

# Unveiling the blended learning factors that affect English as a foreign language learning students' writing

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## ARTICLE INFO

### Keywords:

Blended learning  
EFL students  
Writing performance

## ABSTRACT

While numerous studies targeted the effects of blended learning (BL) on English as a foreign language (EFL) students' written products, a study to determine the mechanism of what factors in the BL environment impact EFL writing performance is under-researched. In response, the authors drew on Bandura's triadic reciprocal determinism and Venkatesh et al.'s unified theory of acceptance and use of technology to navigate the hypothesized research model in an exploratory sequential mixed methods design. The sample included six participants in the initial qualitative phase and 148 respondents in the later quantitative phase. The findings based on the statistical analysis of measurement and structural models indicate that BL improves students' global aspects of writing (task fulfillment, organization) more than their local matters (vocabulary, grammar). In the BL environment, environmental factors and students' personal factors significantly influence their behaviors, which powerfully predict their writing performance. In the indirect relation, writing performance is impacted almost equally by the BL environmental factors and students' personal factors. The study suggests some conclusions on the roles of individual, environmental, and behavioral factors in affecting writing performance and implications for promoting the BL prospect in the EFL writing context.

## 1. Introduction

Blended learning (BL) was defined as “the strategic combination of online and in-person learning” ([1], p. 13). This model has been applied and researched in the educational context for decades under several alternative names, such as *hybrid learning*, *mixed-mode learning*, *integrated learning*, or *mixed-mode education*; however, BL stands out as a dominant name [2]. Though having experienced the BL environment, users did not tend to fully understand the concept of BL and its subtypes [3].

The literature also reveals that scholars have done a lot of BL research, especially the effects of BL on writing [4]. On the one hand, most studies view BL as a beneficial approach to enhancing educational quality. For instance, Quvanch and Kew's [5] systematic reviews concluded that in most studies, BL improved writing outcomes. They also addressed instructors' attitudes toward BL, generally finding them to be supportive of its integration into teaching. In the writing process, BL fostered student collaboration, critical thinking, and interactive discussions, with learners benefiting from practical engagement and

firsthand experiences [6]; nevertheless, what BL factors lead to those improvements have gained little attention so far.

In addition, a smaller group of studies focused on the obstacles associated with BL adoption. For example, BL often reflects instructors' preferences rather than students' choices [4]. Furthermore, Fan et al. [7] and Huynh [3] reported that students frequently lacked the necessary technological tools and digital literacy for successful engagement in BL, and Faizan et al. [8] pointed to issues such as unreliable internet access, inadequate equipment, and insufficient technical support as significant barriers.

Despite these contrasting views, several studies have endorsed the continued implementation of BL (i.e. [9–11]), even though acknowledging its challenges (i.e. [8,3,12]). Moreover, numerous scholars (i.e. [13–15]) believed that BL could effectively support learning and potentially represent a future direction for education. However, it is noted that most previous findings came from experimental or action research, whose conclusions were based on the causal relationship between the BL environment and the recorded results; accordingly, the improvement was attributed to the BL environment in general. Because

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specific cognitive, behavioral, and environmental factors that capture what happens in the BL model are underexplored, BL implementation lacks a solid evidence base.

In Bandura's [16] social cognitive theory, individuals' learning is subject to the bidirectionally reciprocal influences of the environment (teachers, peers, facilities, social influences), their personal properties (gender, experience, self-efficacy, motivation), and their behaviors (self-reflection, self-regulation) in the learning process. Also, Venkatesh et al.'s [17] unified theory of acceptance and use of technology explained the intricacy of how people's exposure to technology influences their acceptance or refusal. In this study, both of the theories were adopted because the BL environment for EFL writing came with an intricate mechanism in which students self-regulated and self-reflected on their learning, used technology to learn to write, collaborated with peers, and responded to the teacher's lessons. Therefore, the authors of this study based their project on Bandura's [16] theory to comprehensively examine the nuanced influences of the *personal*, *behavioral*, and *environmental* elements on students' writing performance in a synchronous BL course.

The aims were to understand how BL factors influenced EFL students' writing and to answer the research questions:

1. What environmental, personal, and behavioral factors impact EFL students' writing performance in a BL course?
2. How do they influence their writing performance in terms of task fulfillment, organization, vocabulary, and grammar?

The present study's findings were supposed to contribute to unveiling the mechanism that governs students' improved writing in a BL course. Then, the BL environment would also be personalized appropriately to meet EFL students' learning needs and enhance their writing outcomes, especially in Asian countries where BL has recently emerged.

## 2. Literature

### 2.1. BL research and English writing

The literature indicates that earlier researchers focused on the effects of BL on English writing. They based their research on Vygotsky's [18] socio-cultural theory to make claims about the BL environment and students' improved achievement.

The first group of research targeted the impacts of BL on students' written products. Specifically, systematic reviews reported that BL improved university students' writing [6] and EFL writing skills [19]. In other studies, BL students showed a high level of text cohesion [15] or increased their lexical range and coherence [15]. In addition, BL was more effective than conventional courses [20] or online courses [21] in contributing to students' improved writing outcomes.

The second group targeted the writing process. For example, Chen et al. [22] claim that BL was effective because students were active and context-sensitive in both online and face-to-face sessions. Wang and Kew [19] also reported that BL enhanced motivation and interaction, and simultaneously mitigated their writing anxiety. Similarly, Dousti and Amirian [21] and Cao et al. [23] praised BL as providing more support and contributing to better writing achievements. Moreover, students developed different behaviors in the two learning modes, complementing each other and influencing their collaborative writing [24]. While generating better ideas offline, they organized ideas better in online sessions (ibid).

The final cohort of BL studies focused on students' autonomy. Li and Wong [25] lauded BL as addressing self-regulation and learner autonomy because of the adaptability and interactive platforms of the online mode. Cao et al. [23] claimed that teacher support is the key factor that leads to BL success through orienting students' learning. They know when and how to adopt technology to facilitate their learning [26]. Furthermore, exposure to the BL environment increases students'

independence and perception of BL's effectiveness and discussion quality [27].

While BL was beneficial, it also faced some barriers. Le et al. [28] claimed that a lack of infrastructure, poor ICT skills, and limited institutional support hinder the efficient implementation of BL. BL brought in such problematic issues as technical issues and time management [6]. Teachers needed to be trained to do their job well in BL [15]. Nevertheless, both students and teachers had positive attitudes towards BL adoption for English writing [20] and supported the incorporation of this model [6]. This implies that adopting BL can increase multiple aspects of students' writing.

Overall, the earlier findings presented a comprehensive picture of how BL influences writing manifested in the writing process and then the written product. This study, however, attempted to validate the environmental, personal, and behavioral factors that took place in a BL course and EFL students' written products observed through their perceived writing performance.

### 2.2. Foundational theory

Most of the previous researchers drew on action research or experimental inquiry and reported that BL can provide abundant resources and facilitate students' engagement, interaction, and discussion [6]. The improvements could be seen in students' achievements, attitudes and self-regulation and autonomy [19]. Then, their improved writing was attached to the BL environment, which is much associated with Vygotsky's [18] socio-cultural theory. However, earlier findings failed to capture students' cognitive or behavioral aspects.

In response, the authors of this study relied on Bandura's [16] social cognitive theory, which treated learning as "learning is vicarious, cognitive, self-reflective, and self-regulatory" (p. 2). Among the major components of his social cognitive theory, Bandura [16] suggested *triadic reciprocal determinism* (TRD). More specifically, individuals acquire knowledge by watching others perform actions, with this process being powerfully shaped by both their environmental factors, such as technology, teachers, peers and learning content as well as their internal characteristics, such as cognitive, emotional, and biological characteristics. Conversely, personal attributes are also subject to the bidirectional influences of the context and the nature of the learning tasks. Similarly, environmental conditions are influenced by both individual and environmental factors at the same time [29,30].

