

Utility perception on virtual learning environments used in Brazilian blended learning

Percepção de utilidade sobre ambientes virtuais de aprendizagem utilizados no blended learning brasileiro

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Abstract

This research aimed to use a data collection instrument, previously proposed, with the purpose of evaluating 11 different factors related to the perception of self-declared utility by users of a virtual learning environment and its information and communication technologies, as pedagogical resources used in the implementation of the blended learning methodology. Based on descriptive statistics and the application of the non-parametric test of Wilcoxon posts, a comparative assessment was carried out between the levels of utility perceived by 71 students and their teachers, in three curricular components of different undergraduate courses of a public university in the state from São Paulo. In addition, Cronbach's alpha coefficient was used to measure the reliability of the data collection instrument used in this research. At the end of this study, it was observed that, although the subjects included in the sample of this research present different levels of perception of utility for most of the factors analyzed, there is a certain degree of convergence in relation to the factors considered most relevant by both, that is, teachers and students attributed a greater perception of usefulness to factors such as interaction and complementarity between classroom and online content, and also to the general utility of information and communication technologies in the respective virtual learning environment. In the specific case of students, the interaction between teacher and student was also considered as one of the most important factors, in the three undergraduate courses analyzed.

Keywords: ICT. VLE. BL. Quantitative methods applied.

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Resumo

Esta pesquisa teve por objetivo utilizar um instrumento de coleta de dados, já proposto anteriormente, com a finalidade de avaliar 11 diferentes fatores relacionados à percepção de utilidade autodeclarada por usuários de um ambiente virtual de aprendizagem e suas tecnologias de informação e comunicação, enquanto recursos pedagógicos utilizados na implementação da metodologia de ensino híbrido (*blended learning*). A partir de estatísticas descritivas e da aplicação do teste não paramétrico de postos de Wilcoxon, foi realizada a avaliação comparativa entre os níveis de utilidade percebida por 71 alunos e seus professores, em 3 componentes curriculares de cursos de graduação distintos de uma universidade pública do estado de São Paulo. Além disso, foi utilizado o coeficiente alfa de Cronbach para avaliar a confiabilidade do instrumento de coleta de dados utilizado nesta pesquisa. Ao final deste estudo, pôde-se observar que, apesar dos alunos e professores integrantes da amostra desta pesquisa apresentarem níveis de percepção de utilidade diferentes para a maioria dos fatores analisados, existe certo grau de convergência em relação aos fatores considerados mais relevantes por ambos. Nesse sentido, professores e alunos atribuíram maior percepção de utilidade a fatores como interação e complementariedade entre o conteúdo presencial e *on-line* e, ainda, à utilidade geral das tecnologias de informação e comunicação do respectivo ambiente virtual de aprendizagem. No caso específico dos alunos, a interação entre professor e aluno também foi considerada como um dos fatores mais importantes nos três cursos de graduação analisados.

Palavras-chave: TIC. AVA. BL. Métodos quantitativos aplicados.

Introduction

The implementation of hybrid teaching methodology or blended learning (BL), as it is best known, in higher education has become increasingly frequent (SHU; GU, 2018). However, the success of this teaching methodology does not just stem from the use of a virtual learning environment (VLE) and its information and communication technologies (ICT) in conjunction with face-to-face teaching; that is, the adoption of BL in higher education requires the implementation of different teaching methods and the introduction of innovations in the teaching and learning process (LÓPEZ-PÉREZ; PÉREZ-LÓPEZ; RODRÍGUEZ-ARIZA, 2011).

On the other hand, the use of new technologies (VLE and ICT), through BL, in situations where the number of students is very high can offer good opportunities for access and production of knowledge (LÓPEZ-PÉREZ; PÉREZ-LÓPEZ; RODRÍGUEZ-ARIZA, 2011).

Regardless of the advantages of using teaching and learning techniques and methods in the hybrid model (BL), both the characteristics related to students and teachers and the VLE and ICT used have an impact on the perception of the utility of BL for the teaching and learning process in the educational curricular components in which this methodology is employed. And this, in turn, requires tools for evaluating this perception of utility for this purpose. However, the literature on this subject has offered few resources focused on VLE evaluation and its ICTs used in BL (RAES *et al.*, 2020).

