

RESEARCH ARTICLE

Modeling the relationship between online L2 motivational self-system and EFL learners' virtual exchange self-regulations: the mediator and moderator roles of L2 grit

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Abstract

While previous studies in computer-assisted language learning have extensively explored sociolinguistic factors, such as cultural competence, important psycholinguistic factors such as online L2 motivational self-system, L2 grit, and online self-regulation in relation to virtual exchange (VE) have remained widely unexplored. To address this gap, a study was conducted with 92 Spanish English as a foreign language learners who exchanged language and culture with Cypriot and Irish students and responded to questionnaires adapted for the study context, as part of the SOCIEMOVE (Socioemotional Skills Through Virtual Exchange) Project. The partial least squares structural equation modeling approach showed that language learners who set positive personal goals for the future and evaluate their current learning progress in VE can regulate their learning in it. Interestingly, the sign of authenticity gap was found in the study context, since learners' motivation to learn in VE was higher compared to their previous language learning contexts, resulting in more effort and consistency of interest in setting their goals, evaluating their progress, and asking for help from others. Furthermore, learners' L2 grit moderated and mediated the correlation between learners' online motivation and online self-regulation, indicating that VE success requires long-term perseverance of effort and consistency of interest. Accordingly, a new conceptual framework for VE was developed. In addition, one of the main implications is that teachers who employ VE should focus more on learners' current needs and the goals they wish to achieve when exchanging information rather than only focusing on their accomplishments based on the course syllabus.

Keywords: virtual exchange; L2 motivational self-system; online self-regulation; L2 grit; digital self-authenticity; partial least squares structural equation modeling (PLS-SEM)

1. Introduction

Increasing trade tensions, political instability, polarization and populism have made connecting more critical than ever for people from different cultures. Virtual exchange (VE) is widely recognized as one of the most effective contexts for enhancing students' intercultural awareness and proficiency in foreign languages. Researchers in computer-assisted language learning (CALL)

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have documented a variety of positive outcomes associated with VE, including the development of language skills (Luo & Gui, 2021), pragmatic competence (Zhang, 2024), grammatical proficiency (Zhang, 2024), lexical competence (Liu, Zhang & Zhang, 2024), and 21st-century digital competences (Sevilla-Pavón & Nicolaou, 2022). Furthermore, its importance has been highlighted for fostering intercultural communicative competence (ICC; O’Dowd, 2021b).

Despite the steady growth of VE in the last two decades, several gaps have yet to be addressed. First, many VE studies rely on qualitative data gathering and analysis with relatively small sample sizes, this being one of the main issues found in such studies (Rienties & Rets, 2022). In line with this, Baroni *et al.*, (2019) underlined that VE studies failed to implement evidence-based designs or use extensive samples to show its influence. This concern was also highlighted by Golonka, Bowles, Frank, Richardson and Freynik (2014), who reported similar findings in their critical review of 350 CALL studies, which were predominantly descriptive case studies with small sample sizes and poor variables.

Second, most studies reported that VE successfully developed learners’ ICC, language skills, or subskills (Luo & Gui, 2021; Zhang, 2024), indicating its success from sociolinguistic and language teaching perspectives. However, in comparison to face-to-face settings, VE’s ecosystem has unique affordances and constraints that may influence learners’ psychology. According to Müller-Hartmann (2005), internet-mediated intercultural exchange is both highly complex and pedagogically challenging, as the “complex learning environments of telecollaborative exchanges” (Kurek, 2015: 27) and “the complexity of the actual telecollaborative classroom” (Grau & Turula, 2019: 110) culminate in “instability and unpredictability” due to a host of different elements involved (i.e. tasks, participants, materials) (Kurek, 2015). A further layer of complexity is added by issues such as failed communication, technological difficulties and tensions, conflicts, and power issues arising from differences in expectations, motivations, and cultural backgrounds. Given this complexity, psychological traits like motivation, persistence, and self-regulation learning (SRL) are key to making sure that VE practices work, ensuring students can handle the difficulties and complexity involved, which could lead to better academic performance. Accordingly, students need to develop cognitive, affective, and behavioral factors to persevere and succeed. These include online motivation, online self-regulation, L2 grit, and emotional engagement (Dörnyei & Ryan, 2015) and are among the dynamic complex systems present in second language acquisition (SLA; Freeborn, Andringa, Lunansky & Rispens, 2023), which, in spite of their relevance, have rarely been explored in VE. In a nutshell, VE has received relatively little attention as a successful tool from a psycholinguistic perspective. In their recent integrative reviews, leading experts recommended that scholars focus on aspects of VE other than language skills and ICC (Colpaert, 2020; Luo & Yang, 2021; O’Dowd, 2021a). In order to bridge these gaps, the present study was guided by online L2 motivational self-system (OL2MSS), L2 grit, and online self-regulation (OSEL). The integration of these psychological traits and factors was deemed appropriate for a better understanding of the psycholinguistic mechanisms underlying VE learning processes. Thus, researchers developed the following research questions:

- RQ1: What are the factorial structures of OL2MSS, online L2 grit, and OSEL in VE and Spanish English as a foreign language (EFL) contexts?
- RQ2: To what extent can learners’ OL2MSS predict their online L2 grit and OSEL in VE?
- RQ3: To what extent can online L2 grit mediate the relationship between learners’ OL2MSS and their OSEL in VE?

2. Theoretical frameworks

2.1 Online L2 motivational self-system

Extensive research into L2 motivation has emphasized motivation’s internal structure as well as its relationship to other concepts. Dörnyei’s (2009) L2 motivational self-system has dominated L2

motivation research, replicating Gardner's (1985) socio-educational model for two reasons. First, there is evidence that integrative motivation is feasible, for instance, with French-speaking learners in bilingual contexts, such as Belgium. However, its explanatory power is limited when it comes to language motivational behavior in EFL contexts (Liu, 2024). Furthermore, Dörnyei (2009) claimed that integrativeness is not possible in EFL contexts because learners do not have direct contact with the target learning context. Thus, he developed the L2MSS theory, which posits that learners' motivation is composed of three main constructs: the ideal L2 self, or the image of one's future self that expresses their desire to become a competent L2 speaker; the ought-to L2 self, or the sense of obligation to meet expectations and avoid negative consequences; and the L2 learning experience, or the specific contextual factors that motivate students to engage in language learning.