Bandura's [16] TRD provides a frame that mechanizes how students' learning is subject to bidirectionally reciprocal influences of the environment, students' behavior, and their personal factors in the learning process; however, the influences vary. Accordingly, the environment affects behavior indirectly through personal factors. In this study, the authors relied on and extended Bandura's [16] TRD to explain how students' writing was influenced in a BL course.

One new feature of the hypothesized research model (Figure 1) was that the framework comprehensively examined the *environmental*, *behavioral*, and *personal* factors that predict students' writing performance. In addition, while previous studies treated the BL environment as a whole, the components of the BL environment in this study were split up and examined separately to see how that affected students' writing results. Moreover, PLS-SEM allowed calculating the direct and indirect effects of the exogenous construct on its corresponding endogenous construct, indicating that numerous new relationships among the constructs would be validated.

In summary, it was highly expected that the above hypothesized research model would successfully explain how EFL students' writing performance was intricately influenced by the environmental, personal, and behavioral factors in a synchronous BL course.

### 2.2. Hypothesized constructs and hypothesis statement

Bandura's [16] TRD explicates how learning is subject to

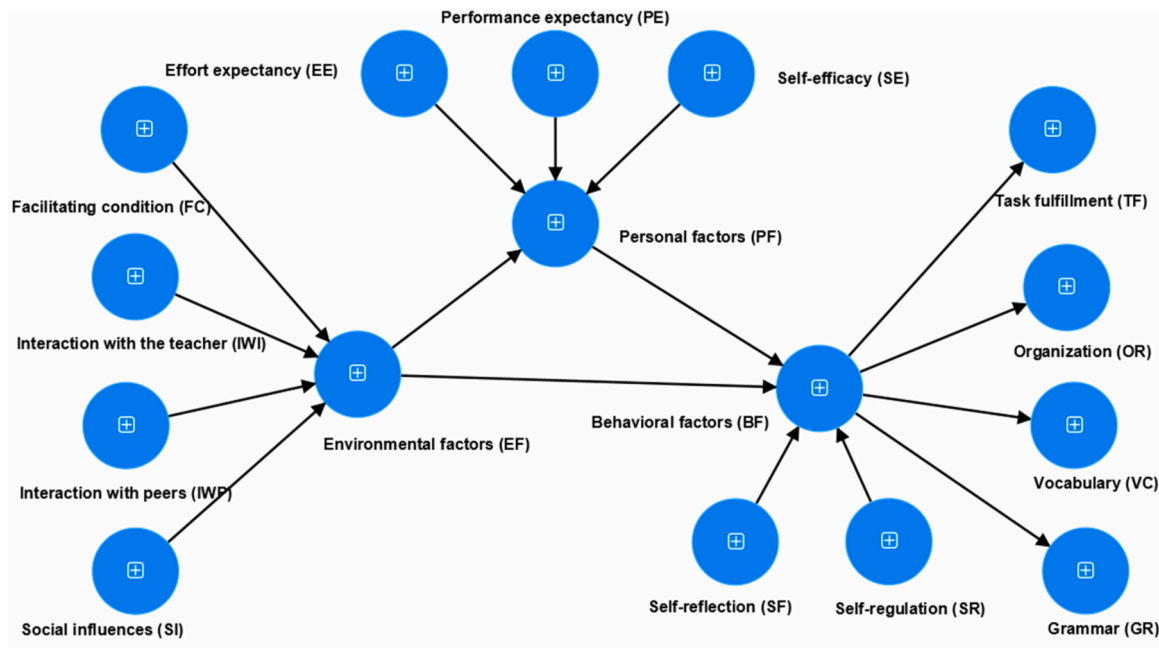


Fig. 1. Hypothesized research model.

bidirectionally reciprocal influences of the environment, learners' behavior, and their personal factors in the learning process. Based on that frame, the exogenous constructs were built (Figure 1); however, the bidirectional relations of TRD were replaced with the causal relations to facilitate regression weights. Furthermore, because the BL environment now contains technological features, the authors relied partly on Venkatesh et al.'s [17] unified theory of acceptance and use of technology (UTAUT) to gauge students' perceived BL environment's influences. Moreover, the only purely endogenous constructs represented different aspects of writing performance. They were measured through the high-stakes Vietnam Standardized Test of English Proficiency (VSTEP) writing scale, which works in reference to the Common European Framework of Reference for Language Competence (Vietnam Ministry of Education and Training [31], 2015).

### 2.3. Endogenous constructs

The literature review showcases that previous studies drew on students' writing results to conclude the effectiveness of the treatment. Most researchers drew on students' average writing course score or GPA (i.e. [32]), English writing ability (i.e. [14]), mid-term test scores (i.e. [33,34]), or the quality of a written text (i.e. [35]) as a means of measuring someone's writing performance. A minority drew on perceived performance (i.e. [36,37]), which reflects the students' self-rated competence in producing written texts to complete their writing tasks.

Qureshi et al. [37] reported that perceived performance was more dynamic in reflecting students' nuanced abilities than a single score. As a consequence, the authors of this study targeted the VSTEP writing scale [31] to observe students' perceived writing performance, which was composed of *task fulfillment*, *organization*, *vocabulary*, and *grammar*. Writing performance worked as the exogenous construct, also known as the dependent one, of the hypothesized research model to help explicate how it was impacted by the other factors in the BL environment.

### 2.4. Task fulfillment

*Task fulfillment* (TF) evaluates how well students meet the writing requirements by addressing key ideas and supporting details,

maintaining appropriate and consistent tone, and achieving intended communication goals [31]. These elements are essential for assessing written work [38] and are operationalized in this study through four specific indicator variables (see [Appendix A](#)).

### 2.5. Organization

*Organization* (OR) pertains to how well students structure their content by arranging information and ideas coherently, employing various cohesive devices and organizational structures, and effectively using paragraphing [31]. These criteria assess the clarity and logical flow of a text [38], and in this study, they are reflected in four specific indicator variables (see [Appendix A](#)).

### 2.6. Vocabulary

*Vocabulary* (VC) assesses students' ability to employ a broad and varied lexical range, including less frequent words, demonstrate appropriate use of style and collocations, and avoid lexical errors [31]. These descriptors emphasize the sophistication of vocabulary use [38] and are represented by four indicator variables in this study (see [Appendix A](#)).

### 2.7. Grammar

*Grammar* (GR) evaluates students' proficiency in utilizing a variety of both simple and complex sentence structures in their writing [31]. In the VSTEP assessments, certified raters use this construct to assess the frequency and accuracy of complex forms, as well as the student's ability to produce diverse sentence types with minimal errors [38]. For this study, these descriptors have been adapted and expressed through four indicator variables (see [Appendix A](#)).

Overall, the four features of the VSTEP writing scale [31] are equally weighted in generating test scores and concluding writer competence [38]; therefore, they were observed independently.

### 2.8. Exogenous constructs

The BL environment is where teaching and learning activities take

place. As suggested by Bandura [16] and Venkatesh et al. [17], it captured the environmental factors (teachers, peers, facilities, and social influences), the students' personal factors (physical properties and mental processes), and their cognitive and behavioral engagement in the writing process. In this study, those features worked as the exogenous (also known as independent) constructs and were hypothesized to impact EFL students' writing results in a BL course.