In this context, Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) proposed and used a data collection tool - in the form of a questionnaire - evaluating a series of factors related to the utility perception, self-declared by students and teachers, about two different VLE (Google Classroom and TIDIA-Ae), and their ICTs, used in the BL model.

The instrument in question allowed evaluating factors related to 11 different characteristics of both VLE, that is: the ease of use of the VLE; the process of interaction between face-to-face and off-campus moments; the perception of the utility of the activities for the process of teaching and learning; the degree of motivation and interest self-declared by the studies developed online; the degree of utility and diversification of activities developed online; the interaction between teacher and student; the interaction between teacher and VLE; the interaction between students themselves; levels of student participation and involvement in online activities; interaction and complementarity between the content developed in-person and online; and, the perception of the general utility of the ICTs and VLEs (CANEPPELE; CARMO; CARMO, 2019; CARMO *et al.*, 2019).

Although the data collection instrument initially proposed by Caneppele, Carmo, and Carmo (2019) was used to evaluate a different VLE from the study by Carmo *et al.* (2019), i.e., Google Classroom and TIDIA-Ae, respectively, both surveys were conducted with a very small number of students in the context of the postgraduate *stricto sensu*.

In this context, this research aimed to use the collection instrument proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019), applying it to three different groups of students from a public university in the state of São Paulo. To assess the perception of self-declared utility of the respective students and teachers about the contribution of a free use VLE (Moodle) and its ICTs to the teaching and learning process of curricular components taught in the BL model, and also, using a sample of research more significant than those of previous studies (CANEPPELE; CARMO; CARMO, 2019; CARMO *et al.*, 2019). Thus, the reliability analysis of the mentioned data collection tool (questionnaire) was carried out in the context of undergraduate studies in higher education.

For this purpose, initially, a research was carried out to understand some critical variables of the BL process. The results of the study developed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) were also analyzed, focusing on the data collection instrument used in these two scientific investigations, as described in section 2 of this article.

Then, the methodology of the study and data analysis used in this scientific investigation was addressed and described, and also the analytical methodology used to assess the degree of reliability of the data collection instrument developed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019), as detailed in section 3 of this study.

Section 4 of this study aimed at the presentation and analysis of the results of this scientific research.

Finally, in section 5, the final considerations about this research process were made and suggestions for its continuity were made to contribute to the debate related to the use of VLE and ICT in the teaching and learning process in the BL model, and also in the identification of data collection instruments capable of evaluating this type of educational technology used in BL.

The present research is justified by the fact that it allows evaluating the use of a new data collection instrument (CANEPPELE; CARMO; CARMO, 2019; CARMO *et al.*, 2019) from two different perspectives: first, since up to now the questionnaire in question has only been applied to surveys involving postgraduate students *stricto sensu*, one can see the possibility of evaluating it in a different educational context, i.e., in higher education; second, since the reliability of the data collection instrument aimed at evaluating the perception of self-

declared utility about VLE and ICT used in the BL has not yet been evaluated, due to the small number of respondents in which it has been applied up to now, one can see the possibility of using a more significant group of respondents. Thus, in addition to greater quantity, there is higher heterogeneity since the data sample of this research was composed of the answers provided by several students and professors from three different classes, in different undergraduate courses of a public university in the state of São Paulo.

Theoretical background

López-Pérez, Pérez-López, and Rodríguez-Ariza (2011) observe that learning in the BL model can be evaluated from several perspectives. However, the most commonly analyzed are utility, motivation, and satisfaction.

Shu and Gu (2018) point out that, although it can already be considered a methodology widely used in higher education, with well-developed analyses and studies about its characteristics, models, and strategies, little research has been done about the interactions between students and their different forms of occurrence in BL, as well as the interactions between online and face-to-face sessions.

Regarding the perception of the several variables involved in the process of knowledge construction from the BL model, Han and Ellis (2019) state that how students conceive and perceive the teaching and learning process influences their learning outcomes. Thus, in turn, it can influence their perception of utility about the respective teaching mode.

Boelens, Voet, and Wever (2018) highlight that most students in higher education have different characteristics, interests, motivations for learning, and previous educational experiences. Thus, VLE and their ICTs need to provide interactions to improve the learning quality using this type of resource applied to the teaching and learning process.

