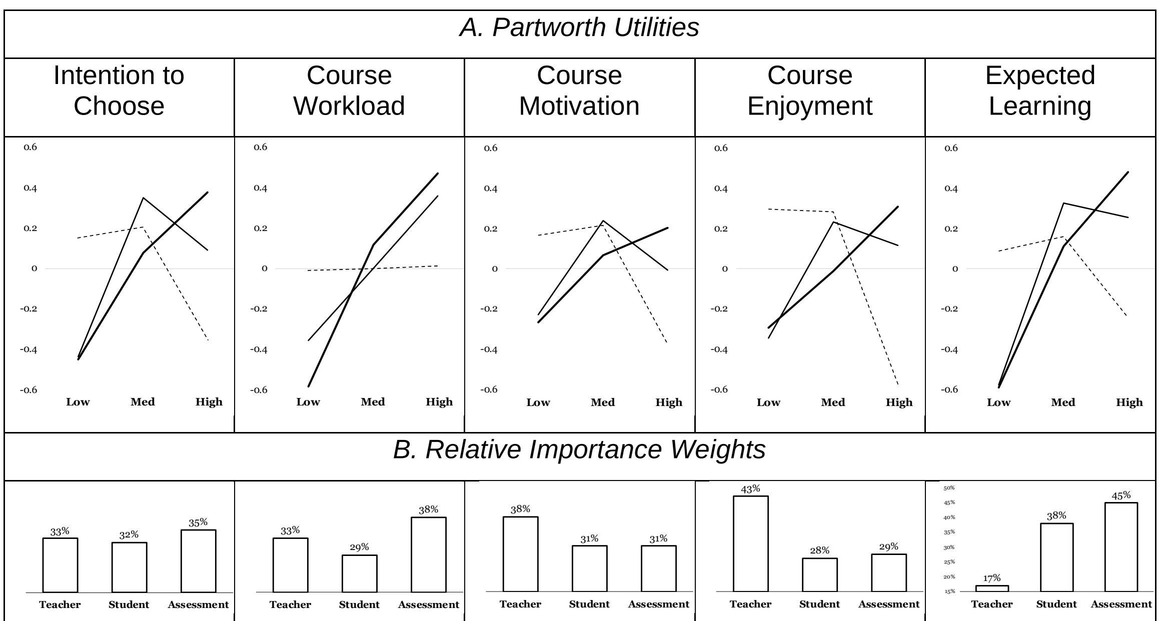
Assessment $_{HIGH}$	0.831*** (0.078)	0.782*** (0.070)	0.756*** (0.071)	0.715*** (0.058)	0.820*** (0.069)
Intercept	3.568*** (0.099)	3.937*** (0.091)	3.758*** (0.091)	4.442*** (0.079)	3.792*** (0.093)
R2	0.08	0.07	0.07	0.07	0.08

*NOTE: Teacher: teacher-student interaction / Student: student-student interaction / Assessment: student-content interaction; Standard errors in parentheses ** p < 0.05, *** p < 0.01 / Random Effects models are presented as recommended by Hausman test / N_{obs}=2178 / N_{group} = 242*

Finally, we analyzed the student responses regarding the advantages and disadvantages of blended learning using Latent Dirichlet Allocation (LDA), a natural language processing technique for probabilistic topic modelling [Blei et al., 2003]. Regarding the advantages, topic modelling identified two topics: (a) flexibility and independence of learning, and (b) efficient and fast paced learning. These topics reflect the fact that the use of technology in education allows students to study in their own pace and more efficiently. Regarding the disadvantages, the identified topics revolved around: (a) lack of motivation and attention, and (b) increased effort and distraction. Both topics reflect the potential decrease of the human contact element in blended learning. We present the methodology and some illustrative quotes from the received answers for each identified topic in Appendix 2.

IV. STUDY 2: INVESTIGATING TEACHER PREFERENCES

We replicated the research design of Study 1, adapting the instructions to a teacher perspective. Teachers were assigned a course, based on the type of courses that they teach. In a hypothetical scenario, they were currently designing a new course for the next academic year. The teachers were asked to assess the same nine courses as in Study 1, based on their teaching motivation, teaching enjoyment, perceived workload, perceived learning outcomes of students, and the likelihood that they would choose the course structure for their new course. 29 teachers from the same major European business school as in Study 1 participated. An overview of the descriptive statistics can be found in Table 2. We followed the same analysis strategy as in Study 1.



NOTES: Teacher Student Assessment; Teacher: teacher-student interaction / Student: student-student interaction / Assessment: student-content interaction / Utilities are scaled to sum to 0 within each attribute. Hence, we do not test whether the mean utilities are significantly different from 0.