*Environmental factors* (EF) refer to the physical and social contexts in which individuals learn new things [16]. Qureshi et al. [37] argued that aspects such as classroom conditions, available resources, teachers, and peers are very likely to affect students' engagement and then their achievements. Accordingly, EF in this study was observed *facilitating condition*, *interaction with the teacher*, *interaction with peers*, and *social influence*.

*Facilitating condition* (FC) is the degree to which technical support and assistance are available for users to deploy a system [17]. Venkatesh et al. [17] introduced FC to estimate people's early adoption of ICT tools [17,39,40], and in recent BL studies, it was adopted to predict students' attitude to use BL [41,42] and behavioral use of BL for their learning needs [10,43]. Relying on this study's qualitative findings, FC observed through available resources, technology literacy, appropriate use of ICT, and institutional assistance (see [Appendix A](#)).

*Interaction with the teacher* (IWI) gauges the degree to which learners were interactive with their teachers in the classroom for their learning needs [37]. In earlier research findings, IWI could motivate students in the learning process, which may then positively impact their attitude and enhance their outcomes [44,45]. Furthermore, Rahman et al. [46] claimed that teachers' attributes can generate positive impacts on their quality teaching or their students' overall performance. In this study, IWI was primarily based on the qualitative findings and measured via the teacher's guidance, motivation, timely response, and instant feedback (see [Appendix A](#)).

*Interaction with peers* (IWP) refers to the degree to which students interact with peers in forms of collaboration, cooperation, and/or discussions to complete their learning tasks [47]. Empirically, IWP is likely to enhance students' overall performance because peer interactions facilitate information sharing and exchanging [48]. Moreover, Qureshi et al. [37] treated it as providing various benefits in the learning process. In this study, it was measured through discussing ideas, bringing in new ideas, solving problems, fostering writing capability, and exchanging instant peer feedback (see [Appendix A](#)).

*Social influence* (SI) refers to how individuals conceive that those around them want them to employ a system [17]. In the learning process, others' achievements were motivating and positively impactful [16], which then lead to their improved learning performance [47]. This suggests that peers and teachers can inspire students in the classroom [33,34]. In recent BL studies, SI positively impacted students' attitudes [41,43] and positively predicts their behavioral use of BL [10]. In this study, SI was measured by the multiple influences of trendy technology, learning contents, the teacher in charge, and the university (see [Appendix A](#)).

To facilitate data calculation, FC, IWI, IWP, and SI were grouped to make EF, a purely exogenous higher-order construct, as Hair et al. [49] suggested. In Bandura's [16] TRD, the hypothesis (H) between EF and writing performance was stated below.

H<sub>1</sub>: EF indirectly affects TF.

H<sub>2</sub>: EF indirectly affects OR.

H<sub>3</sub>: EF indirectly affects VC.

H<sub>4</sub>: EF indirectly affects GR.

*Personal factors* (PF) refer to people's psychological and physical states. Bandura [16] listed the psychological processes, such as their cultures, customs, experiences, expectations, beliefs, and intention, as well as biological characteristics like gender, age, ethnic groups, and physical presence. Li et al. [10] reported that people's mental and physical traits are likely to shape learning engagement and outcomes. In this study, PF was based on the qualitative findings and measured

through effort expectancy, performance expectancy, and self-efficacy, which students perceived about the BL environment.

*Performance expectancy* (PE) is the degree to which deploying a system can promote work efficiency [17,50]. PE is similar to Davis's [51] perceived usefulness, meaning that people are more likely to adopt technology when they find it useful for their needs. In BL contexts, Azizi et al. [41] and Dakduk et al. [52] found that PE was powerful in estimating students' BL acceptance. In this study, the authors largely drew on the qualitative findings to measure PE. Specifically, it was composed of collaboration opportunities, text quality improvements, increased overall performance, and improved achievements (see [Appendix A](#)).

*Effort expectancy* (EE) refers to the degree to which individuals utilize a system with little or no challenges [17]. EE originates from Davis's [51] *perceived ease of use*, which means that when technology is easy, people are more likely to deploy it. While EE was originally developed to estimate people's acceptance of ICT tools [17], some recent researchers like Azizi et al. [41] or Norman [43] adopted it to explain students' intention to accept BL. In this study, the authors drew on the qualitative findings and defined EE as the ease of adopting ICT tools, addressing the writing tasks, producing texts, and accessing various resources (see [Appendix A](#)).

*Self-efficacy* (SE) is people's belief that they have the ability to perform a behavior and gain the desired results [16]. Callum [50] argued that the higher the level of SE is, the more likely they are to act and achieve the goal. In a BL study, Li et al. [10] reported that students' SE positively influences their BL adoption. In this study, the authors relied on the qualitative findings and measured SE through students' confidence and ability to handle writing requirements, gain the desired achievements, collaborate with peers and the teacher, and improve their writing competence (see [Appendix A](#)).

As illustrated in [Figure 1](#), EE, PE, and SE formed PF, a higher-order construct. The relationship between it and writing performance is hypothesized as follows.

H<sub>5</sub>: PF indirectly affects TF.

H<sub>6</sub>: PF indirectly affects OR.

H<sub>7</sub>: PF indirectly affects VC.

H<sub>8</sub>: PF indirectly affects GR.

*Behavioral factors* refer to the course of actions that individuals perform [16]. Bembenutty et al. [53] argued that people are competent and proactive, which shapes their developmental processes and outcomes. In Bandura's [16] view, people's cognitive and behavioral engagements are two significant components in the modeling process; therefore, the authors of this study targeted self-regulation and self-reflection.

*Self-regulation* (SR) suggests that people exert their control and direction over their mental and physical processes to achieve their desired goals [16]. Individuals' self-regulation of learning generates different patterns of thinking and behaving [30]. Empirically, earlier researchers reported that people's SR was powerful in impacting their learning and knowing [42,44]. In this study, the authors defined SR in terms of students' behavioral engagements in the writing process. Consequently, it was observed through students' adopting learning strategies, accessing multiple available resources, working principally, completing tasks, deploying ICT tools to facilitate their writing process, and interacting with peers and teachers to enhance their text quality (see [Appendix A](#)).

*Self-reflection* (SF) refers to how students reflect on their achievement progress and set future directions for their behaviors [16]. In Bandura's [16] view, individuals are the agents of their actions and then the examiners of those actions and the corresponding results. In education, students' SF enables them to examine their achievements against the desired goals, towards which they orient their actions [54] and by which they adopt more appropriate strategies [30]. In this study, SF was a cognitive behavior, and the authors largely relied on the qualitative findings to define it as their deep thoughts on the BL model, their achievement progress, strategies to improve, receiving corrective feedback, collaboration to write, and their trust in the benefits of BL (see



### Appendix A).

As indicated in Fig. 1, SR and SF were grouped to form BF, a higher-order construct. Bandura [16] postulated that people's behaviors directly influence their learning and development; as a consequence, the relations between BF and writing performance were hypothesized below.

**H<sub>9</sub>:** *BF directly affects TF.*

**H<sub>10</sub>:** *BF directly affects OR.*

**H<sub>11</sub>:** *BF directly affects VC.*

**H<sub>12</sub>:** *BF directly affects GR.*

In short, the relationships among the constructs above were supported by Bandura's [16] TRD and Venkatesh et al.'s [17] UTAUT. They were used to estimate the effects of the BL environment on EFL students' writing results. The new feature is that the components of each higher-order construct were extended with the guidance of Venkatesh et al.'s [17] UTAUT and contextualized in EFL writing. Moreover, writing performance was split up into four specific competencies as designed by MOET [31] in order that the validated model could explain the multifaceted effects of BL on EFL students' written texts in terms of TF, OR, VC, and GR.