The alternation and complementarity between online and face-to-face learning provides autonomy for students. But, at the same time, it requires the development of skills related to self-regulation of learning, also requiring a certain degree of customization of learning support, as stated by Vanslambrouck *et al.* (2019).

In proposing an evaluation framework for BL programs from a broader perspective, Chmiel, Shaha, and Schneider (2017) argue that this type of evaluation usually focuses on students, teachers, and technological or institutional aspects. However, it would be necessary to involve the respective administrative teams as well, because, in addition to requiring an integrative evaluation, the BL evaluation process should improve teaching and learning both at the level of the curricular components and a general level from the perspective of the course as a whole.

From the perspective of BL experience and teaching interaction, Chmiel, Shaha, and Schneider (2017) observed that, despite the inherent benefits of expanding student autonomy, there was a certain distance between students and each other, which was not the case in fully face-to-face teaching. Such evidence may indicate the need to contemplate the variables related to teacher interaction in the process of evaluating the perception of tools used in BL (VLE and its ICTs).

When evaluating the perception of added value about online social interaction in the BL model for post-graduate health professionals, Westerlaken *et al.* (2019) observed a higher

perception of utility in online activities. According to the study, this was due to greater collaboration and interaction between students. Besides, a certain value is due to the interaction of moderators and teachers of the course. The authors also pointed out that the alignment between online and face-to-face components and content was one priority of the professionals and students in their research.

Caneppele, Carmo, and Carmo (2019) investigated the perception of the utility of students and teachers participating in a postgraduate course *stricto sensu* belonging to the Faculty of Agronomic Sciences of the Universidade Estadual Paulista "Júlio de Mesquita Filho" (UNESP), in the city of Botucatu-SP (Brazil). The study was about the use of the online platform Google Classroom in the process of teaching and learning a subject taught in the BL model.

Using descriptive statistics and non-parametric tests, Caneppele, Carmo, and Carmo (2019) found that the perception of utility about the VLE used in the BL model obtained an overall average of more than 75% of approval. Both for the students and the point of view of the teacher responsible for the subject in question.

After making small changes to the collection instrument initially proposed by Caneppele, Carmo, and Carmo (2019), Carmo *et al.* (2019) assessed the levels of perceived and self-declared utility about the contribution of the Information Technology system in the Development of the Advanced Electronic Internet (TIDIA Ae) in the teaching and learning process of a subject taught in the BL model in the *stricto sensu* post-graduation course of the Faculty of Animal Science and Food Engineering of the University of São Paulo (USP) of the city of Pirassununga-SP.

Carmo *et al.* (2019) observed that, at different levels, students and teachers perceived the positive contribution of TIDIA Ae to social interaction in the course, which contributed significantly to the process of teaching and learning in the BL model.

Despite evaluating different VLEs and their respective ICTs (Google Classroom and TIDIA Ae), the data collection tool proposed by Caneppele, Carmo, and Carmo (2019) and adjusted by Carmo *et al.* (2019) allowed inferences about the perception of 11 different VLE related factors used in the BL process in the *stricto sensu* graduate course.

For this purpose, Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) prepared a questionnaire to evaluate the self-declared perception of the utility, in which 11 affirmatives are presented to the interviewees and these, in turn, assign scores from 0 (zero) to 10 (ten) individually for each affirmative, according to the respective concordances, as described in Table 1.

Table 1 – Description of the instrument used for data collection

Item	Affirmative presented to the students	Affirmative presented to the teacher	Factor Appraised
1	Navigation in the "VLE" and its use can be considered easy	As a teacher, I realized that navigating the "VLE" and using it can be considered easy	Ease of use
2	The use of the "VLE" in the course helped me to keep up with my studies even when there was no face-to-face class; therefore, there was the interaction between the	As a teacher, I noticed that the use of the "VLE" in the course helped me to keep up with the students even when there was no face-to-face class. Therefore, there was an	Interaction between face-to-face and online moments