L2MSS has successfully been applied to single and multiple target languages in monolingual and multilingual contexts (Rahimi *et al.*, 2025). Its outputs have consistently grown, and SLA meta-analyses have demonstrated the model's utility (Yousefi & Mahmoodi, 2022). Although Dörnyei's model reframes L2 motivation as a self-system, he does not fully elaborate on its function or provide a clear justification for its inclusion within the self-system. This poses difficulties in measuring discrepancies between present and future selves (Thorsen, Henry & Cliffordson, 2020), and the concept of the self-system remains a puzzle. In response to these criticisms, SLA scholars have extended and adapted this model, particularly by incorporating information and communications technology (ICT). For clarification, they introduced the current L2 self factor and compared its predictive power with that of the ideal L2 self in traditional (Henry & Cliffordson, 2017) and online language learning (OLL) contexts (Rahimi & Mosalli, 2024; Smith, Foster, Baffoe-Djan, Li & Yu, 2020). Considering that digital language learning is closer to learners' needs in their private lives, they devote much more motivation and effort to it, leading Henry and Cliffordson (2017) to add the authenticity gap to the original L2MSS and SLA, which was validated by recent studies in language massive open online course (LMOOC; Rahimi, 2023), ChatGPT-assisted language learning (Rahimi, Sheyhkhosslami & Mahmoudi Pour, 2025), and OLL (Rahimi & Mosalli, 2024; Smith *et al.*, 2020). Since the exploratory power of these constructs in VE has not yet been explored, they were operationalized for the current study:

- **Ideal L2 self:** learners' desirable self-image to exchange language in VE to reach their future personal objectives.
- **Ought-to L2 self:** learners' sense of obligation to use the target language in VE to avoid negative outcomes, such as failing a university course.
- **Current L2 self:** learners' self-assessment of their current language proficiency and ability to use the language in VE contexts.
- **Digital self-authenticity:** the comparison between students' motivation in VE and their previous experiences with traditional language learning.

2.2 L2 grit

Grit is a relatively newly established individual trait defined as "perseverance and passion for long-term goals," which comprises two constructs: perseverance of effort and consistency of interest (Duckworth, Peterson, Matthews & Kelly, 2007: 1087). Consistency of interest refers to an individual's consistency of passion for a goal regardless of challenges, obstacles, or failures encountered along the way. Meanwhile, perseverance of effort refers to an individual's ability to invest durable energy over a long period, which enables them to achieve incredible personal growth through more demanding challenges and interests (Duckworth *et al.*, 2007). Nevertheless, a recent meta-analysis questioned the predictive power of general grit in language learning (Cred, Tynan & Harms, 2017), leading Teimouri, Plonsky and Tabandeh (2022) to develop language-specific grit. Since then, exploring L2 grit and how it behaves in various language learning contexts has become an active research topic for both traditional face-to-face classrooms (Zhang, 2023),

OLL (Paradowski & Jelińska, 2024), and CALL environments (Zarrinabadi, Rezazadeh & Mohammadzadeh Mohammadabadi, 2024). It has, however, not been addressed in terms of its effect on learners' behaviors in VE contexts, particularly in correlation with online motivation and self-regulation. Therefore, it is important to study these factors given that they are among complex dynamic systems in SLA that have a significant impact on L2 proficiency development (Oxford, 2016).

2.3 Virtual exchange self-regulation

Self-regulation is derived from educational psychology and is a multifaceted and process-oriented concept (Dörnyei & Ryan, 2015). It refers to “self-generated thoughts, feelings, and actions that are planned and cyclically adapted to attaining personal goals” (Zimmerman, 2000: 14). Learning to regulate one's own behavior becomes a cornerstone of successful communication, which is one of the most critical requirements of VE success. It serves as the internal conductor that guides students in translating their mental abilities into tangible language skills, as highlighted by Zimmerman (2000). This dynamic process encompasses motivation, metacognition, and behavioral control (Oxford, 2016), and equips learners with tools that enable them to effectively manage emotions, thoughts, and behaviors (Zimmerman, 2001). This self-directed process culminates in the development of one's capacity for continuous, conscious cognitive management, which includes self-regulation within complex dynamic systems in SLA (Oxford, 2016).

Due to the context-specific behavior of psychological factors in various language learning contexts and the evolution and integration of ICT into education, where learners require more self-direction and control over their learning process, SLA researchers have started to explore the predictive power of self-regulation in digital language learning contexts. In this line, a six-factor questionnaire for assessing learners' online self-regulation (OSEL) was developed by Barnard, Lan, To, Paton & Lai (2009), which included goal setting, time management, task strategies, environment structuring, help-seeking, and self-evaluation. Furthermore, Fuchs *et al.* (2022) classified these six psychosocial factors into metacognitive strategies (goal setting and self-evaluation), resource management strategies (environment structuring, time management, and help-seeking), and cognitive strategies (task strategies).

OSEL has been applied or adapted to measure learners' online self-regulatory strategies in different CALL contexts, such as ChatGPT-assisted language learning (Rahimi *et al.*, 2025) LMOOCs (Rahimi & Cheraghi, 2022) and OLL (Rahimi & Sevilla-Pavón, 2024b; Zheng, Liang, Chai, Chen & Liu, 2023). Having been designed to measure students' OSEL for general purposes, the questionnaire needs more explanatory power when discussing learners' OSEL strategies relevant to specific academic subfields. Although there has been substantial research on OSEL and technology-supported SRL (Fuchs *et al.*, 2022; Rahimi & Cheraghi, 2022; Zheng, Liang, Li & Tsai, 2018), there are limited empirical reports about learners' OSEL in the CALL field, specifically in VE contexts such as the one in the present study.