## 3. Methodology

### 3.1. Research approach and design

The literature review indicates that numerous researchers targeted the effects of BL on students' English writing; nevertheless, the BL factors that affect EFL students' writing were underexplored. Therefore, the authors of this study selected the exploratory sequential mixed methods design as Creswell and Creswell [55] proposed. Under this research design's framework, this study had three phases: designing the study, building the measurement features, and validating the hypothesized research model.

First, the authors explored secondary resources on BL, learning theories, and EFL writing to build the conceptual framework and tentatively determined the hypothesized research model. Then, they spent three months observing the BL classes for EFL writing and interviewing six students to improve the quality of the hypothesized research model's measurement features. In this second stage, the constructs and their indicators were defined and rationalized for an EFL writing in a BL context. Finally, the questionnaire was sent to EFL students to gather data and validate the measurement features as Nguyen and Vu [56] posited for exploratory inquiry.

A course is seen as BL when 30 % to 80 % of its content is delivered online [57]. In this study, the EFL writing course took place in 11 weeks. The students spent the first five weeks studying in the classroom and another five online in a synchronous BL model. The final week is for the course assessment, and they came back to the classroom again.

### 3.2. Sampling

The study targeted 154 English majors learning to write English correspondence in four BL classes. The authors applied judgment sampling to choose six participants in terms of gender, writing scores, and skills in using technology to take part in the qualitative phase to build the measurement features. Then, 148 others were conveniently selected to respond to the questionnaire, which helped the authors examine the measurement features with empirical evidence.

The demographic information shows that three of the six students in the qualitative phase were males, and all were in their second year at university. They came from three different ability groups, with scores ranging from 4.0 to 8.4, which covers the common EFL writing scores that the English majors achieved in the previous semester. For the 148 students in the quantitative phase, 96.62 % were in their second year, and 80.41 % were females. Regarding their writing capability, 95.27 % had scores between 4.0 and 8.4.

Overall, because the qualitative research came before the quantitative inquiry, as Creswell and Creswell [55] suggested, the qualitative survey did not include those in the earlier qualitative phase. The demographic information shows that the qualitative research participants could be representative of the quantitative sample. Therefore, the data generated by the quantitative phase could be utilized to address the research question.

### 3.3. Instruments

The qualitative research instrument was the semi-structured interview questionnaire. It included nine open-ended questions, each of which was developed in alignment with a construct of the hypothesized research model. All nine constructs were theoretically oriented by the existing concepts (i.e., [17,37,50]), but their indicator variables were observed and justified in the EFL writing context. Therefore, the authors examined the wording and fieldwork procedure carefully before collecting and analyzing data. The qualitative findings were to serve the quantitative phase later.

Then, the questionnaire with two sections was established. Section One elicited the participants' personal information to guarantee that the appropriate data was generated. Section Two featured 13 constructs, nine of which were exogenous. The other four came from the content analysis of the VSTEP writing scale [31] and worked endogenously in the hypothesized research model (Fig. 1). All 13 constructs were arranged under the guidance of Bandura's [16] TRD and Venkatesh et al.'s [17] UTAUT, and the hypotheses about their relations were stated to address the research questions. Then, the questionnaire was reviewed by two English writing teachers with experience teaching English writing in the BL model, and some minor wording changes were made to ensure the scale's content validity. Next, it was piloted; nevertheless, the authors located no extreme cases. Finally, it was formally sent to students in four BL classes via Google Forms, and 148 responses were recorded.

### 3.4. Data analysis

The sample of the survey questionnaire included 148 participants, which exceeded the number of around 30 observations for an exploratory qualitative study, as Hair et al. [49] proposed. Nguyen and Vu [56] suggested that the partial least squares - structural equation modeling, or the PLS-SEM, consists of assessing the measurement and structural models. Specifically, examining the measurement model is to check the reliability and validity of the constructs and their corresponding variables in terms of indicator reliability, internal consistency reliability, internal validity, and discriminant validity. Then, assessing the structural model involves testing the hypothesized relations among the constructs through the significance of path coefficients and locating the effects of the exogenous construct on its corresponding endogenous ones via coefficients of determination, predictive relevance, and sizes of path coefficients. As a result, the authors relied on these procedures to validate the findings.

## 4. Data analysis and findings

### 4.1. Measurement model

The hypothesized model consisted of 13 constructs that had to be checked for reliability and validity. The authors assessed the measurement model first by observing the indicator variables' outer loadings, which were accepted when their indexes were .4 or higher (Hulland, 1999, as cited in [49]). The statistical results (Appendix B) show that all the indicator loadings were  $\geq .4$ . This information means that all the indicator variables contributed significantly to their corresponding constructs; thus, they all were retained for further calculation.

Next, the authors assessed the constructs' validity and reliability. For the construct reliability, Hair et al. [49] postulated that the constructs'

Cronbach's alpha and composite reliability (rho\_a) should be  $\geq .7$  to be accepted. Under this reference, Table 1 indicates that all the constructs in the hypothesized models were accepted. Therefore, they were kept for further analysis. For the construct validity, Nguyen and Vu [56] proposed that a construct's average variance extracted (AVE) should be  $\geq .50$  to be accepted. Table 1 also shows that all the AVE indexes were  $\geq .50$ . These results suggest that all the hypothesized constructs had the convergent validity and were kept for analysis.

Then, the authors examined the constructs' discriminant validity, which relied on the Fornell and Lacker statistics. Hair et al. [49] proposed that the index is accepted when it falls in the zero-one range, and a high index means that two constructs are highly correlated. Table 2 below shows high indexes ( $\geq .9$ ) between some pairs of constructs, suggesting that they are less discriminant from each other. As a result, the authors had to examine another discriminant metric.

To further examine the discriminant validity, the authors assessed the collinearity of each indicator via the tolerance value or VIF. Nguyen and Vu [56] proposed that the VIF of .2 to 5 is acceptable. The statistical figures exhibit that all indicators meet this requirement of the VIF. This result suggests that the indicator variables bore little or no possibility of collinearity. Hence, all the indicators were retained for further analysis.

When the lower-order measurement model was assessed, the authors grouped IWP, IWI, SI, and FC to form EP, SE, PE, and EE to make PF, and SF and Sr to form BF, as shown in Fig. 2. Because EF, PF, and BF were higher-order constructs, they were formative and did not need to be assessed again for reliability and validity. Then, the authors started to examine the structural model.

#### 4.2. Structural model

The authors began by assessing the model fit, whose index should be between .02 and .80, as Nguyen and Vu [56] proposed. The statistical analysis provided 0.212, which meant a good fit. This result suggests that the newly-validated model will likely estimate the BL factors influencing EFL students' writing performance.

Next, the authors checked the coefficients of determination ( $R^2$ ) to understand the causal relationships between exogenous constructs and their endogenous ones. Hair et al.'s [49] proposed that the  $R^2$  values of .75, .50, and .25 indicate that an endogenous construct can be *substantially*, *moderately*, and *weakly* explained by its exogenous ones, respectively. Fig. 2 shows that EF explained the variance of PF by 72.54 %, and EF and PF together explained 67.5 %. Regarding writing performance, BF explained the variance of OR (36.5 %) and TF (35.7 %) more than GR (25.6 %) and VC (19.6 %). This means that BF can explain writing performance at weak to moderate levels.

Then, the authors proceeded with the significance and size of path coefficients. For the significance, a relation is valid when its P value is .5 or lower [49]. Table 3 indicates that all P values were below 5 %,

meaning that all the causal relations were valid. The P values also show that all the hypotheses were accepted. This information suggests that the BL environment, the students' behaviors, and their personal characteristics affected their writing performance.