	face-to-face classes and the "VLE" classes.	interaction between the face-to-face classes and the "VLE".	
3	The activities proposed and developed (readings, exercises, discussions, videos, etc.) via the "VLE" have contributed to my learning	As a teacher, I noticed that the activities proposed and developed (readings, exercises, discussions, videos, etc.) via the "VLE" contributed to the students' learning	The utility of the activities for the teaching and learning process
4	The level of difficulty of the activities proposed/developed via the "VLE" allowed me to maintain my interest in the studies	As a teacher, I noticed that the level of difficulty of the activities proposed/developed via the "VLE" allowed the students to maintain their interest in their studies	Motivation and interest in the studies developed online
5	The variety of activities proposed/developed via "VLE" (e-mail, forum, exercise list, sending feedback, etc.) was well explored throughout the studies	As a teacher, I noticed that the variety of activities proposed/developed via "VLE" (e-mail, forum, exercise list, sending feedback, etc.) was well exploited by the students throughout the studies.	The utility and diversification of the activities developed online
6	Teacher interaction and collaboration via the "VLE" was present throughout the studies proposed/performed in this learning environment	As a teacher, I noticed that my interaction and collaboration with the students via the "VLE" was present throughout the studies proposed/performed in this learning environment	Interaction between teacher and student
7	The teacher's notes and interaction in the "VLE" contributed to my learning	As a teacher, I realized that my notes and my interaction in the "VLE" contributed to the students' learning	Interaction between teacher and "VLE"
8	The interaction and collaboration among students were present throughout the studies proposed/developed via the "VLE"	As a teacher, I noticed that interaction and collaboration among students were present throughout the studies proposed/developed via the "VLE".	Interaction among students
9	I consider that I was "present" and, therefore, there was the interaction between me and the other students in the activities proposed/developed via the "VLE"	As a teacher, I consider that I was "present" and, therefore, there was the interaction between me and the students in the execution of the activities proposed/developed via the "VLE"	Participation and involvement in online activities
10	There were consistency and correlation between the subjects/contents proposed in the "VLE" and those worked on in the classroom	As a teacher, I consider that there were coherence and correlation between the subjects/contents proposed/developed in the "VLE" and those worked on in the classroom	Interaction between the content developed face-to-face and online
11	The "VLE" is a resource that can help maintain the rhythm of studies and learning when face-to-face meetings are not possible	As a teacher, I consider that the VLE is a resource that can help maintain the rhythm of studies and learning when face-to-face meetings are not possible	The overall utility of ICTs and "VLE"

Source: prepared by the authors from Carmo *et al.* (2019).

In addition to evaluating those 11 different factors about the VLE used in the implementation of postgraduate courses in the BL model, the investigations carried out by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) comparatively analyzed whether

the level of self-declared perception of the respondents was the same for students and teachers. This type of information may allow occasional adjustments to be made about a certain factor, considering two different perspectives, that is, that of the student and that of the respective teacher.

Although formally proposing an instrument for evaluating the perception of the utility of VLEs used in the BL model, these two studies were carried out only in the context of graduate studies *stricto sensu*. That is, despite being innovative, both in the proposal of a formal instrument for assessing the perception of the utility of VLE used in the BL model and the accomplishment of studies of such nature in the context of the Brazilian post-graduation *stricto sensu*, the studies developed by Caneppele, Carmo and Carmo (2019) and by Carmo *et al.* (2019) presented as the main limitation the respective number of participants, i.e., 11 students and one teacher, and also 4 students and one teacher, respectively. Attempting to alleviate possible problems due to the low number of respondents, Carmo *et al.* (2019) had to use the bootstrap resampling method to enlarge the study sample.

Thus, due to the small number of participating respondents, Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) could not perform any reliability test to validate the data collection instrument used in their studies.

Additionally, since data were collected only from students and professors of the graduate school *stricto sensu*, the possibility arises that the investigations conducted by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) might contain some bias related to the characteristics of this type of student.

Thus, with the realization of scientific research that applies the methodology proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) with undergraduate students, it is hoped that new contributions can be identified to the debate related to the perception of the utility of VLEs and ICTs used in the teaching and learning process in the BL model.

However, even if no new evidence on the subject is identified, it is expected that the expansion of the number of subjects participating in the research may allow, at a minimum, implementing the reliability analysis on the data collection instrument proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019).