Figure 3: Conjoint Analysis Study 2

First, we conducted a conjoint analysis on the likelihood of teachers to choose a specific course configuration for their next course. We found that the medium levels received the highest relative utility estimates for student-teacher and student-student interactions, whereas the inclusion of multiple blended learning elements was preferred by teachers. All attributes had a comparable weight in the choice of teachers. The results for teaching enjoyment, motivation and expected student learning were robust. Whereas for teacher-student interactions, teachers were less motivated and eager to integrate multiple blended learning elements, for the remaining attributes the inclusion of blended learning elements had a positive effect on a course assessment. Interestingly, the relative importance weights varied across the outputs. For teaching enjoyment, teacher responses were strongly driven by student-teacher interactions, whereas for the expected learning of students, the form of assessment had a substantially larger weight. The results regarding the teacher workload provided some very interesting insights. Teachers expected no difference in workload regarding the student-teacher interactions, whereas for the interaction between students and the assessment, teachers expected an increasing workload with each increase in the implementation of blended learning elements in a course.

We enriched the analyses leveraging the panel data structure of the teacher responses. The results of both random effects and fixed effects models were qualitatively in line with the insights from the conjoint analysis (Table 3). For activities involving teacher to student interaction, the inclusion of multiple blended learning elements had a negative effect and was less preferred. Regarding the student-student interaction, adding multiple blended learning elements had an inferior positive effect compared to no interaction at all. Finally, the inclusion of multiple elements in the assessment increased the utility of a course, signalling the preference of teachers to spread the assessment components to capture different levels of learning. The results for the teaching enjoyment and motivation, as well as the expected student learning indicated comparable effects. For teacher-student interactions, whereas introducing one blended learning element marginally improved the course assessment, introducing multiple blended learning elements had a detrimental effect on how teachers assess the course. However, for student-student interactions and assessment form, the inclusion of more blended learning elements increased the teachers' assessments. Finally, we found that the inclusion of blended learning elements increased the expected workload of teachers for student-student interaction and the assessment. This was in line with the normative expectation regarding the effort needed to set up such processes within a course as these require an effort investment in advance. The results were robust when we controlled for the course order. Further, we found no interaction effects between the attributes of the courses, across the course types, or across demographic characteristics of teachers. Finally, to efficiently account for the error correlation across the multiple models of the different educational outcomes and get more accurate and efficient parameter estimates, we employed a seemingly unrelated regressions (SUR) model. The results were robust.[2]

Table 3: Panel Data Analysis (Study 2)

DV:	Intention to Choose	Expected Workload	Teaching Enjoyment	Expected (student) Learning	Teaching Motivation
Teacher $_{MED}$	0.046 (0.211)	0.011 (0.178)	-0.011 (0.164)	0.069 (0.159)	0.046 (0.165)
Teacher $_{HIGH}$	-0.471** (0.211)	0.023 (0.178)	-0.782*** (0.164)	-0.322** (0.159)	-0.506*** (0.165)
Student $_{MED}$	0.736*** (0.211)	0.356** (0.178)	0.517*** (0.164)	0.874*** (0.159)	0.437*** (0.165)
Student $_{HIGH}$	0.494** (0.211)	0.713*** (0.178)	0.414** (0.164)	0.805*** (0.159)	0.207 (0.165)

[2] Results are not reported due to length restrictions. They can become available upon request.

Assessment MED	0.494** (0.211)	0.701*** (0.178)	0.253 (0.164)	0.678*** (0.159)	0.310* (0.165)
Assessment HIGH	0.770*** (0.211)	1.057*** (0.178)	0.540*** (0.164)	1.034*** (0.159)	0.437*** (0.165)
Intercept	2.824*** (0.306)	3.805*** (0.254)	4.230*** (0.237)	3.536*** (0.235)	4.295*** (0.252)
R^2	0.08	0.12	0.11	0.17	0.06
*NOTE: Teacher: teacher-student interaction / Student: student-student interaction / Assessment: student-content interaction; Standard errors in parentheses ** p < 0.05, *** p < 0.01 / Random Effects models are presented as recommended by Hausman test / N_{obs}=261 / N_{group} = 29*					

Next, we analyzed the teacher responses regarding the advantages and disadvantages of blended learning using LDA [Blei et al., 2003]. Regarding the advantages, topic modelling identified two topics for teachers: (a) teaching support and (b) efficiency. These topics reflect how the use of technology may facilitate teachers through increased interactions and efficient usage of digital resources. Regarding the disadvantages, the identified topics revolved around: (a) lack of human interaction, and (b) increased workload. Both topics reflect concerns over the increased workload of blended learning and the lack of student engagement the remote nature of blended learning brings. We present the analysis in Appendix 2.