3. Literature review and literature gap

CALL studies have indicated that motivation is one of the most critical factors for promoting learners' psychological strengths, including emotional, cognitive, and behavioral factors (Lamb & Arisandy, 2020; Rahimi, 2023). There is evidence that the ideal L2 self has a more significant impact on learners' intended effort in commonly taught languages than in less commonly taught languages (Smith *et al.*, 2020). Moreover, Gu and Cheung (2016) found both a direct and indirect impact of the ideal L2 self on intended effort through acculturation to the mainstream culture. Additionally, Rahimi (2023) reported that both future ideal and ought-to L2 self-images shaped Iranian EFL learners' behavioral intentions to learn a language in LMOOCs. This may be due to the fact that motivational factors exhibit different behaviors depending on the environment and

course (Rahimi, 2023; You & Dörnyei, 2016). To clarify, Thompson & Liu (2018) found that Chinese female language learners exhibited stronger ideal selves than male students and that high motivation was related to the ideal L2 self. Furthermore, lower-proficiency students displayed stronger ought-to L2 selves, possibly due to external pressures. In their study, You and Dörnyei (2016) found that ideal and ought-to L2 selves significantly influenced Chinese learners' attitudes and efforts to learn English. Additionally, motivation differed between more developed and less developed regions. These differences, which may have been influenced by social class and resource allocations, resulted in the finding that Global South learners were more motivated than Global North learners to maintain their efforts and attitudes toward learning. In Eastern and European countries, out-of-class digital learning environments negatively impacted learners' motivation in their traditional language learning context (Henry, 2013). In fact, students may be motivated to seek similar self-congruent and aesthetically powerful experiences elsewhere due to the precious cognitive, emotional, and aesthetic experiences gained in digital environments (Rahimi *et al.*, 2025). Learners are expected to engage in very different social practices in digital learning formats, as opposed to those in the regimented and often mundane language classroom environments. This, caused by the lack of opportunities for autonomy, personal expression, and creativity (Henry & Cliffordson, 2017), led Henry and Cliffordson (2017) to the observation of the "authenticity gap," relating to traditional learning environments, which negatively affected learners' efforts and motivation in classroom settings. They concluded that learners' current L2 self and authenticity gap negatively affected their efforts in traditional learning settings. In a replication study conducted by Smith *et al.* (2020), the authenticity gap and current L2 self were determined as predictors of Chinese language learners' efforts in an online language context. Meanwhile, Lamb and Arisandy (2020) did not observe any authenticity gaps in the Indonesian EFL context. Nevertheless, this gap was recently identified in the Iranian EFL context, and it was found to shape language learners' intention to learn language in LMOOCs (Rahimi, 2023) and OLL (Rahimi & Mosalli, 2024). Although the role of L2 self-identities and digital self-authenticity has been studied in correlation with learners' efforts and attitudes in various digital language learning contexts, their influence on learners' self-direction strategies, efforts, and interests in other Western countries, such as Spain, has not been examined, resulting in the exploration of these correlations with learners' L2 grit and virtual exchange self-regulation (VESRL) in VE in the current study.

L2 self-identities have been cited as one of the prerequisite factors in shaping learners' self-regulation in both traditional (Kormos & Csizér, 2013; Zimmerman & Kitsantas, 2014) and digital language learning contexts (Rahimi & Cheraghi, 2022; Rahimi *et al.*, 2025). Rahimi and Cheraghi (2022) and Zheng *et al.* (2018) provided further supportive evidence that the cultural and instrumental interests of Chinese and Iranian English language learners affected their metacognitive, management, and cognitive strategies in asking for help from others and for evaluating their progress in OLLs and LMOOCs. In an effort to continue exploring the influence of the L2 motivational self-system on learners' OSEL in digital language learning, the current study will use VE as a means to do so.

Alongside learners' motivation and self-regulation, L2 grit has been recognized as a critical psychological factor that can influence learners' language learning performance. However, due to its recent integration, only a few studies have examined its relationship with language learners' motivation. It should be clarified that after developing the concept of L2 grit, Teimouri *et al.* (2022) explored its correlation with EFL learners' motivation, incorporating learners' willingness to communicate (WTC), intended effort, mindset, and attention. They found that language learners' motivation and their level of L2 grit were positively correlated. Furthermore, Paradowski and Jelińska (2024) reported similar findings regarding OLL, where learners were motivated to preserve their effort and devote more interest to their online language course due to their autonomy and online readiness. Furthermore, Fathi and Hejazi (2024) found that Iranian EFL learners' ideal L2 self was related to their L2 grit and that both language learners' perseverance of effort and consistency of interest played a mediation role in their language learning enjoyment, as

Table 1. Participants' demographic information

		<i>n</i>	%
Gender	Male	9	9.8
	Female	83	90.2
Age	18–22	79	83.7
	23–26	7	7.6
	> 26	6	6.5
	Years		
Language learning experience	1–2	2	2.2
	3–5	72	78.3
	4 <	18	14.1

well as their achievement in traditional language learning contexts. Furthermore, the relationship between learners' ideal L2 self and both writing achievements (Zhang, 2023) and WTC (Yu & Ma, 2024) was found to be mediated by L2 grit. However, more research is needed to examine the mediation effects of L2 grit in other language learning contexts and in conjunction with other psychological factors, as the complex dynamic systems highlighted the interrelationship between language learners' cognitive, effective, and behavioral factors in SLA (Oxford, 2016) and every language learning setting, VE not being an exception. As a result, in this study, we are attempting to fill several gaps in the literature regarding psycholinguistics, applied linguistics, and VE. First, not only have learners' motivational self-system, L2 grit, and OSEL been under-researched, but also no study has confirmed the factorial structure of these constructs in VE. Second, there have been no prior studies in VE that look at how online L2 self-identities affect the psychological factors that language learners use to have successful language exchanges, even though L2MSS acts in different ways in different language learning situations (Henry & Cliffordson, 2017; You & Dörnyei, 2016). Third, while applied linguistics has previously discussed the role of motivational self-system factors, such as the ideal self and ought-to self, in shaping language learners' success, the two most recent factors incorporated into L2MSS, the current L2 self and digital self-authenticity, have not been considered. In this regard, recent studies recommend exploring the predictive differences between the current L2 self and the ideal L2 self in predicting learners' behaviors (Rahimi & Mosalli, 2024; Rahimi *et al.*, 2025; Smith *et al.*, 2020). Moreover, even though digital self-authenticity in LMOOCs (Rahimi, 2023), ChatGPT-assisted language learning (Rahimi *et al.*, 2025), and OLL (Smith *et al.*, 2020) has been studied in applied linguistics, it still needs to be addressed in VE. Additionally, while recent studies in VE have extensively explored cultural competence and applied qualitative designs (O'Dowd, 2021b), we intend to take a step forward by using a multi-level analysis to validate the factorial structure of OL2MSS, L2 grit, and OSEL in VE, as well as to develop a conceptual model to show how these factors are serially related to the development of learners' cognitive, metacognitive, and management strategies while exchanging language in VE.