On the other hand, there is still a third factor that justifies the realization of the present scientific research: the possibility of evaluating the perception of the utility of a new type of VLE. If Caneppele, Carmo, and Carmo (2019) carried out their research applied to Google Classroom, and Carmo *et al.* (2019) evaluated the TIDIA-Ae, this scientific study was developed from the evaluation about the use of Moodle in the teaching and learning process in BL model.

Thus, it is expected that the results identified from this research can be added to the scientific findings of other studies and thus produce new scientific knowledge on the subject involving the teaching and learning of the BL model. Mainly on the perception of self-declared utility about their respective VLE, and also the validation of a new scale of evaluation of this type of educational technology.

Methodology

The collection instrument (questionnaire) proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) was applied to the students of three undergraduate courses of the Faculty of Animal Science and Food Engineering of USP Pirassununga-SP to collect the data used in this study. In these courses, curricular components (subjects) were taught using the BL model having Moodle as the VLE.

Table 2 presents a descriptive summary of the students' profile of the collection instrument proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) and used in this study.

Table 2 – The general profile of student respondents

Curricular component	Number of respondents	Sex		Age			Previous Moodle experience	
		Mal.	Fem.	Max.	Min.	Avg.	Yes	No
Food Eng. (full-time)	27	9	18	26	19	22	26	1
Food Eng. (nocturnal)	30	11	19	25	19	21	28	2
Biosystems Eng. (full-time)	14	13	1	24	19	20	13	1
Total	71	33	38	26	19	21	67	4

Source: elaborated by the authors, based on survey data.

As a first step in the analysis process, the Kolmogorov-Smirnov normality test was performed to identify the profile of the distributions of the data integrating the research sample formed from the answers (notes) provided by the 71 participants of this study.

The p-value significance analysis of the Kolmogorov-Smirnov test did not indicate a normal distribution ($p\text{-value} < 0.05$) for all the series of data formed by the students' scores for each of the factors evaluated about Moodle.

Given the absence of normal distribution, we opted for the Wilcoxon signposts test to compare the grades representative of the self-declared perception of utility by the students of those three undergraduate courses developed in the BL model with the self-declared perception of the respective teachers.

The nonparametric Wilcoxon sign post-test can be used in place of the Student t parametric test when the hypothesis of statistically significant equality between the median of a series of data and a given value assumed as the median understudy is to be evaluated (TRIOLA, 2012).

After evaluating if the perception of self-declared utility by the students about Moodle was the same as that of the respective teachers, the reliability analysis of the collection instrument proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) used in this research, was performed. The reliability analysis of a questionnaire or scale aims to evaluate if the set of factors of a given construction is consistent with the respective measurements (HAIR JUNIOR *et al.*, 2005).

For the reliability analysis, it was used Cronbach's alpha coefficient, whose values vary from 0 to 1, being desirable the closest possible values to 1 (HAIR JUNIOR *et al.*, 2005; RODRÍGUEZ-RODRÍGUEZ; REGUANT-ÁLVAREZ, 2020).

Cronbach's alpha measures the degree of correlation of the answers provided for a questionnaire compared to the general variance of the answers provided by all respondents. Internal reliability considered adequate is between 0.70 and 0.95, since values very close to 1.00 (>0.95) tend to reflect the evaluation of redundant items and that may not provide relevant information about the attributes of a given construct under analysis (RODRÍGUEZ-RODRÍGUEZ; REGUANT-ÁLVAREZ, 2020).

This research proposed to carry out an exploratory-comparative analysis on the theme related to the perception of the utility of an open-use VLE adopted in the BL implemented along with undergraduate courses. Furthermore, it intends to evaluate the internal reliability of the respective data collection instrument, which until then was only used in research developed along with the postgraduate *stricto sensu*, this research can be classified as a scientific investigation of qualitative nature of exploratory character whose data analytical methodology based on applied quantitative methods.

Data analysis and results

The collection of data on self-declared perceptions of utility through the attribution of scores, with open values between 0 and 10, for each of those 11 factors assessed based on the questionnaire proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019), presented the sample profile described by the information contained in Table 3, regardless of the respective curricular components and undergraduate courses.