V. DISCUSSION

The digital transformation in education has facilitated the adoption of blended learning, an educational practice which combines traditional face-to-face instruction with technology-mediated learning [Graham 2006]. Previous research showcased the potential of blended learning in improving students' engagement and learning outcomes [Garrison and Kanuka, 2004], yet it lacked focus on specific elements of blended learning and how these impact the overall student experience. Yet, teachers have been largely neglected from blended learning studies. This paper bridges the existing gap by exploring the influence of specific blended learning components on the comprehensive experiences of both students and teachers. In two experiments with students and teachers from a major European school, we analyzed preferences for various levels of blended learning across three attributes: teacher-student interaction, student-student interaction, and student-content interaction.

In study 1, we found that students positively value the inclusion of blended learning elements in a course. In that respect, they expect to be more concentrated, and motivated to follow such a course, and they report a high expected enjoyment. Further we find that the expected value of a course is largely driven by the way students are assessed rather than the expected interactions with teaching stuff or peers. Remarkably, we show that the effect of the introduction of blended learning components in a course on different measures of students' learning experience is not linear. We suggest that there is an optimal level beyond which the benefits of blended learning may diminish or even become detrimental to the overall learning experience. The study highlights the importance of examining the overall student experience, rather than focusing solely on academic outcomes (e.g., grades) when considering the integration of blended learning. By assessing aspects such as learning motivation, concentration, enjoyment, and perceived learning, we provide a comprehensive overview of the impact of blended learning on students [Ndibalema, 2021]. Such an approach enables educators and institutions to make more informed decisions when implementing blended learning, ensuring that the approach not only supports academic achievement but also fosters a positive and engaging learning environment for students.

In study 2, we conducted a follow up experiment with teachers at the same business school. We found that that while implementing blended learning elements increases their workload, teachers generally prefer blended learning to traditional education, demonstrating a willingness to experiment with blended learning elements. Teacher preferences for blended learning elements offer interesting insights in terms of workload, teaching motivation, and enjoyment. Teachers tend to prefer traditional methods due to the potential time and effort required to integrate technology into their educational programs [Prensky, 2001; Chulkov, 2017; Gupta et al., 2020]. In conclusion, teachers are open to adopting blended learning methods, recognizing their potential benefits for student outcomes. However, concerns about workload and the challenges of implementing new technologies remain. Addressing these concerns and providing support for teachers can help facilitate the successful integration of blended learning elements into educational programs.

From an educational institution perspective, it is important to consider both students and teachers, as the main actors in the educational experience. To optimize higher education from a student perspective, educational institutions should focus on striking a balance, using technology to support the frequency and personalization of face-to-face interactions without replacing them entirely. This finding suggests that an optimal balance between traditional and technology-enhanced learning methods can lead to a more effective and engaging educational experience for students. In that respect, it is essential to approach blended learning as a complex system with multiple elements instead of a one size fits all endeavour. Similarly, educational institutions should consider teacher preferences as well as the expected workload from the implementation of blended learning. The insights from the two studies allow us to match the preferences of both groups to provide recommendations for an optimal configuration of blended learning implementation. We plotted the student and teacher preferences for all combinations of attribute levels in a course. We find that the course configuration that maximize the utility of both groups is a course which combines face-to-face lectures with student response system (e.g., Mentimeter), supported Q&A sessions, online discussion forum for voluntary interaction between students, and spreads the assessment form across traditional exam, weekly quizzes, and student presentation (Figure 4a). A comparable recommendation can be given when looking at student utility in contrast to the expected teacher workload (Figure 4b).

This research has several implications for the existing IS and educational literature on blended learning. First, this is the first study which examines the introduction of specific blended learning elements in higher education and compares their relative effectiveness. Previous studies focused on the introduction of blended learning in a uniform way, without focusing on the type of elements to be implemented. Moreover, whereas most studies focus on the impact of blended learning on academic performance, we analyze its impact on a multitude of outcomes which all shape different perspective of the overall learning experience from a course. Second, we incorporate insights from teachers, frequently overlooked in education and technology adoption research. Finally, we enrich our comprehension of the blended learning experience with the use of qualitative insights from participants. The managerial relevance of the study is twofold. First, it provides value for educational institutions by offering insights into students' and teachers' blended learning preferences and suggestions for enhancing knowledge exchange. Second, it presents valuable findings for instructors seeking to optimize the learning experience by reorganizing curricula or specific courses. We stress out the need to provide teachers with comprehensive training, resources, and ongoing support.