4. Methodology

4.1 Study participants

The study involved 92 students majoring in English studies at the Universitat de València (UV) in Spain. During the fall semester of 2023, they exchanged cultural and historical information with

Cypriot and Irish students from Cyprus University of Technology (CUT) and Limerick University (UL) in Ireland, respectively. Most respondents (83%) were female, followed by a smaller number of males (9.8%). There were 79 participants aged 18–22, seven aged 23–26, and six over 26. Table 1 summarizes the demographic information.

4.2 Study procedure

The SOCIEMOVE project participants came from Cyprus, Ireland, and Spain. Throughout the fall semester of 2023, they collaborated in two hybrid tandem partnerships from which data were collected. The first partnership involved students from Cyprus and Spain, interacting in English as a lingua franca, while the second one involved Irish and Spanish learners participating in tandem (Spanish–English) exchanges. Participants were grouped to communicate synchronously and collaborate on the final project output. Moreover, all of them interacted asynchronously on Google Classroom in either English or Spanish through a common discussion forum. Together with lecturers from the other two participant institutions, the second author of this paper facilitated both partnerships and designed the tasks completed by participants.

Guth and Helm's (2011) model was followed. Thus, three main VE stages were present, involving communication via a wide range of synchronous and asynchronous tools: learning management systems (Moodle), virtual learning environments (Google Classroom), 3D (Spatial) and 2D (Zoom) videoconferencing tools, instant messaging tools (WhatsApp), collaborative writing tools (Google Docs), and video editing tools (Movie Maker), among others. Several tasks were common to both partnerships, while the tasks connected to the final collaborative artifact differed, as they were adapted to each curriculum and needs: Business Management and Spanish Language and Culture for UL participants, History and Culture of English-Speaking Countries for UV participants, and Public Relations and English Language Communication for CUT participants.

As part of the “Breaking the Ice” stage between three universities, participants exchanged short self-introduction videos as well as ice-breaking questions and answers in the Google Classroom community in written, audio, or video forms. Different games (e.g. Kahoot!) and language activities were then played. Next, participants interviewed a female historical figure from the target country in the AI app Hello History and shared the results in a Google Docs summary. After locating additional information about their chosen historical figure, they compared the information gathered from multiple online and written sources and updated their summaries. In the second stage, learners completed comparison tasks regarding cultural, linguistic, and historical elements from their target country(ies) and culture(s). Then they moved on to the main collaborative task, which differed for each partnership, resulting in different final artifacts.

In the third and last stage, participants in the UV–CUT partnership created their ideal country and collaboratively wrote two scripts, with the first describing the features of the new country as objectively as possible, and the second communicating the advantages of the new country more persuasively. These scripts subsequently became the voice-over narration of (a) a digital story in the form of a fictitious history documentary that objectively described the main characteristics of the new, ideal country; and (b) a digital story in the form of an advertisement aimed at persuading the earth population to move into the new country. Students met synchronously in Spatial for the first and second time to organize their work, and then exchanged feedback and suggestions for improvement on the scripts, before submitting their final project artifacts.

As for the UV–UL partnership, the third and final stage involved creating digital stories using the information from their interviews with historical figures. Thus, three synchronous meetings were held on Spatial. A report followed, as well as different drafts of scripts about historical figures from English-speaking countries (UV) or Hispanic countries (UL), with opportunities to exchange feedback and suggestions for improvement. The final script became the voice-over

narration, which was combined with images, text (e.g. subtitles and captions), videos, and music to create digital stories as their final artifacts.

Having created and shared these artifacts on Google Classroom, the final common task was to assess the work produced by the different groups by exchanging comments asynchronously on Google Classroom, as if reviewing a movie. Afterwards, each digital story was assessed individually with a rubric. A third and last synchronous meeting in Spatial followed to assess the project from their own perspectives as well as their partners'. The final step involved submitting their third report and answering the post-questionnaire (see supplementary material), which was rated on a 5-point Likert scale ranging from 1 = *strongly disagree* to 5 = *strongly agree*. The data were normally distributed between -2 and 2.

4.3 Data analysis

The partial least squares structural equation modeling approach (PLS-SEM) was applied for several reasons. First, several recent studies have widely applied qualitative designs, but VE literature requires more quantitative statistics (Rienties & Rets, 2022) with a higher level of accuracy and exploratory nature. Having grafted ordinary least squares with principal components analysis, the PLS-SEM minimizes the error terms and explains latent variables' variance through the coefficient of determination (R^2), specializing this approach for theory development (Hair, Sarstedt, Ringle & Gudergan, 2023), which is the main objective of this study. It also implements higher-order constructs, which simultaneously specify a construct on multiple levels of abstraction, making it a superior approach for mediation analysis (Sarstedt, Hair, Nitzl, Ringle & Howard, 2020). As an additional advantage, it can simultaneously process reflective and formative evaluation (Hair *et al.*, 2023).

5. Results

5.1 Measurement model

An assessment of the variables' indicator reliability, internal consistency reliability, convergent validity, and discriminant validity forms the basis of the measurement phase of PLS-SEM. In general, indicator loadings greater than 0.708 are acceptable, as this construct will explain over 50% of the indicator variance (Hair *et al.*, 2023). Cronbach's alpha and composite reliability coefficients (ρ_A) were applied in this case, and all three measures were significant. Average variance extracted (AVE) was applied to assess the convergent validity of the indicators. To accurately predict at least 50% of the variance associated with indicators, Hair *et al.* (2023) concluded that the AVE needs to be above 0.50. As illustrated in Table 2, the study items demonstrated greater convergent validity.

The measurement model should also assess discriminant validity. A heterotrait-monotrait ratio of correlations was used to evaluate discriminant validity, and the validity of the study variables was found to be below the criteria of 0.90 (Hair *et al.*, 2023), as shown in Table 3.