For the sizes of the path coefficients, Nguyen and Vu [56] suggest that the higher an index is, the bigger the size effect is. The original sample (O) column in Table 3 indicates that all the coefficients were positive, meaning that the increase of an exogenous construct will likely lead to that of a corresponding endogenous one.

In direct relations, writing performance was greatly predicted by BF. Specifically, BF positively influenced it from 41.1 % to 60.4 %, with the impact on TF (59.8 %) and OR (60.4 %) higher than on GR (50.6 %) and VC (41.1 %). Moreover, Table 3 indicates that EF mediated PF (85.1 %), which impacted BF by 63.1 %. This information suggests the causal path by which the environment impacts the students' personal factors, which concurrently predict their behaviors. Finally, their behaviors are responsible for their improved writing performance.

In indirect relations, the original sample index of Table 3 indicates that EF and PF held a positive relation with writing performance; nevertheless, EF affected writing performance more than PF did. In addition, both EF and PF improved the global aspects (TF, OR) more than the personal ones (GR, VC). This information suggests that EF and BP in the BL environment contribute to students' improved writing through their enhanced behaviors, and BL enables EFL students to handle global aspects of writing better than local matters.

Another metric to understand the effect size is the  $f^2$ , which is based on  $R^2$ . The  $f^2$  thresholds of .02, 0.15, and 0.35 are considered *small*, *medium*, and *large* impacts, respectively. Under this reference, Table 4's effect sizes show that while BF generates more than medium effects on VC, it has large impacts on the other components of writing performance. Though  $R^2$  in Fig. 2 means that BF can explain the variance of TF, OR, VC, and GR at small to moderate levels. Whereas it is just a stand-alone index,  $f^2$  has a more powerful prediction based on the inclusion and exclusion of  $R^2$ . Therefore, the authors based the findings on  $f^2$  to claim that BF generates considerable direct impacts on students' writing performance.

Finally, the authors examined the predictive relevance ( $Q^2$ ) of TF, OR, VC, and GR when they were the endogenous construct in four partial models (Fig. 2). This step involves the blindfolding technique to evaluate the cross-validated redundancy indexes. Hair et al. [49] proposed that the predictability of  $Q^2$  is *low* (zero to below .25), *moderate* (.25 to below .5), and *high* (.5 or higher). The analytical figures in Table 4 exhibit that the models in which GR and VC work as the endogenous constructs carry low predictive relevance, whereas the models in which TF and OR work as the endogenous constructs have moderate predictive relevance. This information indicates that BL affects global issues (task fulfillment, organization) rather than local aspects (vocabulary and grammar).

In conclusion, assessing the measurement showed that all the indicator variables were retained. This means that they contributed considerably to forming their corresponding attentive constructs. When it came to the structural models, all the relations were valid and positive, suggesting that the increase of an exogenous construct will entail that of a corresponding one in the validated model. Finally, the findings pointed out the impacts of BL on EFL students' writing and supported Bandura's [16] TRD in the EFL writing context.

#### 5. Discussion

This study's findings addressed the research questions by locating and quantifying the factors of the BL environment that affect EFL students' writing. In the section below, the authors will provide some discussions and implications for the prospects of BL in writing contexts.

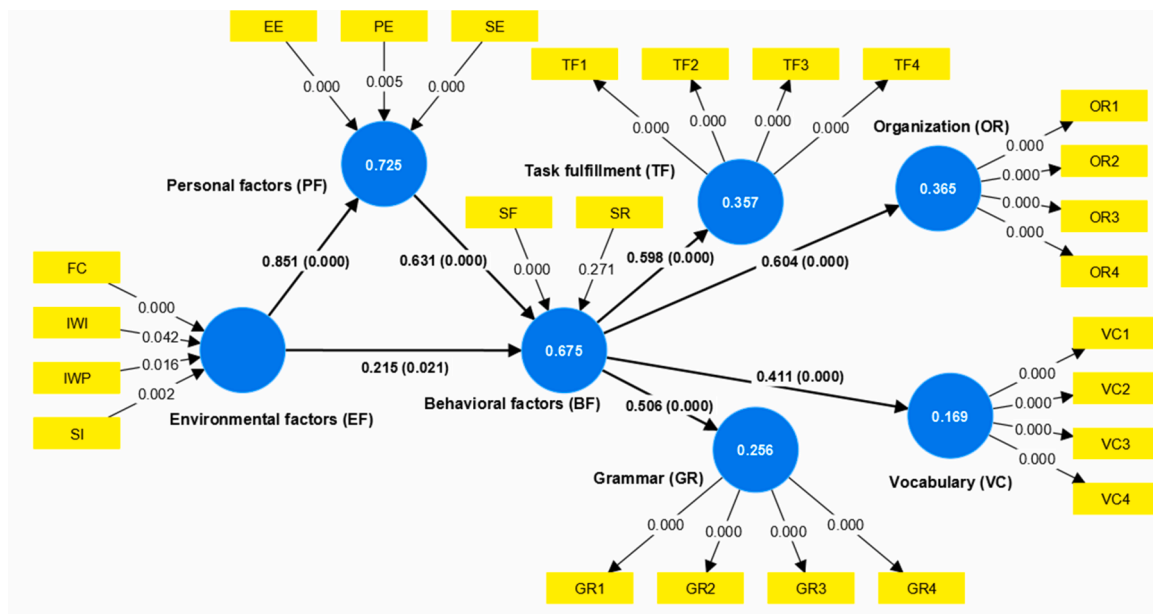
Firstly, *writing performance is influenced directly by students' behaviors*. This finding is consistent with Bandura's [16] claims about the direct effects of one behavior on their learning and knowing, and with Qi et al. [6] and Wang and Kew [19], who claimed that BL can improve students'

**Table 1**  
Construct validity and reliability.

|     | Cronbach's alpha | Composite reliability (rho_a) | Composite reliability (rho_c) | Average variance extracted (AVE) |
|-----|------------------|-------------------------------|-------------------------------|----------------------------------|
| EE  | 0.845            | 0.859                         | 0.896                         | 0.684                            |
| FC  | 0.797            | 0.805                         | 0.867                         | 0.621                            |
| GR  | 0.863            | 0.864                         | 0.907                         | 0.708                            |
| IWP | 0.906            | 0.910                         | 0.930                         | 0.727                            |
| IWI | 0.916            | 0.918                         | 0.941                         | 0.801                            |
| OR  | 0.862            | 0.869                         | 0.906                         | 0.707                            |
| PE  | 0.905            | 0.906                         | 0.934                         | 0.779                            |
| SE  | 0.866            | 0.869                         | 0.909                         | 0.714                            |
| SF  | 0.827            | 0.830                         | 0.874                         | 0.538                            |
| SR  | 0.835            | 0.839                         | 0.879                         | 0.550                            |
| SI  | 0.786            | 0.787                         | 0.862                         | 0.609                            |
| TF  | 0.892            | 0.894                         | 0.925                         | 0.755                            |
| VC  | 0.867            | 0.898                         | 0.908                         | 0.714                            |