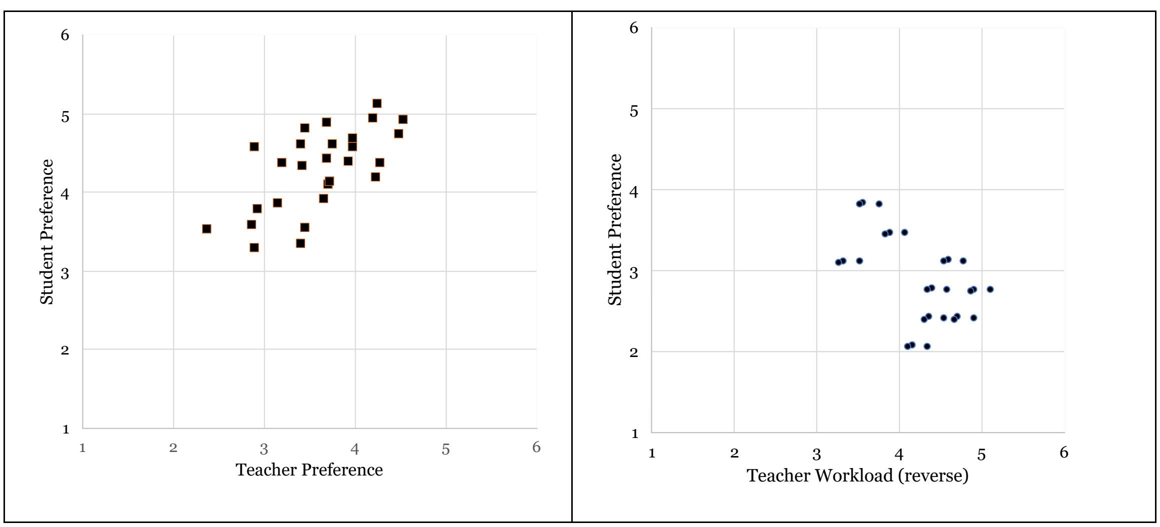


Figure 4: Optimizing student-teacher perspectives.

The study has some limitations which offer great potential for further research. First, the findings could be generalized by drawing from a long list of blended learning elements available for teachers. Moreover, we operationalized the levels of blended learning in an additive way, so that a high level of e.g., student-teacher interaction is including one extra component of blended learning in top of the medium level. Future research could explore the trade-off between quantity (how many) and quality (which ones) of blended learning elements to identify an optimal way of integrating it in a course. Second, the conjoint analyses rely on self-reported data from students and teachers, which may not accurately reflect actual behavior or rational decision-making. Future research could examine changes in behavior and learning through field experiments. Third, future research can replicate these studies across different faculties (e.g., technical universities) or different countries (study culture may vary across countries). Exploring these research directions will contribute to a more comprehensive understanding of the optimal implementation of blended learning in various educational settings. In conclusion, the study demonstrates that blended learning can effectively enhance various aspects of the learning experience when implemented in a balanced manner, considering the type of interaction and the specific needs and preferences of students and teaching faculty. As in most cases of technology adoption, there should be careful steps in integrating it to balance the advantages with the potential negative implication for the users.

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APPENDIX I. ATTRIBUTES AND LEVELS OF BLENDED LEARNING

For teacher-student interaction, a low level consists of a traditional (non-blended) form of interaction (face-to-face lectures and Q&A sessions). A medium level introduces the use of a student response system (SRS; e.g., Mentimeter) [Majuri et al., 2018]. A high level adds a flipped classroom approach, by enabling students to watch pre-recorded video lectures and discuss the materials in detail during Q&A sessions with the use of an SRS. Student-student interaction can still occur in the classroom, but not explicitly structured via course activities. Yet, digital tools provide teachers with opportunities for a structured student – student interaction, e.g., via a discussion board [Balaji and Chakrabarti, 2010]. The low level entails no teacher guidance. The medium level includes an online discussion board with voluntary participation. The high level contains an online discussion board with a mandatory participation. Regarding the assessment, the low level consists of an offline exam, accounting for 100% of the final grade. The medium level introduces weekly online quizzes [Gholami and Moghaddam, 2013] and the high level a video presentation.