5.2 Structural model

The structural model was evaluated through collinearity, path coefficients, significance levels, and predictive power, accuracy, and overall fit, and 5,000 subsamples were used to determine the robustness of the indicator loadings and the significance of the relationship between variables. To begin with, the variance inflation factor was used to measure collinearity, and all of them were below the cut-off threshold of 0.05 (Hair *et al.*, 2023). An analysis of path coefficient, which is shown in Table 4, presented that the paths DSA->CI ($\beta = 0.391$), DSA->PE ($\beta = 0.326$), IDL->CI ($\beta = 0.379$), IDL->PE ($\beta = 0.319$), IDL->CI ($\beta = 0.379$), CU->PE ($\beta = 0.192$), CI->HS ($\beta = 0.548$), CI->SE ($\beta = 0.490$), PE->GS ($\beta = 0.633$), and PE->SE ($\beta = 0.212$) were

Table 2. The reliability and validity of the study variables

Variable	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
DSA	0.856	0.864	0.912	0.776
CI	0.846	0.848	0.907	0.765
CU	0.869	0.877	0.920	0.793
GS	0.858	0.869	0.913	0.779
HS	0.789	0.816	0.876	0.704
IDL	0.894	0.896	0.934	0.825
OUT	0.904	0.906	0.940	0.839
PE	0.837	0.843	0.902	0.754
SE	0.804	0.832	0.883	0.715
TS	0.849	0.925	0.903	0.758

Table 3. Heterotrait-monotrait ratio – Matrix

Variable	DSA	CI	CU	GS	HS	IDL	OUT	PE	SE	TS
DSA										
CI	0.653									
CU	0.361	0.234								
GS	0.468	0.407	0.089							
HS	0.440	0.734	0.364	0.301						
IDL	0.546	0.634	0.384	0.350	0.600					
OUT	0.218	0.159	0.115	0.202	0.162	0.129				
PE	0.657	0.554	0.480	0.770	0.457	0.641	0.266			
SE	0.431	0.692	0.185	0.459	0.448	0.482	0.307	0.538		
TS	0.194	0.229	0.229	0.090	0.283	0.101	0.098	0.220	0.138	

significant. As for the rest, their t value and p value were below 1.96 and higher than 0.05, respectively, indicating no significant correlation between the variables.

The direct bootstrap analysis with 5,000 subsamples was run to explore the direct effect size of OL2MSS on learners' OSEL. As shown in Table 5, digital self-authenticity significantly predicted GS ($\beta = 0.228$; confidence interval (CI) [0.104, 0.362]), HS ($\beta = 0.254$; CI [0.148, 0.353]), SE ($\beta = 0.261$; CI [0.159, 0.374]). Moreover, ideal L2 self positively predicted learners' goal-setting ($\beta = 0.223$; CI [0.086, 0.355]), help-seeking ($\beta = 0.247$; CI [0.112, 0.393]), and self-evaluation ($\beta = 0.254$; CI [0.125, 0.379]), while the remainder failed to directly predict learners' OSEL factors.

To answer the third research question, we ran an indirect bootstrap analysis with 5,000 subsamples to investigate the mediation role of L2 grit. Accordingly, the results showed that learners' consistency of interest significantly mediated the correlation between IDL-SE ($\beta = 0.186$; CI [0.074, 0.300]), IDL-HS ($\beta = 0.208$; CI [0.077, 0.357]), DSA-SE ($\beta = 0.192$; CI [0.081, 0.312]), and DSA-HS ($\beta = 0.214$; $t = 3.23$; CI [0.107, 0.322]). Furthermore, the consistency of interest significantly

Table 4. Result of the bootstrap analysis

Paths	β	Variance inflation factor	<i>t</i> values	<i>p</i> values
DSA->CI	0.391	1.37	5.145	0.000
DSA->PE	0.326	1.37	4.289	0.000
IDL->CI	0.379	1.37	3.792	0.000
IDL->PE	0.319	1.37	3.665	0.000
OUT->CI	-0.027	1.04	0.318	0.751
OUT->PE	-0.113	1.04	1.446	0.148
CU->CI	-0.057	1.16	0.553	0.581
CU->PE	0.192	1.16	2.091	0.037
PE->GS	0.633	1.28	5.050	0.000
PE->HS	0.123	1.28	1.272	0.203
PE->SE	0.212	1.28	2.332	0.020
PE->TS	0.137	1.28	1.207	0.228
CI->GS	0.056	1.28	0.438	0.662
CI->HS	0.548	1.28	5.876	0.000
CI->SE	0.490	1.28	5.048	0.000
CI->TS	0.151	1.28	1.191	0.234

Table 5. Result of the direct analysis

Paths	β	2.5%	97.5%	<i>t</i> value	<i>p</i> values
DSA->GS	0.228	0.104	0.362	3.476	0.001
DSA->HS	0.254	0.148	0.353	4.871	0.000
DSA->SE	0.261	0.159	0.374	4.786	0.000
DSA->TS	0.104	-0.008	0.209	1.955	0.051
CU->GS	0.118	-0.022	0.244	1.786	0.074
CU->HS	-0.008	-0.139	0.119	0.120	0.904
CU->SE	0.013	-0.110	0.136	0.203	0.839
CU->TS	0.018	-0.052	0.103	0.450	0.653
IDL->GS	0.223	0.086	0.355	3.255	0.001
IDL->HS	0.247	0.112	0.393	3.433	0.001
IDL->SE	0.254	0.125	0.379	3.953	0.000
IDL->TS	0.101	-0.017	0.210	1.838	0.066
OUT->GS	-0.073	-0.196	0.025	1.315	0.188
OUT->HS	-0.029	-0.129	0.073	0.567	0.571
OUT->SE	-0.038	-0.141	0.055	0.755	0.450
OUT->TS	-0.020	-0.067	0.033	0.791	0.429

Table 6. Indirect bootstrap analysis

Indirect paths	β	2.5%	97.5%	<i>t</i> value	<i>p</i> value
OUT->CI->GS	-0.002	-0.036	0.019	0.120	0.905
IDL->CI->SE	0.186	0.074	0.300	3.234	0.001
IDL->CI->HS	0.208	0.077	0.357	2.877	0.004
DSA->PE->TS	0.045	-0.030	0.129	1.137	0.256
IDL->PE->SE	0.068	0.008	0.150	1.858	0.063
DSA->PE->HS	0.040	-0.023	0.111	1.201	0.230
DSA->CI->GS	0.022	-0.085	0.125	0.426	0.670
IDL->PE->HS	0.039	-0.018	0.119	1.118	0.264
CU->CI->HS	-0.031	-0.148	0.078	0.550	0.582
OUT->PE->GS	-0.072	-0.193	0.023	1.316	0.188
OUT->CI->SE	-0.013	-0.102	0.069	0.313	0.754
CU->PE->GS	0.122	0.004	0.247	2.014	0.044
CU->CI->SE	-0.028	-0.135	0.071	0.548	0.584
IDL->PE->TS	0.044	-0.027	0.131	1.105	0.269
OUT->CI->HS	-0.015	-0.106	0.079	0.322	0.747
IDL->CI->GS	0.021	-0.083	0.122	0.422	0.673
OUT->PE->SE	-0.024	-0.078	0.007	1.096	0.273
CU->CI->TS	-0.009	-0.057	0.034	0.396	0.692
DSA->CI->SE	0.192	0.081	0.312	3.217	0.001
DSA->PE->GS	0.206	0.091	0.358	3.006	0.003
IDL->PE->GS	0.202	0.081	0.337	3.094	0.002
CU->PE->TS	0.026	-0.016	0.094	0.917	0.359
OUT->CI->TS	-0.004	-0.041	0.034	0.238	0.812
DSA->PE->SE	0.071	0.010	0.148	1.963	0.049
CU->CI->GS	-0.003	-0.061	0.014	0.173	0.863
DSA->CI->HS	0.214	0.107	0.322	3.847	0.000
IDL->CI->TS	0.057	-0.058	0.155	1.122	0.262
OUT->PE->TS	-0.016	-0.055	0.018	0.872	0.383
OUT->PE->HS	-0.014	-0.059	0.008	0.787	0.431
CU->PE->HS	0.024	-0.014	0.078	1.006	0.315
CU->PE->SE	0.041	-0.001	0.104	1.481	0.139
DSA->CI->TS	0.059	-0.048	0.167	1.113	0.266