Table 3 – The general profile of the data in the research sample

Factors	Minimum	Maximum	Average	Deviation
Ease of use	6.00	10.00	9.11	1.03
Interaction between face-to-face and online moments	5.00	10.00	8.47	1.33
The utility of the activities for the teaching and learning process	5.00	10.00	8.90	1.16
Motivation and interest in the studies developed online	3.00	10.00	7.65	1.47
The utility and diversification of the activities developed online	5.00	10.00	8.76	1.31
Interaction between teacher and student	6.00	10.00	9.39	0.96
Interaction between teacher and “VLE”	3.00	10.00	9.01	1.28
Interaction among students	4.00	10.00	8.04	1.82
Participation and involvement in online activities	4.00	10.00	8.25	1.69
Interaction between the content developed face-to-face and online	6.00	10.00	9.36	0.97
The overall utility of ICTs and “VLE”	5.00	10.00	9.57	0.87

Source: elaborated by the authors, based on survey data.

Assessing the perception of self-declared utility by the 27 students in the food engineering course (full-time period) about those 11 factors related to the VLE (Moodle) used as a technological resource of the BL, it was possible to perceive average grades between 8.00

and 10.00 (column "Students' grades" of Table 3), while the grades assigned by the teacher varied between 6.00 and 10.00 (column "Null Hypothesis" of Table 4).

Table 4 – Wilcoxon sign rank test for the food engineering course (full-time period).

Factor Appraised	Test Parameters	Students' grades^(a)	Null Hypothesis^(b)	Statistics	p-value^(c)
Ease of use		9.00	8.00	186	0.000
Interaction between face-to-face and online moments		9.00	9.00	99	0.127
The utility of the activities for the teaching and learning process		9.00	9.00	114	0.438
Motivation and interest in the studies developed online		8.00	7.00	234	0.003
The utility and diversification of the activities developed online		9.00	6.00	351	0.000
Interaction between teacher and student		10.00	8.00	260	0.000
Interaction between teacher and "VLE"		9.00	8.00	233	0.000
Interaction among students		8.00	7.00	254	0.003
Participation and involvement in online activities		8.00	9.00	90	0.073
Interaction between the content developed face-to-face and online		10.00	10.00	0	0.004
The overall utility of ICTs and "VLE"		10.00	10.00	0	0.024
(a)Median of students' scores for each question (factor appraised)					
(b)Null Hypothesis = teacher's score for each question (factor appraised)					
(c)Probability = 95% confidence.					

Source: elaborated by the authors, based on survey data.

The application of the Wilcoxon sign post-test for the food engineering course (full-time period) showed that students and the teacher responsible for the subject had statistically equal self-declared levels of utility perception ($p\text{-value} > 0.05$) only for the factors related to "interaction between the presence and non-presence moments", "utility of the activities for the teaching and learning process" and "participation and involvement in online activities", as demonstrated by the information summarized in Table 3.

Both the students and the teacher of the food engineering course (full-time period) attributed more relevance to factors related to "interaction and complementarity between face-to-face and online content" and to the "general utility of ICTs and the VLE". Besides, for the students' there was still a third factor considered equally relevant, i.e., the "interaction between teacher and student".

The assessment of self-declared utility perception by the 30 students of the food engineering course (nocturnal period) (applied to those 11 factors related to the VLE (Moodle) used as a resource to support the implementation of BL also identified average grades between 8.00 and 10.00 (column "Students' grades" of Table 4). Regard the grades assigned by the teacher, they also ranged between 6.00 and 10.00 (column "Null Hypothesis" of Table 5).

However, Wilcoxon's sign post-test for the food engineering course (nocturnal period) showed that students and the teacher had statistically equal self-declared levels of utility perception ($p\text{-value} > 0.05$) only for factors related to "utility of activities for the teaching and learning process" and "participation and involvement in online activities", as shown in Table 4.