**Table 2**  
Fornell and Lacker's statistics.

|     | EE           | FC    | GR           | IWP   | IWI   | OR           | PE    | SE           | SF           | SR    | SI    | TF    |
|-----|--------------|-------|--------------|-------|-------|--------------|-------|--------------|--------------|-------|-------|-------|
| FC  | <b>0.947</b> |       |              |       |       |              |       |              |              |       |       |       |
| GR  | 0.425        | 0.583 |              |       |       |              |       |              |              |       |       |       |
| IWP | 0.588        | 0.682 | 0.424        |       |       |              |       |              |              |       |       |       |
| IWI | 0.665        | 0.658 | 0.372        | 0.619 |       |              |       |              |              |       |       |       |
| OR  | 0.494        | 0.664 | 0.876        | 0.550 | 0.492 |              |       |              |              |       |       |       |
| PE  | 0.719        | 0.747 | 0.612        | 0.666 | 0.584 | 0.728        |       |              |              |       |       |       |
| SE  | 0.815        | 0.833 | 0.547        | 0.646 | 0.633 | 0.651        | 0.869 |              |              |       |       |       |
| SF  | 0.817        | 0.812 | 0.607        | 0.670 | 0.639 | 0.714        | 0.768 | <b>0.905</b> |              |       |       |       |
| SR  | 0.826        | 0.776 | 0.454        | 0.704 | 0.677 | 0.577        | 0.678 | 0.859        | <b>0.953</b> |       |       |       |
| SI  | 0.807        | 0.882 | 0.608        | 0.709 | 0.737 | 0.742        | 0.857 | 0.794        | 0.801        | 0.769 |       |       |
| TF  | 0.522        | 0.718 | 0.805        | 0.566 | 0.533 | <b>0.941</b> | 0.773 | 0.711        | 0.692        | 0.602 | 0.744 |       |
| VC  | 0.255        | 0.495 | <b>0.921</b> | 0.381 | 0.328 | 0.890        | 0.570 | 0.450        | 0.483        | 0.355 | 0.514 | 0.825 |



**Fig. 2.** Structural model with higher order constructs.

**Table 3**  
Path coefficients.

| Relations                        | Original sample (O) | Sample mean (M) | Standard deviation (STDEV) | Effect sizes ( $f^2$ ) | P values | Acceptance |
|----------------------------------|---------------------|-----------------|----------------------------|------------------------|----------|------------|
| H <sub>12</sub> Direct BF -> GR  | 0.506               | 0.511           | 0.067                      | 0.344                  | 0.000    | Yes        |
| H <sub>10</sub> BF -> OR         | 0.604               | 0.606           | 0.054                      | 0.574                  | 0.000    | Yes        |
| H <sub>9</sub> BF -> TF          | 0.598               | 0.605           | 0.045                      | 0.556                  | 0.000    | Yes        |
| H <sub>11</sub> BF -> VC         | 0.411               | 0.419           | 0.070                      | 0.204                  | 0.000    | Yes        |
| EF -> BF                         | 0.215               | 0.218           | 0.093                      |                        | 0.021    |            |
| EF -> PF                         | 0.851               | 0.855           | 0.023                      |                        | 0.000    |            |
| PF -> BF                         | 0.631               | 0.629           | 0.089                      |                        | 0.000    |            |
| EF -> BF                         | 0.537               | 0.538           | 0.078                      |                        | 0.000    |            |
| H <sub>4</sub> Indirect EF -> GR | 0.381               | 0.387           | 0.060                      |                        | 0.000    | Yes        |
| H <sub>2</sub> EF -> OR          | 0.454               | 0.459           | 0.054                      |                        | 0.000    | Yes        |
| H <sub>1</sub> EF -> TF          | 0.450               | 0.458           | 0.046                      |                        | 0.000    | Yes        |
| H <sub>3</sub> EF -> VC          | 0.309               | 0.317           | 0.058                      |                        | 0.000    | Yes        |
| H <sub>8</sub> PF -> GR          | 0.319               | 0.320           | 0.056                      |                        | 0.000    | Yes        |
| H <sub>6</sub> PF -> OR          | 0.381               | 0.380           | 0.058                      |                        | 0.000    | Yes        |
| H <sub>5</sub> PF -> TF          | 0.377               | 0.381           | 0.064                      |                        | 0.000    | Yes        |
| H <sub>7</sub> PF -> VC          | 0.260               | 0.263           | 0.058                      |                        | 0.000    | Yes        |

English writing skills. It also aligns with Tobari [58], who claimed that BL improved both macro and micro aspects of written products, and Chu [36], who reported that EFL students' collaborative writing directly impacts their improved competence. The path coefficients and effect sizes in Table 3 indicate that BF positively affects TF, OR, VC, and GR varying at moderate to large levels. As a result, the increase in students'

cognitive and behavioral engagement will likely increase their writing performance. This claim suggests that teachers should improve their students' activities in the BL classroom, which fosters their interactions, collaborations, and discussions, and eventually enhances their performance.

Secondly, BL affects students' global aspects of writing more than their

**Table 4**  
Predictive relevance.

|                       | SSO     | SSE     | Q <sup>2</sup> (=1-SSE/SSO) |
|-----------------------|---------|---------|-----------------------------|
| Grammar (GR)          | 592.000 | 489.190 | 0.174                       |
| Organization (OR)     | 592.000 | 444.100 | 0.250                       |
| Task fulfillment (TF) | 592.000 | 434.972 | 0.265                       |
| Vocabulary (VC)       | 592.000 | 525.792 | 0.112                       |

*local matters*. The path coefficients in Table 3 and the predictive relevance in Table 4 show the causal relations between writing performance as the endogenous constructs and their corresponding exogenous constructs, suggesting that BL affects task fulfillment and organization more than vocabulary and grammar. This finding is similar to Phan et al. [15], who reported that BL increased students' cohesion, coherence, and/or lexical range. A good BL model is expected to enable students to develop their writing competence comprehensively. Accordingly, teachers of EFL writing should construct a good BL model in which students can develop all four aspects of writing performance equally.

Thirdly, *writing performance is impacted indirectly by the BL environments and students' personal factors*. The direct relations in Table 3 exhibit that EF and PF positively affect all the examined aspects of writing performance. This finding supports Bandura's [16] TRD and is consistent with Chu [36], who reported that the collaborative writing environment and students' beliefs positively affect their writing competence. As a consequence, teachers of EFL writing should enhance the BL environment, which captures students' beliefs and behaviors, in order to improve their writing performance. When students engage in the BL environment, and they have a positive belief in it, their writing performance can be improved.

Fourthly, *increasing students' behaviors means that the environment and their beliefs have to be enhanced first*. Table 3 shows the positive effects of the BL environment and students' beliefs on their behaviors. This finding supports Bandura's [16] argument that the environment affects students' behavior through their personal traits. It is also concurrent with Chu [36], who reported that both the collaborative writing environment and students' beliefs affect their behaviors. In BL research, Li et al. [10] and Norman [43] claimed that the positive perception of BL can increase students' behavioral use of this model. Therefore, if teachers of EFL writing wish to increase students' BL behaviors, they should improve the BL environment first, which then changes the students' behaviors.

Finally, *increasing the BL environment can predict an increase in students' beliefs and behaviors*. The validated model in Fig. 2 shows that the BL environment is the most exogenous, which suggests that its improvement will linearly boost the other endogenous factors. This finding coincides with Azizi et al. [41] and Dakduk et al. [52], who claimed that BL can positively change students' attitudes and behavioral use of this model. As a result, building an efficient BL environment is the first step to forming students' right perception and enhancing their BL behaviors. As for the BL environment, stakeholders should pay special attention to such features as available facilitating conditions, teachers' methods, students' engagement activities, and the contextual encouragement as indicated in Fig. 1. When the BL environment is well built, students' beliefs and behavior in the writing process will also increase.

Overall, implementing effective BL means that teachers and students should construct a good BL environment, which then influences the other elements of the validated model positively. Regarding students' behaviors, teachers of EFL writing should pay attention to the local aspects of writing in order that students can develop their writing competence more fully.

## 6. Conclusion

The study has addressed the research questions and provided the systems information on how BL impacts EFL students' writing performance. Drawing on the validated model, stakeholders could personalize

the BL environment for EFL writing, especially by maximizing students' behaviors in the writing process, which will likely lead to their improved learning.