mediated the correlation between CU-GS ($\beta = 0.122$; CI [0.004, 0.247]), IDL-HS ($\beta = 0.208$; CI [0.077, 0.357]), DSA-GS ($\beta = 0.206$; CI [0.091, 0.328]), IDL-HS ($\beta = 0.208$; CI [0.077, 0.357]), IDL-GS ($\beta = 0.206$; CI [0.091, 0.328]), IDL-HS ($\beta = 0.208$; CI [0.077, 0.357]), DSA-GS, ($\beta = 0.208$; CI [0.077, 0.357]), DSA-SE ($\beta = 0.206$; CI [0.091, 0.328]), and IDL-HS ($\beta = 0.202$; CI [0.081, 0.337]), as shown in Table 6.

Table 7. Result of the predictive power, accuracy, and model fit

Variables	Q^2	R^2
CI	0.302	0.421
GS	0.316	0.437
HS	0.255	0.379
PE	0.330	0.465
SE	0.256	0.383
TS	0.05	0.061
SRMR = 0.07		

Note. SRMR = standardized root-mean-square residual.

The coefficient of determination (R^2) was then calculated to assess the robustness of exogenous variable prediction when shaping endogenous latent variables (Hair *et al.*, 2023). The R^2 should be evaluated as low, medium, and substantial based on the values of 0.19, 0.37, and .067 (Hair *et al.*, 2023). Additionally, Stone–Geisser (Q^2) was used to assess the predictive relevance of each endogenous variable, which is beyond zero. Lastly, the standardized root-mean-square residual was below 0.08, indicating a good fit (Hair *et al.*, 2023). Table 7 summarizes the results of the structural model, while Figure 1 displays the study model with relative values.

6. Discussion

6.1 Factorial structure of OL2MSS, online L2 grit, and OSEL in VE

In light of the measurement model results, OL2MSS, online L2 grit, and VESRL were validated in the context of VE. Accordingly, along with previous studies that validated L2MSS in traditional language learning contexts in China (You & Dörnyei, 2016), LMOOCs (Rahimi, 2023; Rahimi & Cheraghi, 2022), ChatGPT-assisted language learning (Rahimi *et al.*, 2025), and OLL (Smith *et al.*, 2020), we now validated it in VE, and in Spain. As far as the researchers are aware, L2 grit had not been validated in the VE context until now, although it had been validated in both online (Paradowski & Jelińska, 2024) and traditional (Teimouri *et al.*, 2022) language learning contexts. Likewise, the OSEL factors had only been previously validated in the context of LMOOCs (Rahimi & Cheraghi, 2022), ChatGPT-assisted language learning (Rahimi *et al.*, 2025), and OLL (Zheng *et al.*, 2018). Thus, we extended their validity to another CALL context, and VE.

These findings support previously published research recommending the validation of OL2MSS, especially the two newly identified factors, digital self-authenticity (Rahimi, 2023; Rahimi & Mosalli, 2024; Rahimi *et al.*, 2025) and current L2 self (Rahimi & Mosalli, 2024; Rahimi *et al.*, 2025), in another digital learning context. These discriminations between the factors highlighted that VE can cover language learners' future self-image, current L2 needs, and the obligations they must fulfill to achieve their future self-image. Furthermore, the digital context validated was found to be much more authentic than traditional language learning contexts, as well as closer to both their academic and private lives. In addition, by validating three new trends in this context, we respond to the pressing need previously pointed out by leading CALL figures that research in VE should focus on new trends (Colpaert, 2020; O'Dowd, 2021b).

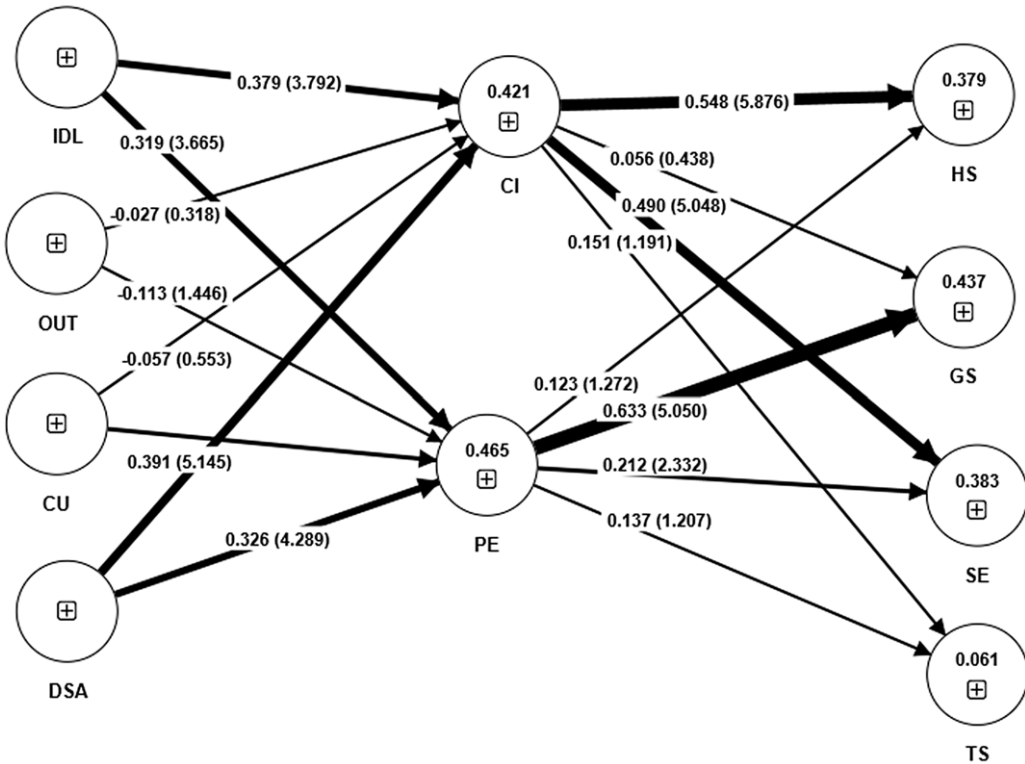


Figure 1. Structural model with relative values.