Table 5 – Wilcoxon sign rank test for the food engineering course (nocturnal period)

Factor Appraised	Test Parameters	Students' grades ^(a)	Null Hypothesis ^(b)	Statistics	<i>p-value</i> ^(c)
Ease of use		9.00	8.00	234	0.000
Interaction between face-to-face and online moments		8.00	9.00	63	0.009
The utility of the activities for the teaching and learning process		9.00	9.00	99	0.860
Motivation and interest in the studies developed online		8.00	7.00	210	0.025
The utility and diversification of the activities developed online		9.00	6.00	435	0.000
Interaction between teacher and student		10.00	8.00	348	0.000
Interaction between teacher and "VLE"		10.00	8.00	331	0.000
Interaction among students		8.50	7.00	335	0.002
Participation and involvement in online activities		9.00	9.00	124	0.425
Interaction between the content developed face-to-face and online		10.00	10.00	0	0.002
The overall utility of ICTs and "VLE"		10.00	10.00	0	0.015
(a)Median of students' scores for each question (factor appraised)					
(b)Null Hypothesis = teacher's score for each question (factor appraised)					
(c)Probability = 95% confidence.					

Source: elaborated by the authors, based on survey data.

Again, both the students and the course teacher, in this case, the food engineering course (nocturnal period), attributed more relevance to the factors related to the "interaction and complementarity between face-to-face and online content" and to the "general utility of ICTs and VLE". However, this time, students still considered the "teacher-student interaction" equally relevant to those two factors mentioned initially, and they also attributed equal importance to the "teacher-VLE interaction".

Unlike the full-time and nocturnal period food engineering courses, the evaluation of the self-declared utility perception by the 14 students in the biosystems engineering course (full-time period), referring to those 11 factors evaluated, signaled grades with medians between 7.00 and 10.00 (column "Students' grades" of Table 4), with grades assigned by the teacher varying between 6.00 and 10.00 (column "Null Hypothesis" of Table 4).

However, Wilcoxon's signal posts test for the full biosystem engineering course showed a higher level of agreement between students and the teacher about the intensity of their self-declared perceptions of utility on those 11 factors assessed. That is, the grades attributed by the students and the teacher responsible for the class showed statistically equal self-declared utility perception levels (*p-value* > 0.05) for 6 of the 11 factors related to the VLE (Moodle) used in the implementation of BL. Thus, the causes referring to the "utility of the activities for the teaching and learning process", "motivation and interest for studies developed online", "interaction between teacher and student", "interaction between teacher and VLE", "interaction between students" and "interaction and complementarity between the classroom and online content", as shown in Table 6.

Table 6 – Wilcoxon sign rank test for the biosystems engineering course (full-time period).

Factor Appraised	Test Parameters	Students' grades^(a)	Null Hypothesis^(b)	Statistics	p-value^(c)
Ease of use		10.00	8.00	76	0.002
Interaction between face-to-face and online moments		8.50	10.00	0	0.007
The utility of the activities for the teaching and learning process		9.00	9.00	36	0.796
Motivation and interest in the studies developed online		7.00	8.00	12	0.051
The utility and diversification of the activities developed online		9.00	6.00	103	0.001
Interaction between teacher and student		10.00	9.00	40	0.166
Interaction between teacher and "VLE"		8.50	9.00	30	0.439
Interaction among students		7.50	7.00	57	0.415
Participation and involvement in online activities		7.00	9.00	2	0.006
Interaction between the content developed face-to-face and online		10.00	9.00	36	0.083
The overall utility of ICTs and "VLE"		10.00	10.00	0	0.041
(a)Median of students' scores for each question (factor appraised)					
(b)Null Hypothesis = teacher's score for each question (factor appraised)					
(c)Probability = 95% confidence.					

Source: elaborated by the authors, based on survey data.

Both the students and the teacher of the food engineering course (full-time period) attributed more relevance to factors related to the "general utility of ICTs and the VLE". For students, factors related to "interaction and complementarity between face-to-face and online content", "teacher-student interaction" and "ease of use" were also considered among the most relevant. For the teacher, in addition to the "general utility of ICTs and VLE", the other factor considered one of the most relevant in terms of perceived utility about VLE used in the BL was the "interaction between the presence and non-presence moments".

These findings suggest that, in general, that teachers and students have predominantly different levels of utility perceptions about the VLE used in the BL in food engineering courses (full-time period: 8 out of 11 factors; and nocturnal: 9 out of 11 factors), and also, levels of utility perceptions about the VLE used in the BL in biosystems engineering courses (full-time period) (6 out of 11 factors); in all cases, the levels of utility perceived by students were higher than the levels perceived by the respective teachers.