This study was completed with the participants from one university; thus, its findings were participant-, context-, and situation-bound. Also, done in a limited amount of time, the validated model did not fully capture all the elements of personal factors such as gender, age groups, experiences, or digital literacy, as Bandura [16] suggested. As a result, the present study's findings have limited generalizability and applicability to all types of BL's issues.

Besides, this study's findings were based on the exploratory inquiry with some limitations mentioned above; future researchers should evaluate their new study contexts closely if they wish to replicate the design or apply its findings. In addition, subsequent studies should be conducted on a larger sample scale to promote its representativeness and applicability.

## Public interest statement

Blended learning (BL), which integrates traditional classroom teaching with online learning, has become a key feature of modern education, offering greater accessibility and engagement. This study investigates the factors that shape English as a Foreign Language (EFL) students' writing performance, with particular emphasis on the affecting role of their behavioural engagement. Focusing on the experiences of university students in Vietnam, the results indicate that boosting students' behaviours can increase their writing competences, manifested in *task fulfillment, organization, vocabulary, and grammar*. At the same time, the environment and the students' personal characteristics show the influences directly on their behaviours and indirectly on their writing results. These insights have important implications for educators and policymakers seeking to personalise BL environments and refine digital learning strategies to increase their students' writing. Overall, the study adds to the ongoing discussion about how technology can be effectively incorporated into language education to promote student achievement and engagement.

## Ethical approval

This paper is part of a PhD project of study in Vietnam and is coauthored by me (Phe Quang Chu), Dr Chowdhury (main supervisor) and Dr Le (Secondary supervisor). The team has worked hard on the project methodologically and methodically for about more than a year now. We all agreed to have part of the project published in your journal.

## Informed consent

The three of us have worked together and met online many times. We have unanimously chosen your journal to submit the manuscript.

## Statement regarding research involving human participants and/or animals

We followed ethical conduct to keep the participants anonymous during and after the project of study was conducted.

## Consent to participate

All the students in the four classes where we conducted research signed the approval form to show their consent for data to be collected. This written approval will be provided if required.

## Consent to publish

The rector of the university where we did research gave us written permission to collect data and have it published. I will include the



approval (in Vietnamese) if required. In the article, we have anonymized the study site.

### Funding

This research is partly funded by University of Finance - Marketing and Ho Chi Minh City Open University.

### Availability of data and materials

The data was collected firsthand from EFL students in a university in Vietnam, and it is stored in the author's devices.

### CRediT authorship contribution statement

**Phe Quang Chu:** Writing – original draft, Validation, Resources, Investigation, Conceptualization. **Raqib Chowdhury:** Writing – review & editing, Methodology, Formal analysis, Data curation, Conceptualization. **Le Thi Thanh Thu:** Writing – review & editing, Visualization, Supervision, Methodology, Conceptualization.

### Declaration of competing interest

Not applicable

## Appendix A. The Scale

| Constructs                            | Variables                                                             | Scores |   |   |   |   |
|---------------------------------------|-----------------------------------------------------------------------|--------|---|---|---|---|
| Self-reflection (SF)                  | SF1. I know how to learn English writing in a BL course.              | 1      | 2 | 3 | 4 | 5 |
|                                       | SF2. I think about what I have gained in the course.                  | 1      | 2 | 3 | 4 | 5 |
|                                       | SF3. I think about how I can write English better.                    | 1      | 2 | 3 | 4 | 5 |
|                                       | SF4. I review what I have written.                                    | 1      | 2 | 3 | 4 | 5 |
|                                       | SF5. Collaboration is good for my writing.                            | 1      | 2 | 3 | 4 | 5 |
|                                       | SF6. I can write English better in BL.                                | 1      | 2 | 3 | 4 | 5 |
| Self-regulation (SR)                  | SR1. I tried to complete writing tasks.                               | 1      | 2 | 3 | 4 | 5 |
|                                       | SR2. I use various resources to write better.                         | 1      | 2 | 3 | 4 | 5 |
|                                       | SR3. I follow certain steps to write an English text.                 | 1      | 2 | 3 | 4 | 5 |
|                                       | SR4. I use technology to improve the quality of my text.              | 1      | 2 | 3 | 4 | 5 |
|                                       | SR5. I give feedback on my peers' papers.                             | 1      | 2 | 3 | 4 | 5 |
|                                       | SR6. I use feedback to improve my writing.                            | 1      | 2 | 3 | 4 | 5 |
| Self-efficacy (SE)                    | SE1. I can address writing tasks.                                     | 1      | 2 | 3 | 4 | 5 |
|                                       | SE2. I can get the results that I expect.                             | 1      | 2 | 3 | 4 | 5 |
|                                       | SE3. I can discuss writing tasks with my peers and teachers.          | 1      | 2 | 3 | 4 | 5 |
|                                       | SE4. BL can help me improve my writing skills.                        | 1      | 2 | 3 | 4 | 5 |
| Effort expectancy (EE)                | EE1. I can use ICT to study English writing in a BL course.           | 1      | 2 | 3 | 4 | 5 |
|                                       | EE2. I can address the writing tasks more easily.                     | 1      | 2 | 3 | 4 | 5 |
|                                       | EE3. BL eases English writing.                                        | 1      | 2 | 3 | 4 | 5 |
|                                       | EE4. I could access various resources to support my writing.          | 1      | 2 | 3 | 4 | 5 |
| Performance expectancy (PE)           | PE1. BL offers opportunities for collaborative writing.               | 1      | 2 | 3 | 4 | 5 |
|                                       | PE2. ICT improves the quality of my text.                             | 1      | 2 | 3 | 4 | 5 |
|                                       | PE3. BL improved my writing performance.                              | 1      | 2 | 3 | 4 | 5 |
|                                       | PE4. BL helps me gain the output I wish to gain.                      | 1      | 2 | 3 | 4 | 5 |
| Facilitating condition (FC)           | FC1. I have the resources necessary to study in BL.                   | 1      | 2 | 3 | 4 | 5 |
|                                       | FC2. I have sufficient knowledge to use technology in BL.             | 1      | 2 | 3 | 4 | 5 |
|                                       | FC3. Technology in the BL course is compatible with my writing needs. | 1      | 2 | 3 | 4 | 5 |
|                                       | FC4. Technical assistance is available.                               | 1      | 2 | 3 | 4 | 5 |
| Social influence (SI)                 | SI1. Using BL for learning is a trend now.                            | 1      | 2 | 3 | 4 | 5 |
|                                       | SI2. <i>Writing 3</i> is a good course for my major.                  | 1      | 2 | 3 | 4 | 5 |
|                                       | SI3. The teacher delivers the course in BL.                           | 1      | 2 | 3 | 4 | 5 |
|                                       | SI4. The university supports my use of BL (policy, facilities...).    | 1      | 2 | 3 | 4 | 5 |
| Interaction with the instructor (IWT) | IWT1. My teacher guides me in learning in BL.                         | 1      | 2 | 3 | 4 | 5 |
|                                       | IWT2. The teacher encourages me to write.                             | 1      | 2 | 3 | 4 | 5 |
|                                       | IWT3. The teacher provides good feedback on my writing.               | 1      | 2 | 3 | 4 | 5 |
|                                       | IWT4. My teacher responds to my needs.                                | 1      | 2 | 3 | 4 | 5 |
| Interaction with peers (IWP)          | IWP1. I exchange my ideas with the other members of my group.         | 1      | 2 | 3 | 4 | 5 |
|                                       | IWP2. I learn new things from the other group members.                | 1      | 2 | 3 | 4 | 5 |
|                                       | IWP3. I develop problem-solving skills through peer collaboration.    | 1      | 2 | 3 | 4 | 5 |
|                                       | IWP4. I develop my writing abilities through peer collaboration.      | 1      | 2 | 3 | 4 | 5 |
| Task fulfillment (TF)                 | IWP5. My peer feedback is helpful for me to improve my writing.       | 1      | 2 | 3 | 4 | 5 |
|                                       | TF1. I generate enough ideas for my writing tasks.                    | 1      | 2 | 3 | 4 | 5 |
|                                       | TF2. My ideas can address all the requirements of the writing task.   | 1      | 2 | 3 | 4 | 5 |
|                                       | TF3. My ideas are well-supported.                                     | 1      | 2 | 3 | 4 | 5 |
| Organization (OR)                     | TF4. I present a clear position in your writing.                      | 1      | 2 | 3 | 4 | 5 |
|                                       | OR1. I organize the information and ideas logically.                  | 1      | 2 | 3 | 4 | 5 |
|                                       | OR2. I use a variety of linking words.                                | 1      | 2 | 3 | 4 | 5 |
|                                       | OR3. I present the text appropriately.                                | 1      | 2 | 3 | 4 | 5 |
| Vocabulary (VC)                       | OR4. My writing is paragraphed appropriately.                         | 1      | 2 | 3 | 4 | 5 |
|                                       | VC1. I use a sufficient range of words.                               | 1      | 2 | 3 | 4 | 5 |
|                                       | VC2. I use a variety of vocabulary.                                   | 1      | 2 | 3 | 4 | 5 |
|                                       | VC3. I can use difficult and less common words.                       | 1      | 2 | 3 | 4 | 5 |
| Grammar (GR)                          | VC4. My vocabulary is error-free.                                     | 1      | 2 | 3 | 4 | 5 |
|                                       | GR1. I can use complicated structures.                                | 1      | 2 | 3 | 4 | 5 |
|                                       | GR2. I can ensure a variety of sentence structures.                   | 1      | 2 | 3 | 4 | 5 |
|                                       | GR3. My grammar mistakes rarely lead to misunderstanding.             | 1      | 2 | 3 | 4 | 5 |
|                                       | GR4. Most sentences are error-free.                                   | 1      | 2 | 3 | 4 | 5 |