6.2 Relationship between OL2MSS, online L2 grit, and OSEL

The result of the structural model showed that, among the OL2MSS factors, learners’ ideal L2 self significantly predicted their perseverance of effort ($\beta = 379$) and consistency of interest ($\beta = 319$). Their ought-to L2 self, however, did not contribute to learners’ L2 grit in the VE context. This finding might lie behind the fact that the ideal L2 self covers learners’ personal and future desirable self-image to exchange language in VE, and L2 grit is related to long-term goals rather than short-term ones (Duckworth *et al.*, 2007), since in this study the ought-to L2 self represents learners’ short-term goals (e.g. to succeed in their university course).

This also reflects the dynamic features of OL2MSS, in line with You and Dörnyei’s (2016) observation that Eastern language learners prefer to use their ought-to L2 self more than their ideal L2 self when the target language is directly related to their careers. In our VE, however, this was not the case, as Spanish language learners appear to have a higher likelihood of acquiring cultural competence and a social entrepreneurial mindset to achieve their ideal future (Sevilla-Pavón & Nicolaou, 2022), with VE providing an appropriate venue. As previously mentioned, VE provides students with the opportunity to develop global language competence, and learners invest their time and effort in the learning context they are expected to be in (Csizér & Tankó, 2017).

The ideal L2-self also predicted learners’ online self-regulation, including their goal setting ($\beta = 223$), help-seeking ($\beta = 247$), and self-evaluation ($\beta = 254$), meaning that a future-oriented learner was more likely to plan their own learning with specific objectives, ask for assistance, and conduct frequent self-assessments in VE. As per previous findings, learners with promotional motivation could regulate their learning (You & Dörnyei, 2016; Zheng *et al.*, 2018). Elements such

as the ideal future self of university learners to exchange or learn another language as a means for immigrants to enter the target country (Castañeda, 2021), achieve better employment prospects (O'Dowd & Dooly, 2022), acquire more opportunities for advancement at university (Sevilla-Pavón & Nicolaou, 2022), or achieve a higher social status (O'Dowd & Dooly, 2022) might relate to these findings.

Moreover, the current L2 self only predicted learners' perseverance of effort ($\beta = .192$), while failing to predict consistency of interest and learners' VESRL. Accordingly, the higher the learners' assessment of their learning progress in VE, the more they preserve their effort to reach their objects in VE. Hence, we found discrepancies between learners' ideal L2 self and current L2 self in shaping learners' efforts in VE. However, Smith *et al.* (2020) and Henry and Cliffordson (2017) found no discrepancy between these two constructs in online and digital language learning in Chinese and Swedish contexts to shape learners' intended efforts. The concept of "keep on chasing" (Thorsen *et al.*, 2020) may explain such outcomes, as learners strive to achieve better results by evaluating their current language skills and competence. The communicative nature of VE offers continuous opportunities for self-evaluation, which in turn leads to dedicating more effort than mere interest. The notion of "upward revised possible selves" (Carroll *et al.*, 2015) also supports our findings, as learners who understand their core competences and progress are more likely to utilize upward revised current self systematically, which ultimately results in greater effort.

Notably, digital self-authenticity significantly predicted learners' CI ($\beta = 0.391$) and PE (0.326), showing that learners had a high level of motivation to exchange language and information in VE in comparison to their previous language learning contexts, which led them to achieve their long-term goals by dedicating more effort and interest in this context. It also directly (see Table 6) predicted learners' goal setting ($\beta = 0.228$), help-seeking ($\beta = 0.254$), and self-evaluation ($\beta = 0.261$) in VE. Hence, a higher level of motivation to use the language in VE, compared to previous learning contexts, would encourage learners to evaluate their progress, seek help from others, and set goals. Accordingly, we observed the sign of authenticity gap in the VE and Spanish EFL contexts. This way, the sign of authenticity gap, after being recently observed in OLL (Smith *et al.*, 2020), ChatGPT-assisted language learning (Rahimi *et al.*, 2025), and LMOOCs (Rahimi, 2023), is now reported in another CALL area. While previous studies found that digital self-authenticity impacted learners' attitudes (Rahimi, 2023) and OLL efforts (Smith *et al.*, 2020), we now add to the CALL field evidence of the high level of shared variance of digital self-authenticity to shape language learners' L2 grit and VESRL. The findings may be explained by various contextual factors related to VE. First, the multimodality and adaptability of VE (O'Dowd, 2021a), where learners access various VR, AR, and AI modules and adapt to these environments for learning.

The notion of the "life stage" (Rahimi, 2023) also supports this finding, since learners can take advantage of older students' experiences to reach their ideal future image, which is observed in the correlation between IDL and OSEL. This is also observable in VE, as professional peers with diverse cultures, experiences, and backgrounds relevant to the target context share their experiences with others – something that would be impossible in traditional language instruction. Furthermore, the VE context specializes in exchanging cultural competence in addition to performing tasks related to such exchange (O'Dowd & Dooly, 2022; O'Dowd & Ritter, 2006), which sets it apart from traditional learning contexts since, in those contexts, students follow teachers' "mirror in-class" tasks, and try to emulate their pronunciation or adhere to a set of grammatical rules (Rahimi, 2023). This finding and reports may be a valid response to Kurek (2015) and Grau and Turula (2019), who found that the complex VE learning environments resulted in instability and unpredictability due to a variety of factors such as tasks, participants, and materials, all of which were signs of digital self-authenticity, as reported by Rahimi (2023). The variety of digital tasks, modules (AI, VR), and participants' skills and experiences (life stage) can raise learners' attitudes and motivation in digital language learning while decreasing their

motivation in traditional language learning (Rahimi, 2023; Rahimi & Mosalli, 2024), which are present in VE, as mentioned above. Additionally, it has been reported that students from Western Europe (Henry & Cliffordson, 2017), Iran (Rahimi, 2023; Rahimi & Mosalli, 2024), and China (Smith et al., 2020) are more likely to dedicate more time and effort to unstructured learning environments. This was also evident in our study, where learners exhibited higher levels of online L2 grit and VESRL in VE.