However, as initially demonstrated in Table 2, in all cases the average score attributed by students on those 11 factors evaluated was between 80% and 90% ($[\text{average} \times 10] / 100$), except for the "motivation and interest for studies developed online", whose average level of perception of utility was 76.50%.

Thus, it suggests that students and teachers - in the sample of this research - presented high levels of self-declared perception of utility about the ICTs and the VLE (Moodle) used as a technological and instructional resource enabling the BL in the three curricular components evaluated by this study. With special emphasis on those factors related to the "interaction and complementarity between the classroom and online content", the "interaction between teacher and student", and also the perception of "general utility of ICTs and the VLE".

After evaluating the perception of self-declared utility by students, and teachers about the VLE and its ICTs (Moodle) used in the BL implemented with three curricular components of different undergraduate courses, the reliability analysis of the collection instrument proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) and used in this research was performed.

The internal reliability test of the questionnaire was aimed at calculating and identifying the Cronbach alpha coefficient for the groups of respondents or curricular components. Besides, calculating and identifying the general Cronbach alpha for the total set of data formed by the responses of the 71 (27+30+14) respondents in the sample of this study, as described in Table 7.

Table 7 – Summary of the internal reliability test of the collection instrument (questionnaire)

Groups of respondents	Cronbach's Alpha	Factors Appraised	Number of questionnaires evaluated		
			Valid	Excluded	Total
Overall (all courses together)	0.890	11	71	0	71
Food Eng. (full-time)	0.893	11	27	0	27
Food Eng. (nocturnal)	0.847	11	30	0	30
Biosystems Eng. (full-time)	0.930	11	14	0	14

Source: elaborated by the authors, based on survey data.

Both in the general analysis and the individual analysis by curricular component, Cronbach's alpha coefficient was higher than 0.80, which suggests an adequate internal reliability level, according to the criteria described by Rodríguez-Rodríguez and Reguant-Álvarez (2020).

Overall, besides allowing the evaluation of 11 different factors related to the perception of the utility of the VLEs used in BL, both individually (factor by factor) and comparatively (between students and teachers), it is possible to state that the collection instrument proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) had its internal reliability evaluated and confirmed based on the Cronbach's alpha coefficient raised from the responses provided by students participating in this study.

Conclusions

This study was conducted by using the data collection method proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) for the evaluation of the perception of self-declared utility by students and teachers about the contribution of a free use VLE (Moodle), and its ICTs, to the process of teaching and learning curricular components taught in the BL model. Thus, the present research suggests that the students and teachers tended to present different levels of utility perceptions in most of the cases analyzed.

Besides, it was observed some convergence concerning some of the factors considered most relevant by the participants of this research, since, almost in their totality, teachers and students attributed higher perception of utility to factors related to "interaction and complementarity between face-to-face and online content" and to the "general utility of ICTs and the VLE". About the students, the "interaction between teacher and student" was also

considered one of the most significant factors in three undergraduate courses at the higher level analyzed.

Unlike what happened in previous studies ((CANEPELE; CARMO; CARMO, 2019); CARMO *et al.*, 2019), the number and diversity of respondents participating in this study allowed evaluating and proving the internal reliability of the collection instrument in question, at least about undergraduate students taught in the BL model.

Thus, it is possible to state that the questionnaire proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) may contribute significantly to the evaluation process regarding the perception of the utility of VLE, and their ICTs, used in the implementation of BL.

A natural progression of this work is to analyze the internal reliability of the collection instrument proposed by Caneppele, Carmo, and Carmo (2019) and Carmo *et al.* (2019) in a research sample formed exclusively by students and professors of postgraduate courses *stricto sensu*. Therefore, it should be remembered that the questionnaire used in this study was initially proposed in this context and, although it proved to be efficient and valid in the context of the courses taught through the BL methodology at a higher level, it has not yet had its reliability evaluated in the context of postgraduate courses *stricto sensu*.

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Authors' contributions

On behalf of all authors, the corresponding author states that all the authors have contributed equally to this study. All authors read and approved the final version of the manuscript.

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