## Appendix B. Outer loadings

|      | EE    | FC    | GR    | IWP   | IWI   | OR    | PE    | SE    | SF    | SR    | SI    | TF    | VC    |
|------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| EE1  | 0.866 |       |       |       |       |       |       |       |       |       |       |       |       |
| EE2  | 0.819 |       |       |       |       |       |       |       |       |       |       |       |       |
| EE3  | 0.874 |       |       |       |       |       |       |       |       |       |       |       |       |
| EE4  | 0.742 |       |       |       |       |       |       |       |       |       |       |       |       |
| FC1  |       | 0.823 |       |       |       |       |       |       |       |       |       |       |       |
| FC2  |       | 0.745 |       |       |       |       |       |       |       |       |       |       |       |
| FC3  |       | 0.814 |       |       |       |       |       |       |       |       |       |       |       |
| FC4  |       | 0.767 |       |       |       |       |       |       |       |       |       |       |       |
| GR1  |       |       | 0.847 |       |       |       |       |       |       |       |       |       |       |
| GR2  |       |       | 0.865 |       |       |       |       |       |       |       |       |       |       |
| GR3  |       |       | 0.812 |       |       |       |       |       |       |       |       |       |       |
| GR4  |       |       | 0.842 |       |       |       |       |       |       |       |       |       |       |
| IWI1 |       |       |       |       | 0.940 |       |       |       |       |       |       |       |       |
| IWI2 |       |       |       |       | 0.918 |       |       |       |       |       |       |       |       |
| IWI3 |       |       |       |       | 0.889 |       |       |       |       |       |       |       |       |
| IWI4 |       |       |       |       | 0.831 |       |       |       |       |       |       |       |       |
| IWP1 |       |       |       | 0.874 |       |       |       |       |       |       |       |       |       |
| IWP2 |       |       |       | 0.889 |       |       |       |       |       |       |       |       |       |
| IWP3 |       |       |       | 0.810 |       |       |       |       |       |       |       |       |       |
| IWP4 |       |       |       | 0.868 |       |       |       |       |       |       |       |       |       |
| IWP5 |       |       |       | 0.819 |       |       |       |       |       |       |       |       |       |
| OR1  |       |       |       |       |       | 0.821 |       |       |       |       |       |       |       |
| OR2  |       |       |       |       |       | 0.824 |       |       |       |       |       |       |       |
| OR3  |       |       |       |       |       | 0.856 |       |       |       |       |       |       |       |
| OR4  |       |       |       |       |       | 0.861 |       |       |       |       |       |       |       |
| PE1  |       |       |       |       |       |       | 0.891 |       |       |       |       |       |       |
| PE2  |       |       |       |       |       |       | 0.884 |       |       |       |       |       |       |
| PE3  |       |       |       |       |       |       | 0.905 |       |       |       |       |       |       |
| PE4  |       |       |       |       |       |       | 0.850 |       |       |       |       |       |       |
| SE1  |       |       |       |       |       |       |       | 0.869 |       |       |       |       |       |
| SE2  |       |       |       |       |       |       |       | 0.868 |       |       |       |       |       |
| SE3  |       |       |       |       |       |       |       | 0.792 |       |       |       |       |       |
| SE4  |       |       |       |       |       |       |       | 0.848 |       |       |       |       |       |
| SF1  |       |       |       |       |       |       |       |       | 0.796 |       |       |       |       |
| SF2  |       |       |       |       |       |       |       |       | 0.739 |       |       |       |       |
| SF3  |       |       |       |       |       |       |       |       | 0.730 |       |       |       |       |
| SF4  |       |       |       |       |       |       |       |       | 0.660 |       |       |       |       |
| SF5  |       |       |       |       |       |       |       |       | 0.689 |       |       |       |       |
| SF6  |       |       |       |       |       |       |       |       | 0.778 |       |       |       |       |
| SI1  |       |       |       |       |       |       |       |       |       |       | 0.758 |       |       |
| SI2  |       |       |       |       |       |       |       |       |       |       | 0.778 |       |       |
| SI3  |       |       |       |       |       |       |       |       |       |       | 0.797 |       |       |
| SI4  |       |       |       |       |       |       |       |       |       |       | 0.788 |       |       |
| SR1  |       |       |       |       |       |       |       |       |       | 0.780 |       |       |       |
| SR2  |       |       |       |       |       |       |       |       |       | 0.707 |       |       |       |
| SR3  |       |       |       |       |       |       |       |       |       | 0.823 |       |       |       |
| SR4  |       |       |       |       |       |       |       |       |       | 0.764 |       |       |       |
| SR5  |       |       |       |       |       |       |       |       |       | 0.679 |       |       |       |
| SR6  |       |       |       |       |       |       |       |       |       | 0.685 |       |       |       |
| TF1  |       |       |       |       |       |       |       |       |       |       |       | 0.850 |       |
| TF2  |       |       |       |       |       |       |       |       |       |       |       | 0.891 |       |
| TF3  |       |       |       |       |       |       |       |       |       |       |       | 0.859 |       |
| TF4  |       |       |       |       |       |       |       |       |       |       |       | 0.876 |       |
| VC1  |       |       |       |       |       |       |       |       |       |       |       |       | 0.861 |
| VC2  |       |       |       |       |       |       |       |       |       |       |       |       | 0.905 |
| VC3  |       |       |       |       |       |       |       |       |       |       |       |       | 0.870 |
| VC4  |       |       |       |       |       |       |       |       |       |       |       |       | 0.734 |

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## Further reading

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