6.3 The mediation role of L2 grit

A final analysis aimed to explore the mediation role of online L2 grit between learners' OL2MSS and their VESRL. Based on the indirect bootstrap analysis, learners' consistency of interest in exchanging information in VE mediated the relationship between their future L2 self and digital self-authenticity with their metacognitive (self-evaluation) and resource management (help-seeking) strategies in VE. Similarly, their perseverance of effort to exchange information in VE mediated the correlation between learners' ideal L2 self and digital self-authenticity with their metacognitive strategies, particularly selecting their objects in VE. All these mediations were complementary, as direct and indirect bootstraps were along the same lines.

On the other hand, L2 grit acted as moderator variables in IDL->PE->SE; IDL->PE->HS; DSA->PE->HS; DSA->CI->GS; and DSA->PE->SE, as it negatively affected the direct correlation between learners' ideal L2 self and self-evolution, help-seeking, as well as digital self-authenticity, with help-seeking, goal setting, and self-evaluation. More importantly, perseverance of effort acted as a moderator variable between current L2 self and learners' goal setting since CU did not correlate with OSEL. Accordingly, the flipping effect occurred by PE in this correlation. Moreover, the suppression phenomenon observed in this serial correlation as PE increased the productive power of CU ($\beta = 0.118$) to ($\beta = 0.122$).

As Duckworth *et al.* (2007) points out, being gritty requires long-term dedication. It is likely that learners' current language needs do not correspond to their future goals at the beginning of VE. However, with time and perseverance of effort, learners will achieve a high level of self-regulation, especially when it comes to setting goals in VE. This reminds us that internet-mediated intercultural exchange is both an extremely complex social activity and a highly challenging educational endeavor (Müller-Hartmann, 2005). It should also be borne in mind that it can be unpredictable due to a variety of factors, such as participants' psychological factors (Grau & Turula, 2019; Kurek, 2015). This is demonstrated in our direct and indirect results, where the perseverance of effort and consistency of interest mediated learners' motivation to self-regulate themselves in the VE. This serial mediation responds to the call to understand "*the relations that connect the components of a complex system*" (Hiver & Larsen-Freeman, 2020: 287, as cited in Paradowski & Jelińska, 2024: 2344) in various language learning contexts, and we provided such understanding in a VE context.

7. Implications for theory and practice

Several aspects of this study contribute to the humanities literature in general, as well as language teaching and learning, CALL, VE, and psycholinguistics specifically. First, a psycholinguistic perspective was adopted instead of a sociolinguistic approach in the exam of VE success in CALL. We addressed recent VE figureheads' requests to integrate new aspects and explore beyond ICC (Colpaert, 2020; O'Dowd, 2021b) by incorporating new trends, such as OL2MSS, online grit, and VESRL. Our study also validated the factorial structures of OL2MSS, OSEL, and online L2 grit in the context of VE and added them to both the CALL and psycholinguistics literature. A sign of the authenticity gap was also discovered in VE, which had already been reported in previous CALL studies in OLL and LMOOCs. Furthermore, this study is among the first to apply an exploratory

quantitative design and develop a conceptual framework specific to VE, as recent studies have relied heavily on qualitative approaches and reported the role of VE in shaping learners' ICC.

Three levels of practical implications may be apparent from our study. First, educators should be aware of the role that both the ideal L2 self and the current L2 self play in shaping learners' VESRL and L2 grit in VE. Therefore, language educators should place greater emphasis on developing learners' ideal future selves rather than focusing on their past learning achievements. This can be done by encouraging students to evaluate their progress in VE while engaging in information exchange. Additionally, students should recognize the importance of their future goals and how these contribute to their OSEL and L2 grit, as opposed to focusing on fulfilling their obligations, since the ought-to L2 self failed to predict both OSEL and L2 grit in VE. Moreover, to help students become successful and gritty L2 learners, teachers should promote self-regulation and reflection on learners' motivation.

Practitioners should also become aware of the signs of authenticity gap in VE in Spain and allocate more financial resources to its integration into their educational contexts, since learners are more motivated to learn in VE settings than in previous learning contexts, resulting in a higher level of both perseverance of effort and consistency of interest, which impacted their VESRL as well. Training opportunities should also be provided, focusing on the integration of VE in language learning settings, going beyond the class syllabus and the development of learners' ICC. The focus should also be switched from merely passing the course to addressing learners' current needs as well as their future personal and academic images when exchanging information.

At the final level, this study introduces a new conceptual framework to CALL scholars and provides a new avenue for validating, extending, and replicating the current model in other VE contexts. While researchers in other CALL areas, such as those focused on LMOOCs (Rahimi, 2023), have already developed their own conceptual frameworks, our framework may serve as a starting point for VE researchers to develop a specific framework tailored to VE. In this way, VE researchers will be better equipped to conduct more in-depth analyses of variables and uncover correlations, mediations, or moderations that may not be identifiable through qualitative or basic quantitative research designs.

Future studies could address several limitations of this research. Given the exploratory nature of the current study, conducting multi-group analyses and applying more rigorous tests are recommended to validate the findings. Additionally, since data in this study were collected using self-reported Likert scales, future research could incorporate qualitative data from in-depth interviews or focus groups to provide a deeper understanding of the complex relationships between OL2MSS, L2 grit, and OSEL among students from diverse sociocultural backgrounds. Such research could also explore VE success from a psycholinguistic perspective.

We also recommend a more quantitative design for future VE research, specifically the by-symmetric research design recently introduced by Rahimi and Sevilla-Pavón (2024a) and integrated into CALL. This approach allows researchers to explore direct correlations, mediation, and moderation symmetrically, through the average impact of each variable on one another (as in the current study), as well as asymmetrically, through necessary conditional analysis to examine combinations of independent variables that drive target outcomes.

Supplementary material. To view supplementary material referred to in this article, please visit <https://doi.org/10.1017/S095834402400034X>

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