Table A1. Attributes and levels of blended learning

Attribute	Level of blended learning
1. Activities involving teachers	1. Low: Face-to-face lectures and Q&A sessions 2. Medium: Face-to-face lectures and Q&A sessions with a student response system (e.g., Mentimeter) 3. High: Pre-recorded video lectures and face-to-face Q&A sessions with a student response system (e.g., Mentimeter)
2. Guided interaction between students	1. Low: No structured interaction between students 2. Medium: Online discussion forum for voluntary interaction between students

	3. High: Online discussion forum for mandatory, supervised interaction between students
3. Form of assessment	1. Low: Traditional exam (100%) 2. Medium: Traditional exam (60%) and weekly quizzes (40%) 3. High: Traditional exam (40%), weekly quizzes (30%), and video presentation (30%)

APPENDIX 2. ADVANTAGES & DISADVANTAGES OF BLENDED LEARNING

Participants were asked two open text questions regarding their opinion on the advantages and the disadvantages of the use of technology in education. To compute and categorize the topics raised by participants, we use Latent Dirichlet Allocation (LDA), a natural language processing technique for probabilistic topic modelling [Blei et al., 2003]. LDA assumes that each document is a mixture of topics generated from a Dirichlet distribution. In our context, a document is a participant answer to the open text questions. We preprocessed the text of each answer by tokenization and removing the stop words (e.g., "a", "the", "of", "and") as they provide limited semantic value. Next, to determine the optimal number of topics, we calculated the coherence and perplexity scores of the LDA model for a range of 2 to 15 topics. Based on the trade-off between coherence and perplexity scores, we selected the model with 2 topics for analysis. To confirm the meaningfulness of each topic and assign a topic label, we examined the top words of each topic.

First, we conducted the analysis using student responses (Study 1). Regarding the advantages, the two identified topics concentrate around: (a) flexibility and independence of learning, and (b) efficient and fast paced learning. These two topics reflect the fact that the use of technology in education allows students to study in their own pace and more efficiently. We followed the same procedure to identify the disadvantages of blended learning. The respective identified topics revolve around: (a) lack of motivation and attention, and (b) increased effort and distraction. Both topics reflect the potential decrease of the human contact element in blended learning. Table A2 presents illustrative quotes from the received answers for each identified topic.

Second, we conducted the analysis using teacher responses (Study 2). Regarding the advantages, topic modelling identified two topics for teachers: (a) teaching support and (b) teaching efficiency. The topics reflect how the use of technology in education facilitates teachers, specially through the streamlined communication, asynchronous interactions, and the reuse and adaptation of digital resources [Picciano, 2009]. Regarding the disadvantages, the identified topics are: (a) lack of human interaction, and (b) increased workload. Both topics mirror concerns expressed by teaching faculty over workload, technical issues, and challenges in maintaining student engagement [Garrison and Vaughan, 2008]. Table A3 presents illustrative quotes for each identified topic.

Table A2. Advantages and disadvantages of blended learning (quotes from students)

Advantages	**Disadvantages**
Topic #1: Learning flexibility / independence	*Topic #1: lack of motivation and attention*
• *"Flexibility in terms of student participation and time management, combined with additional possibilities for course material demonstration and learning."* • *"…freedom and independence for students, possibilities to combine studies with other activities more easily"*	• *"The attention span is decreased, as you have no control of keeping people's attention if they are seated behind a screen."* • *"Less interaction is not motivating students to keep up with their work."* • *"Creates a distance between students and teachers. Less able to ask specific questions during lectures."*

Topic #2: efficient and fast paced learning	*Topic #2: increased effort and distraction*
• *"It is a faster way to communicate with other students. For me technology makes it easier to study also."* • *"…connect with the younger generation. The lack of technology in a degree would seem "old fashioned" and less appealing."*	• *"Sometimes technology can be hard to grasp, and while a student may understand the subject matter, he or she may not be able to convey that understanding because of a lack of technological skills."* • *"Sometimes it might be distracting in the form of getting taught via a laptop and on that laptop there are different things to do rather than studying."*

Table A3. Advantages and disadvantages of blended learning (quotes from teachers)

Advantages	**Disadvantages**
Topic #1: Teaching support	*Topic #1:Lack of human interaction*
• *"reduces workload, or gives opportunities for interaction that would have not been present otherwise, facilitates assessment"* • *"support teaching; stimulate and activate students…it makes grading super simple"*	• *"Lack of direct human communication"* • *"Anonymity and absenting."* • *"Hard to make it professional, no interaction."*
Topic #2: Teaching efficiency	*Topic #2: Increased workload*
• *"Repeated access to the study materials, flexibility of time and location"* • *"Enable self-learning, make it fun, complement face-to-face sessions"* • *"…allows for interesting explanatory media to be used, allows for the delivery of a well structured content"*	• *"Often additional work to set things up, students might have trouble using the technology."* • *"It takes more planning and setup time than traditional methods. There are so many tools available, I often feel that I am not always using the right tool for the job I need to be done."*